AFRICAN CHIROPTERA REPORT

2019



LISTED ON EBSCO PUBLISHING DATABASE

AFRICAN CHIROPTERA REPORT

Published by: AfricanBats NPC, African Chiroptera Project, Pretoria, Republic of South Africa

Copyright: © 2019 African Chiroptera Project
© 2019 African Chiroptera Report
© 2019 African Chiroptera Database
Reproduction of this publication for educational or other non-commercial purposes is authorized without prior written permission from the copyright holder provided the source is fully acknowledged. Reproduction of this publication for resale or other commercial purposes is prohibited without prior written permission of the copyright holders.

Citation: ACR. 2019. African Chiroptera Report 2019. AfricanBats NPC, Pretoria. i-xv + 8297 pp. doi: 10.13140/RG.2.2.27442.76482.

ISSN: 1990-6471

DOI: 10.13140/RG.2.2.27442.76482.

Database development:
Victor Van Cakenberghe.

Available from: http://www.africanbats.org

Online Available: Monday, 30 December 2019

Note:
The designation of geographical entities in this report, and the presentation of the material, do not imply the expression of any opinion whatsoever on the part of the African Chiroptera Project, managing editors, or other collaborating individuals or organisations concerning the legal status of any country, territory, or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. Furthermore, the views expressed in this report do not necessarily reflect those of any of the collaborating organisations.

This is a print report from the data contained in the 2019 version of the African Chiroptera Database. The resulting views and outputs are based solely on the data contained within the tables in this database.

Cover image: © ECJ Seamark (AfricanBats NPC). A Bushveld Horseshoe Bat (*Rhinolophus simulator* K. Andersen, 1904) from Madimatle Cave, Limpopo Province, South Africa.

Managing Editors:
Victor Van Cakenberghe and Ernest C.J. Seamark

Taxonomic Advisory Committee:
Victor Van Cakenberghe (University of Antwerp, Belgium), Teresa C. Kearney (Ditsong National Museum of Natural History Museum, South Africa), Peter J. Taylor (University of Venda, South Africa), Petr Benda (National Museum (Natural History), Prague, Czech Republic), Gabor Csorba (Hungarian Natural History Museum, Hungary), and Stéphane Aulagnier (I.N.R.A., Castanet Tolosan Cedex).

Contributors:

Dr. Stéphane AULAGNIER
Comportement & Ecologie de la Faune Sauvage
I.N.R.A.
BP 52627
31326
Castanet Tolosan Cedex
France

Dr. Nico AVENANT
National Museum of Bloemfontein
P.O. Box 266
Bloemfontein, 9300
South Africa

Dr. Eric Moise BAKWO FILS
Department of Biological Sciences
Faculty of Sciences
University of Maroua
Cameroon

Dr. Petr BENDA
Department of Zoology
National Museum (Natural History)
Vaclavske nam. 68
Prague, 115 79
Czech Republic

Dr. Marike GELDENHUYS
Centre for Viral Zoonoses
Department of Medical Virology
Faculty of Health Sciences
University of Pretoria
0001
South Africa

Rudolf HASLAUER
Oberkreut 4A
D-85309 Poernbach
Germany

Dr. Cornelis J. HAZEVOET
Resarch Associate
Zoölogisch Museum Amsterdam and Museu Nacional de História Natural, Lisbon
Rua dos Prazeres 91-2
1200-354 Lisboa
Portugal

Dr. Teresa KEARNEY
Small Mammal Department
Ditsong National Museum of Natural History
P.O. Box 413
Pretoria, 0001
South Africa

Dr. Mark KEITH
Eugène Marais Chair of Wildlife Management
Mammal Research Institute
Faculty of Natural and Agricultural Sciences
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa

Alan KEMP
Special Pathogens Unit - Arbovirology
National Institute for Communicable Diseases
Private Bag X4
Sandringham, 2131
South Africa

Prof. Wanda MARKOTTER
Centre for Viral Zoonoses
Department of Medical Virology
Faculty of Health Sciences
University of Pretoria
0001
South Africa

Dr. Marinda MORTLOCK
Centre for Viral Zoonoses
Department of Medical Virology
Faculty of Health Sciences
University of Pretoria
0001
South Africa

Ernest C.J. SEAMARK
AfricanBats NPC
357 Botha Ave
Kloofsig, 0157
South Africa

Dr. Hendrik TURNI
Humboldt Universität zu Berlin
Museum für Naturkunde
Invalidenstr. 43
10115 Berlin
Germany

Dr. Victor VAN CAKENBERGHE
University of Antwerp
Department of Biology
Labo for Functional Morphology
Campus Drie Eiken
Universiteitsplein 1
B-2610 Wilrijk
Belgium

Luis VERISSIMO
Ecologist and Geospatial Specialist
Hancock, Michigan, USA 49930

Dr. Marianne VOLLETH
Dept. of Human Genetics
Leipziger Str. 44
D-39120 Magdeburg
Germany

Wim WENDELEN
Royal Museum of Central Africa
Leuvensesteenweg 13
B-3080 Tervuren
Belgium

Mengjing WEI
AfricanBats NPC
357 Botha Ave
Kloofsig, 0157
South Africa

Supporting Organizations:

Funding Organizations:

The organizations shown below have contributed funds to support projects that assist with the production and refinement of the African Chiroptera Report 2019.

Table of Contents:

Introduction 1
Taxa profiles 11
ORDER CHIROPTERA Blumenbach, 1779 11
†Family AEGYPTONYCTERIDAE Simmons, Seiffert and Gunnell, 2016 22
†Genus ***Aegyptonycteris*** Simmons, Seiffert and Gunnell, 2016 22
†***Aegyptonycteris knightae*** Simmons, Seiffert and Gunnell, 2016 22
†Family NECROMANTIDAE Sigé, 2011 23
†Genus ***Necromantis*** Weithofer, 1887 23
†***Necromantis fragmentum*** (Ravel, 2016) 23
SUBORDER PTEROPODIFORMI Van Cakenberghe, Kearney and Seamark, 2007 24
INFRAORDER PTEROPODIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007 25
Superfamily PTEROPODOIDEA Gray, 1821 25
Family PTEROPODIDAE Gray, 1821 25
Subfamily Eidolinae Almeida, Giannini and Simmons, 2016 29
Genus ***Eidolon*** Rafinesque, 1815 29
Eidolon dupreanum (Schegel, 1867) 30
Eidolon helvum (Kerr, 1792) 33
Eidolon helvum helvum (Kerr, 1792) 47
†Subfamily Propottininae Butler, 1984 48
†Genus ***Propotto*** Simpson, 1967 48
†***Propotto leakeyi*** Simpson, 1967 49
Subfamily Pteropodinae Gray, 1821 49
Genus ***Pteropus*** Brisson, 1762 50
Pteropus aldabrensis True, 1893 52
Pteropus livingstonii Gray, 1866 54
Pteropus niger (Kerr, 1792) 57
Pteropus rodricensis Dobson, 1878 60
Pteropus rufus E. Geoffroy St.-Hilaire, 1803 63
Pteropus seychellensis A. Milne-Edwards, 1877 68
Pteropus subniger (Kerr, 1792) 71
Pteropus voeltzkowi Matschie, 1909 73
Subfamily Rousettinae Andersen, 1912 74
Genus ***Casinycteris*** Thomas, 1910 75
Casinycteris argynnis Thomas, 1910 75
Casinycteris campomaanensis Hassanin, 2014 77
Casinycteris ophiodon (Pohle, 1943) 77
Genus ***Epomophorus*** Bennett, 1836 78
Epomophorus angolensis Gray, 1870 80
Epomophorus anselli Bergmans and Van Strien, 2004 81
Epomophorus crypturus Peters, 1852 82
Epomophorus dobsonii Bocage, 1889 84
Epomophorus gambianus (Ogilby, 1835) 86
Epomophorus gambianus gambianus (Ogilby, 1835) 89
Epomophorus gambianus pousarguesi Trouessart, 1904 91
Epomophorus grandis (Sanborn, 1950) 91
Epomophorus labiatus (Temminck, 1837) 92
Epomophorus minimus Claessen & De Vree, 1991 95
Epomophorus minor Dobson, 1880 97
Epomophorus wahlbergi (Sundevall, 1846) 98
Genus ***Epomops*** Gray, 1866 105
Epomops buettikoferi (Matschie, 1899) 106
Epomops franqueti (Tomes, 1860) 107
Genus ***Hypsignathus*** H. Allen, 1862 111
Hypsignathus monstrosus H. Allen, 1862 111
Genus ***Megaloglossus*** Pagenstecher, 1885 116
Megaloglossus azagnyi Nesi, Kadjo and Hassanin, 2012 116
Megaloglossus woermanni Pagenstecher, 1885 118
Genus ***Micropteropus*** Matschie, 1899 120
Micropteropus intermedius Hayman, 1963 120
Micropteropus pusillus (Peters, 1868) 121
Genus ***Myonycteris*** Matschie, 1899 124
Myonycteris angolensis (Bocage, 1898) 125
Myonycteris angolensis angolensis (Bocage, 1898) 128
Myonycteris angolensis goliath (Bergmans, 1997) 128
Myonycteris angolensis petraea (Bergmans, 1997) 129

Myonycteris angolensis ruwenzorii (Eisentraut, 1965) 130
Myonycteris angolensis smithii (Thomas, 1908) 130
Myonycteris brachycephala (Bocage, 1889) 131
Myonycteris leptodon K. Andersen, 1908 132
Myonycteris relicta Bergmans, 1980 133
Myonycteris torquata (Dobson, 1878) 134
Myonycteris torquata torquata (Dobson, 1878) 137
Myonycteris torquata wroughtoni K. Andersen, 1908 137
Genus ***Nanonycteris*** Matschie, 1899 138
Nanonycteris veldkampii (Jentink, 1888) 138
Genus ***Plerotes*** K. Andersen, 1910 140
Plerotes anchietae (Seabra, 1900) 140
Genus ***Rousettus*** Gray, 1821 142
Rousettus aegyptiacus (E. Geoffroy St.-Hilaire, 1810) 144
Rousettus madagascariensis G. Grandidier, 1929 163
Rousettus obliviosus Kock, 1978 167
Genus ***Scotonycteris*** Matschie, 1894 170
Scotonycteris bergmansi Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, 2015 171
Scotonycteris bergmansi bergmansi Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, 2015 171
Scotonycteris bergmansi congoensis Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, 2015 172
Scotonycteris occidentalis Hayman, 1947 172
Scotonycteris zenkeri Matschie, 1894 173
Genus ***Stenonycteris*** Gray, 1870 174
Stenonycteris lanosus (Thomas, 1906) 174
INFRAORDER RHINOLOPHIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007 176
Superfamily RHINOLOPHOIDEA J. E. Gray, 1825 177
Family HIPPOSIDERIDAE Lydekker, 1891 177
Genus ***Asellia*** Gray, 1838 180
Asellia italosomalica de Beaux, 1931 180
Asellia patrizii de Beaux, 1931 180
Asellia tridens (E. Geoffroy St.-Hilaire, 1813) 181
Genus ***Doryrhina*** Peters, 1871 185
Doryrhina cyclops (Temminck, 1853) 185
Genus ***Hipposideros*** Gray, 1831 188
†***Hipposideros africanum*** Ravel, 2016 191
†***Hipposideros amenhotepos*** Gunnell, Winkler, Miller, Head, El-Barkooky, Gawad, Sanders, and Gingerich, 2015 191
†***Hipposideros kaumbului*** Wesselman, 1984 192
†***Hipposideros vetus*** (Lavocat, 1961) 192
Hipposideros abae J.A. Allen, 1917 192
Hipposideros beatus (K. Andersen, 1906) 194
Hipposideros caffer (Sundevall, 1846) 195
Hipposideros camerunensis Eisentraut, 1956 201
Hipposideros cf. centralis Andersen, 1906 203
Hipposideros curtus G.M. Allen, 1921 203
Hipposideros fuliginosus (Temminck, 1853) 204
Hipposideros jonesi Hayman, 1947 206
Hipposideros lamottei Brosset, 1985 207
Hipposideros marisae Aellen, 1954 208
Hipposideros megalotis (Heuglin, 1861) 209
Hipposideros ruber (Noack, 1893) 210
Hipposideros tephrus (Cabrera, 1906) 214
Genus ***Macronycteris*** Gray, 1866 216
†***Macronycteris besaoka*** (Samonds, 2007) 216
Macronycteris commersoni (E. Geoffroy St.-Hilaire, 1813) 217
Macronycteris cryptovalorona (Goodman, Schoeman, Rakotoarivelo and Willows-Munro, 2016) 220
Macronycteris gigas (Wagner, 1845) 221
Macronycteris vittatus (Peters, 1852) 224
†Genus ***Palaeophyllophora*** Revilliod, 1917 227
†***Palaeophyllophora tunisiensis*** (Ravel, 2016) 227
Family MEGADERMATIDAE H. Allen, 1864 228
Genus ***Cardioderma*** Peters, 1873 228
†***Cardioderma leakeyi*** Gunnell, Butler, Greenwood and Simmons, 2015 229

Cardioderma cor (Peters, 1872) 229
Genus ***Lavia*** Gray, 1838 231
Lavia frons (E. Geoffroy St.-Hilaire, 1810) 232
Genus ***Megaderma*** E. Geoffroy St.-Hilaire, 1810 234
†***Megaderma gaillardi*** (Trouessart, 1898) 234
†***Megaderma gigas*** (Lavocat, 1961) 235
†***Megaderma jaegeri*** Sigé, 1976 235
†Genus ***Saharaderma*** Gunnell, Simons and Seiffert, 2008 235
†***Saharaderma pseudovampyrus*** Gunnell, Simons and Seiffert, 2008 235
Family RHINOLOPHIDAE Gray, 1825 236
Genus ***Rhinolophus*** Lacépède, 1799 237
†***Rhinolophus maghrebensis*** Gunnell, Eiting, and Geraads, 2011 242
†***Rhinolophus mellali*** Lavocat, 1961 242
Rhinolophus adami Aellen and Brosset, 1968 242
Rhinolophus alcyone Temminck, 1853 243
Rhinolophus blasii Peters, 1867 245
Rhinolophus capensis Lichtenstein, 1823 249
Rhinolophus clivosus Cretzschmar, 1828 252
Rhinolophus cohenae Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012 258
Rhinolophus damarensis Roberts, 1946 259
Rhinolophus darlingi K. Andersen, 1905 260
Rhinolophus deckenii Peters, 1868 263
Rhinolophus denti Thomas, 1904 264
Rhinolophus eloquens K. Andersen, 1905 267
Rhinolophus euryale Blasius, 1853 269
Rhinolophus ferrumequinum (Schreber, 1774) 273
Rhinolophus fumigatus Rüppell, 1842 279
Rhinolophus gorongosae Taylor, MacDonald, Goodman, Kearney, Cotterill, Stoffberg, Monadjem, Schoeman, Guyton, Naskrecki and Richards, 2018 283
Rhinolophus guineensis Eisentraut, 1960 283
Rhinolophus hildebrandtii Peters, 1878 285
Rhinolophus hilli Aellen, 1973 288
Rhinolophus hillorum Koopman, 1989 288
Rhinolophus hipposideros (Bechstein, 1800) 290
Rhinolophus horaceki Benda and Vallo, 2012 294
Rhinolophus kahuzi Fahr and Kerbis Peterhans, 2013 294
Rhinolophus landeri Martin, 1838 295
Rhinolophus lobatus Peters, 1852 297
Rhinolophus mabuensis Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012 299
Rhinolophus maclaudi Pousargues, 1898 299
Rhinolophus maendeleo Kock, Csorba and Howell, 2000 301
Rhinolophus mehelyi Matschie, 1901 302
Rhinolophus mossambicus Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012 306
Rhinolophus rhodesiae Roberts, 1946 307
Rhinolophus ruwenzorii J. Eric Hill, 1942 307
Rhinolophus sakejiensis Cotterill, 2002 309
Rhinolophus silvestris Aellen, 1959 309
Rhinolophus simulator K. Andersen, 1904 311
Rhinolophus smithersi Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012 314
Rhinolophus swinnyi Gough, 1908 315
Rhinolophus willardi Kerbis Peterhans and Fahr, 2013 317
Rhinolophus ziama Fahr, Vierhaus, Hutterer and Kock, 2002 318
Family RHINONYCTERIDAE J. E. Gray, 1866 319
†Genus ***Brachipposideros*** Sigé, 1968 320
†Genus ***Brevipalatus*** Hand and Archer, 2005 320
Genus ***Cloeotis*** Thomas, 1901 320
Cloeotis percivali Thomas, 1901 320
Genus ***Paratriaenops*** Benda and Vallo, 2009 323
Paratriaenops auritus (G. Grandidier, 1912) 323
Paratriaenops furculus (Trouessart, 1907) 325
Paratriaenops pauliani (Goodman and Ranivo, 2008) 327
Genus ***Triaenops*** Dobson, 1871 328
†***Triaenops goodmani*** Samonds, 2007 329

Triaenops afer Peters, 1877 329
Triaenops menamena Goodman and Ranivo, 2009 330
Superfamily RHINOPOMATOIDEA Dobson, 1872 333
Family RHINOPOMATIDAE Dobson, 1872 334
†Genus ***Qarunycteris*** Gunnell, Simons and Seiffert, 2008 335
†***Qarunycteris moerisae*** Gunnell, Simons and Seiffert, 2008 335
Genus ***Rhinopoma*** E. Geoffroy St.-Hilaire, 1818 336
Rhinopoma cystops Thomas, 1903 336
Rhinopoma macinnesi Hayman, 1937 340
Rhinopoma microphyllum (Brünnich, 1782) 341
†Family TANZANYCTERIDIDAE Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003 344
†Genus ***Tanzanycteris*** Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003 344
†***Tanzanycteris mannardi*** Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003 345
SUBORDER VESPERTILIONIFORMI Van Cakenberghe, Kearney and Seamark, 2007 346
INFRAORDER NOCTILIONIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007 347
Superfamily NOCTILIONOIDEA Gray, 1821 347
Family MYZOPODIDAE Thomas, 1904 348
Genus ***Myzopoda*** Milne-Edwards and A. Grandidier, 1878 348
†***Myzopoda africana*** Gunnell, Butler, Greenwood and Simmons, 2015 349
Myzopoda aurita Milne-Edwards and A. Grandidier, 1878 349
Myzopoda schliemanni Goodman, Rakotondraparany and Kofoky, 2007 351
†Genus ***Phasmatonycteris*** Gunnell, Simmons and Seiffert, 2014 352
†***Phasmatonycteris butleri*** Gunnell, Simmons and Seiffert, 2014 353
†***Phasmatonycteris phiomensis*** Gunnell, Simmons and Seiffert, 2014 353
INFRAORDER NYCTERIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007 353
Superfamily NYCTEROIDEA Van der Hoeven, 1855 354
Family EMBALLONURIDAE Gervais, 1855 354
Genus ***Coleura*** Peters, 1867 355
†***Coleura muthokai*** Wesselman, 1984 355
Coleura afra (Peters, 1852) 356
Coleura kibomalandy Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, 2012 359
Coleura seychellensis Peters, 1868 361
†Genus ***Dhofarella*** Sigé, Thomas, Sen, Gheerbrant, Roger, and Al-Sulaimani, 1985 363
†***Dhofarella sigei*** Gunnell, Simons and Seiffert, 2008 363
†***Dhofarella thaleri*** Sigé et al., 1994 364
Genus ***Paremballonura*** Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, 2012 364
Paremballonura atrata (Peters, 1874) 364
Paremballonura tiavato (Goodman, Cardiff, Ranivo, Russell, and Yoder, 2006) 366
†Genus ***Pseudovespertiliavus*** Ravel, 2016 367
†***Pseudovespertiliavus parva*** Ravel, 2016 368
Subfamily Taphozoinae Jerdon, 1867 368
Genus ***Saccolaimus*** Temminck, 1838 368
†***Saccolaimus abitus*** (Wesselman, 1984) 369
Saccolaimus peli (Temminck, 1853) 369
Genus ***Taphozous*** E. Geoffroy St.-Hilaire, 1818 370
†***Taphozous incognita*** (Butler & Hopwood, 1957) 371
Taphozous hamiltoni Thomas, 1920 372
Taphozous hildegardeae Thomas, 1909 372
Taphozous mauritianus E. Geoffroy St.-Hilaire, 1818 374
Taphozous nudiventris Cretzschmar, 1830 377
Taphozous perforatus E. Geoffroy St.-Hilaire, 1818 381
Taphozous perforatus perforatus E. Geoffroy St.-Hilaire, 1818 383
Taphozous perforatus sudani Thomas, 1915 384
†Genus ***Vespertiliavus*** Schlosser, 1887 384
†***Vespertiliavus aenigma*** (Ravel, 2016) 384
†***Vespertiliavus kasserinensis*** (Ravel, 2016) 384
Family NYCTERIDAE Van der Hoeven, 1855 385
†Genus ***Khoufechia*** Ravel, 2016 386
†***Khoufechia gunnelli*** Ravel, 2016 386
Genus ***Nycteris*** G. Cuvier and E. Geoffroy, 1795 386
Nycteris arge Thomas, 1903 387
Nycteris aurita (K. Andersen, 1912) 389

Nycteris cf. parisii De Beaux, 1924 390
Nycteris gambiensis (K. Andersen, 1912) 390
Nycteris grandis Peters, 1865 392
Nycteris hispida (Schreber, 1774) 394
Nycteris intermedia Aellen, 1959 398
Nycteris macrotis Dobson, 1876 399
Nycteris madagascariensis G. Grandidier, 1937 402
Nycteris major (K. Andersen, 1912) 403
Nycteris nana (K. Andersen, 1912) 404
Nycteris parisii (de Beaux, 1924) 406
Nycteris thebaica E. Geoffroy St.-Hilaire, 1818 407
Nycteris vinsoni Dalquest, 1965 416
Nycteris woodi K. Andersen, 1914 417
INFRAORDER VESPERTILIONIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007 418
Superfamily MOLOSSOIDEA Gervais, 1856 419
Family MOLOSSIDAE Gervais, 1856 419
Subfamily Molossinae Gervais, 1856 421
Genus ***Chaerephon*** Dobson, 1874 421
Chaerephon aloysiisabaudiae (Festa, 1907) 424
Chaerephon ansorgei (Thomas, 1913) 425
Chaerephon atsinanana Goodman, Buccas, Naidoo, Ratrimomanarivo, Taylor and Lamb, 2010 427
Chaerephon bemmeleni (Jentink, 1879) 428
Chaerephon bivittatus (Heuglin, 1861) 430
Chaerephon chapini J.A. Allen, 1917 431
Chaerephon gallagheri (Harrison, 1975) 433
Chaerephon jobimena Goodman and Cardiff, 2004 434
Chaerephon leucogaster (A. Grandidier, 1869) 436
Chaerephon major (Trouessart, 1897) 438
Chaerephon nigeriae Thomas, 1913 439
Chaerephon nigeriae nigeriae Thomas, 1913 441
Chaerephon nigeriae spillmanni (Monard, 1933) 442
Chaerephon pumilus (Cretzschmar, 1826) 442
Chaerephon pusillus (Miller, 1902) 453
Chaerephon russatus J.A. Allen, 1917 455
Chaerephon tomensis (Juste and Ibáñez, 1993) 456
Genus ***Mops*** Lesson, 1842 457
†***Mops rusingae*** (Arroyo-Cabrales, Gregorin, Schlitter and Walker, 2002) 458
Subgenus *Mops (Mops)* Lesson, 1842 458
Mops (Mops) condylurus (A. Smith, 1833) 458
Mops (Mops) congicus J.A. Allen, 1917 465
Mops (Mops) demonstrator (Thomas, 1903) 465
Mops (Mops) leucostigma (G.M. Allen, 1918) 467
Mops (Mops) midas (Sundevall, 1843) 469
Mops (Mops) midas miarensis (A. Grandidier, 1869) 472
Mops (Mops) midas midas (Sundevall, 1843) 472
Mops (Mops) niangarae J.A. Allen, 1917 473
Mops (Mops) niveiventer Cabrera and Ruxton, 1926 474
Mops (Mops) trevori J.A. Allen, 1917 475
Subgenus *Mops (Xiphonycteris)* Dollman, 1911 476
Mops (Xiphonycteris) bakarii Stanley, 2009 477
Mops (Xiphonycteris) brachypterus (Peters, 1852) 478
Mops (Xiphonycteris) nanulus J.A. Allen, 1917 480
Mops (Xiphonycteris) petersoni (El Rayah, 1981) 481
Mops (Xiphonycteris) spurrelli (Dollman, 1911) 483
Mops (Xiphonycteris) thersites (Thomas, 1903) 484
Genus ***Mormopterus*** Peters, 1865 486
Mormopterus acetabulosus (Hermann, 1804) 487
Mormopterus acetabulosus acetabulosus (Hermann, 1804) 489
Mormopterus acetabulosus natalensis (A. Smith, 1847) 489
Mormopterus francoismoutoui Goodman, Jansen Van Vuuren, Ratrimomanarivo, Probst, Bowie, 2008 490
Mormopterus jugularis (Peters, 1865) 493
Genus ***Myopterus*** E. Geoffroy St.-Hilaire, 1818 495
Myopterus daubentonii Desmarest, 1820 495
Myopterus whitleyi (Scharff, 1900) 496
Genus ***Otomops*** Thomas, 1913 497

Otomops harrisoni Ralph, Richards, Taylor, Napier and Lamb, 2015....498
Otomops madagascariensis Dorst, 1953....500
Otomops martiensseni (Matschie, 1897)....502
Otomops martiensseni icarus Chubb, 1917....505
Otomops martiensseni martiensseni (Matschie, 1897)....505
Genus ***Platymops*** Thomas, 1906....506
Platymops setiger (Peters, 1878)....506
Platymops setiger macmillani Thomas, 1906....507
Platymops setiger setiger (Peters, 1878)....508
Genus ***Sauromys*** Roberts, 1917....508
Sauromys petrophilus (Roberts, 1917)....509
Sauromys petrophilus erongensis (Roberts, 1946)....511
Sauromys petrophilus haagneri (Roberts, 1917)....512
Sauromys petrophilus petrophilus (Roberts, 1917)....512
Sauromys petrophilus umbratus (Shortridge & Carter, 1938)....513
Genus ***Tadarida*** Rafinesque, 1814....513
†***Tadarida engesseri*** Rachl, 1983....514
Tadarida aegyptiaca (E. Geoffroy St.-Hilaire, 1818)....514
Tadarida aegyptiaca aegyptiaca (E. Geoffroy St.-Hilaire, 1818)....518
Tadarida aegyptiaca bocagei (Seabra, 1900)....518
Tadarida fulminans (Thomas, 1903)....519
Tadarida lobata (Thomas, 1891)....521
Tadarida teniotis (Rafinesque, 1814)....522
Tadarida ventralis (Heuglin, 1861)....527
Superfamily VESPERTILIONOIDEA Gray, 1821....528
Family CISTUGONIDAE Lack, Roehrs, Stanley, Ruedi and Van den Bussche, 2010....529
Genus ***Cistugo*** Thomas, 1912....529
Cistugo lesueuri Roberts, 1919....530
Cistugo seabrae Thomas, 1912....532
†Family INDETERMINATE....534
†Genus ***Chambinycteris*** Ravel, 2016....534
†***Chambinycteris pusilli*** Ravel, 2016....534
†Genus ***Drakonycteris*** Ravel, 2016....534
†***Drakonycteris glibzegdouensis*** Ravel, 2016....534
Family MINIOPTERIDAE Dobson, 1875....534
Genus ***Miniopterus*** Bonaparte, 1837....535
†***Miniopterus horaceki*** Gunnell, Eiting, and Geraads, 2011....538
Miniopterus aelleni Goodman, Maminirina, Weyeneth, Bradman, Christidis, Ruedi and Appleton, 2009....538
Miniopterus africanus Sanborn, 1936....540
Miniopterus ambohitrensis Goodman, Ramasindrazana, Naughton and Appleton, 2015....541
Miniopterus brachytragos Goodman, Maminirina, Bradman, Christidis and Appleton, 2009....542
Miniopterus egeri Goodman, Ramasindrazana, Maminirina, Schoeman, and Appleton, 2011....544
Miniopterus fraterculus Thomas and Schwann, 1906....545
Miniopterus gleni Peterson, Eger and Mitchell, 1995....547
Miniopterus griffithsi Goodman, Maminirina, Bradman, Christidis and Appleton, 2009....549
Miniopterus griveaudi Harrison, 1959....550
Miniopterus inflatus Thomas, 1903....552
Miniopterus inflatus inflatus Thomas, 1903....555
Miniopterus inflatus rufus Sanborn, 1936....555
Miniopterus maghrebensis Puechmaille, Allegrini, Benda, Bilgin, Ibañez and Juste, 2014....555
Miniopterus mahafaliensis Goodman, Bradman, Christides and Appleton, 2009....557
Miniopterus majori Thomas, 1906....560
Miniopterus manavi Thomas, 1906....562
Miniopterus minor Peters, 1867....564
Miniopterus mossambicus Monadjem, Goodman, Stanley and Appleton, 2013....566
Miniopterus natalensis (A. Smith, 1833)....567
Miniopterus newtoni Bocage, 1889....573
Miniopterus petersoni Goodman, Bradman, Maminirina, Ryan, Christidis & Appleton, 2008....574
Miniopterus schreibersii (Kuhl, 1817)....575

Miniopterus sororculus Goodman, Ryan, Maminirina, Fahr, Christidis and Appleton, 2007 580
Miniopterus villiersi Aellen, 1956 582
†Family PHILISIDAE Sigé, 1985 583
†Genus ***Dizzya*** Sigé, 1991 583
†***Dizzya exsultans*** Sigé, 1991 584
†Genus ***Philisis*** Sigé, 1985 584
†***Philisis sphingis*** Sigé, 1985 584
†Genus ***Witwatia*** Gunnell, Simons and Seiffert, 2008 584
†***Witwatia eremicus*** Gunnell, Simons and Seiffert, 2008 585
†***Witwatia schlosseri*** Gunnell, Simons and Seiffert, 2008 585
†***Witwatia sigei*** Ravel, Marivaux, Tabuce, Bel Haj Ali, Essid, and Vianey-Liaud, 2012 585
Family VESPERTILIONIDAE Gray, 1821 586
Subfamily Kerivoulinae Miller, 1907 589
†Genus ***Chamtwaria*** Butler, 1984 589
†***Chamtwaria pickfordi*** Butler, 1984 589
Genus ***Kerivoula*** Gray, 1842 589
Kerivoula africana Dobson, 1878 591
Kerivoula argentata Tomes, 1861 591
Kerivoula cuprosa Thomas, 1912 593
Kerivoula eriophora (Heuglin, 1877) 594
Kerivoula lanosa (A. Smith, 1847) 595
Kerivoula phalaena Thomas, 1912 597
Kerivoula smithii Thomas, 1880 598
Subfamily Myotinae Tate, 1942 599
†Genus ***Khonsunycteris*** Gunnell, Simons and Seiffert, 2008 600
†***Khonsunycteris aegypticus*** Gunnell, Simons and Seiffert, 2008 600
Genus ***Myotis*** Kaup, 1829 600
†***Myotis darelbeidensis*** Gunnell, Eiting, and Geraads, 2011 606
Myotis anjouanensis (Dorst, 1960) 607
Myotis bocagii (Peters, 1870) 607
Myotis bocagii bocagii (Peters, 1870) 610
Myotis bocagii cupreolus Thomas, 1904 610
Myotis capaccinii (Bonaparte, 1837) 610
Myotis dieteri M. Happold, 2005 614
Myotis emarginatus (E. Geoffroy St.-Hilaire, 1806) 615
Myotis goudoti (A. Smith, 1834) 617
Myotis morrisi Hill, 1971 620
Myotis mystacinus (Kuhl, 1817) 621
Myotis punicus Felten, 1977 623
Myotis scotti Thomas, 1927 628
Myotis tricolor (Temminck, 1832) 628
Myotis welwitschii (Gray, 1866) 631
Myotis zenatius Ibáñez, Juste, Salicini, Puechmaille and Ruedi, 2019 634
Subfamily Scotophilinae Van Cakenberghe and Seamark, 2008 636
†Genus ***Scotophilisis*** Horácek, Fejfar and Hulva, 2006 636
†***Scotophilisis libycus*** Horácek, Fejfar and Hulva, 2006 636
Genus ***Scotophilus*** Leach, 1821 636
Scotophilus altilis G.M. Allen, 1914 638
Scotophilus andrewreborii Brooks and Bickham, 2014 639
Scotophilus borbonicus (E. Geoffroy St.-Hilaire, 1803) 640
Scotophilus dinganii (A. Smith, 1833) 641
Scotophilus ejetai Brooks and Bickham, 2014 645
Scotophilus leucogaster (Cretzschmar, 1826) 646
Scotophilus livingstonii Brooks and Bickham, 2014 649
Scotophilus marovaza Goodman, Ratrimomanarivo and Randrianandrianina, 2006 649
Scotophilus nigrita (Schreber, 1774) 651
Scotophilus nigritellus de Winton, 1899 653
Scotophilus nucella Robbins, 1983 654
Scotophilus nux Thomas, 1904 655
Scotophilus robustus A. Milne-Edwards, 1881 657
Scotophilus tandrefana Goodman, Jenkins and Ratrimomanarivo, 2005 659
Scotophilus trujilloi Brooks and Bickham, 2014 660
Scotophilus viridis (Peters, 1852) 660
Scotophilus "incertae-sedis" 662
†Genus ***Vampyravus*** Schlosser, 1910 662
†***Vampyravus orientalis*** Schlosser, 1910 663

Subfamily Vespertilioninae Gray, 1821 663
Genus ***Barbastella*** Gray, 1821 666
Barbastella barbastellus (Schreber, 1774) 666
Barbastella leucomelas (Cretzschmar, 1826) 668
Genus ***Eptesicus*** Rafinesque, 1820 670
Eptesicus bottae (Peters, 1869) 672
Eptesicus floweri (de Winton, 1901) 675
Eptesicus hottentotus (A. Smith, 1833) 676
Eptesicus isabellinus (Temminck, 1840) 681
Eptesicus platyops (Thomas, 1901) 685
Genus ***Glauconycteris*** Dobson, 1875 686
Glauconycteris alboguttata J.A. Allen, 1917 687
Glauconycteris argentata (Dobson, 1875) 688
Glauconycteris atra Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, 2017 689
Glauconycteris beatrix Thomas, 1901 690
Glauconycteris cf. beatrix Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, 2017 691
Glauconycteris cf. humeralis Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, 2017 692
Glauconycteris curryae Eger and Schlitter, 2001 692
Glauconycteris egeria Thomas, 1913 693
Glauconycteris gleni Peterson and Smith, 1973 694
Glauconycteris humeralis J.A. Allen, 1917 695
Glauconycteris kenyacola Peterson, 1982 696
Glauconycteris machadoi Hayman, 1963 697
Glauconycteris poensis (Gray, 1842) 698
Glauconycteris superba Hayman, 1939 699
Glauconycteris variegata (Tomes, 1861) 701
Genus ***Hypsugo*** Kolenati, 1856 704
Hypsugo anchietae (Seabra, 1900) 704
Hypsugo ariel (Thomas, 1904) 706
Hypsugo bemainty Goodman, Rakotondramanana, Ramasindrazana, Kearney, Monadjem, Schoeman, Taylor, Naughton and Appleton, 2015 708
Hypsugo cf. eisentrauti Hill, 1968 708
Hypsugo crassulus (Thomas, 1904) 709
Hypsugo eisentrauti (Hill, 1968) 711
Hypsugo musciculus (Thomas, 1913) 712
Hypsugo savii (Bonaparte, 1837) 713
Genus ***Laephotis*** Thomas, 1901 717
Laephotis angolensis Monard, 1935 719
Laephotis botswanae Setzer, 1971 721
Laephotis namibensis Setzer, 1971 725
Laephotis wintoni Thomas, 1901 728
Genus ***Mimetillus*** Thomas, 1904 731
Mimetillus moloneyi (Thomas, 1891) 732
Mimetillus thomasi Hinton, 1920 733
Genus ***Neoromicia*** Roberts, 1926 734
Neoromicia aff. guineensis Bocage, 1889 735
Neoromicia brunnea (Thomas, 1880) 736
Neoromicia capensis (A. Smith, 1829) 738
Neoromicia guineensis (Bocage, 1889) 744
Neoromicia helios (Heller, 1912) 746
Neoromicia humbloti (A. Milne-Edwards, 1881) 747
Neoromicia isabella Decher, Hutterer and Monadjem, 2016 748
Neoromicia malagasyensis (Peterson, Eger and Mitchell, 1995) 749
Neoromicia matroka (Thomas and Schwann, 1905) 750
Neoromicia nana (Peters, 1852) 751
Neoromicia rendalli (Thomas, 1889) 759
Neoromicia robertsi Goodman, Taylor, Ratrimomanarivo and Hoofer, 2012 762
Neoromicia roseveari Monadjem, Richards, Taylor and Stoffberg, 2013 763
Neoromicia somalica (Thomas, 1901) 764
Neoromicia stanleyi Goodman, Kearney, Ratsimbazafy and Hassanin, 2017 767
Neoromicia tenuipinnis (Peters, 1872) 769
Neoromicia zuluensis (Roberts, 1924) 772
Neoromicia "incertae-sedis" 775
Genus ***Nyctalus*** Bowdich, 1825 776

Nyctalus azoreum (Thomas, 1901).....776
Nyctalus lasiopterus (Schreber, 1780).....778
Nyctalus leisleri (Kuhl, 1817).....781
Genus ***Nycticeinops*** Hill & Harrison, 1987 784
†***Nycticeinops serengetiensis*** Gunnell, Butler, Greenwood and Simmons, 2015 785
Nycticeinops schlieffenii (Peters, 1859).....785
Nycticeinops "incertae-sedis".....788
Genus ***Otonycteris*** Peters, 1859 788
Otonycteris hemprichii Peters, 1859 789
Genus ***Pipistrellus*** Kaup, 1829.....793
Pipistrellus aero Heller, 1912 796
Pipistrellus grandidieri (Dobson, 1876).....797
Pipistrellus hanaki Hulva and Benda, 2004 799
Pipistrellus hesperidus (Temminck, 1840) 801
Pipistrellus hesperidus broomi Roberts, 1948 804
Pipistrellus hesperidus hesperidus (Temminck, 1840) 805
Pipistrellus hesperidus subtilis (Sundevall, 1846).....805
Pipistrellus inexspectatus Aellen, 1959 806
Pipistrellus kuhlii (Kuhl, 1817) 807
Pipistrellus maderensis (Dobson, 1878).....814
Pipistrellus nanulus Thomas, 1904.....816
Pipistrellus permixtus Aellen, 1957 817
Pipistrellus pipistrellus (Schreber, 1774) 818
Pipistrellus pygmaeus (Leach, 1825) 822
Pipistrellus raceyi Bates, Ratrimomanarivo, Harrison and Goodman, 2006 823
Pipistrellus rueppellii (Fischer, 1829) 825
Pipistrellus rueppellii fuscipes Thomas, 1913.....828
Pipistrellus rueppellii pulcher (Dobson, 1875) 829
Pipistrellus rueppellii rueppellii (J. B. Fischer, 1829) 829
Pipistrellus rueppellii senegalensis Dorst, 1960 830
Pipistrellus rueppellii vernayi Roberts, 1932.....831
Pipistrellus rusticus (Tomes, 1861).....831
****Pipistrellus*** sp. aff. ****kuhlii*** Kuhl, 1817 834
Pipistrellus "incertae-sedis".....834
Genus ***Plecotus*** E. Geoffroy St.-Hilaire, 1818.....835
Plecotus balensis Kruskop & Lavrenchenko, 2000 835
Plecotus christii Gray, 1838 837
Plecotus gaisleri Benda, Kiefer, Hanak & Veith, 2004.....839
Plecotus teneriffae Barrett-Hamilton, 1907 840
Genus ***Scotoecus*** Thomas, 1901 841
†***Scotoecus olduvensis*** Gunnell, Butler, Greenwood and Simmons, 2015.....842
Scotoecus albigula Thomas, 1909.....842
Scotoecus albofuscus (Thomas, 1890) 843
Scotoecus hindei Thomas, 1901.....845
Scotoecus hirundo (de Winton, 1899).....846
Acknowledgements.....849
Glossary.....851
References.....856
Appendices.....1035
Appendix 1: Current Taxonomy.....1035
Appendix 2: Voucher specimens.....1043
Appendix 2a: Museum Acronyms and Number of Specimens.....1043
Appendix 2b: Voucher Specimen Details.....1075
Appendix 2c: Voucher Specimens per Museum.....1461
Appendix 2d: Voucher Specimens per Museum and Country.....1601
Appendix 2e: Voucher Specimens per Country.....1686
Appendix 2f: Voucher Specimens from Protected Areas.....1783
Appendix 2f1: Sorted by Country, Protected Area, Taxon.....1784
Appendix 2f2: Sorted by Taxon, Country, Protected Area.....1821
Appendix 2f3: Number of specimens of the given taxa collected in and outside Protected Areas.....1868
Appendix 2f4: Number of specimens of the given taxa recently [in the last 20 years] collected in and outside Protected Areas.....1875
Appendix 2f5: Number of localities in which the given taxa was collected in and outside Protected Areas.....1881
Appendix 2f6: Number of localities in which the given taxa was recently [in the last 20 years] collected in and outside Protected Areas.....1888

Appendix 2g: Distribution Maps per Taxon 1894
Appendix 2h: Species Richness Maps per Country 2216
Appendix 2i: Distribution per quarter degree 2276
Appendix 3: Synonyms 3025
Appendix 3a: Synonyms by Name 3025
Appendix 3b: Synonyms by Author 3049
Appendix 3c: Synonyms by Publication Date 3083
Appendix 3d: Synonyms by Country of Type Specimen 3105
Appendix 3e: Common Names in Alphabetical Order 3129
Appendix 3f: Common Names by Language 3203
Appendix 3g: Original Descriptions 3279
Appendix 4: Collector Information 3585
Appendix 4a: Follow the Collector 3585
Appendix 4b: Chronological 4133
Appendix 4c: Per Country and Locality 5483
Appendix 4d: Collector Biographies 5745
Appendix 5: Keys from the Literature 5813
Appendix 5a: Dobson (1877). A Monograph of the Group Molossi. 5813
Appendix 5b: Dobson (1878). Catalogue of the Chiroptera in the collection of the British Museum. 5816
Appendix 5c: Lataste (1885). Etude de la faune des Vertébrés de Barbarie (Algérie, Tunisie et Maroc) 5843
Appendix 5d: Monticelli (1889). LIX. Some remarks on the genus Taphozous. 5846
Appendix 5e: Matschie (1895). Die Säugethiere Deutsch-Ost-Afrikas 5847
Appendix 5f: Sclater (1901). The mammals of South Africa. 5849
Appendix 5g: Jameson (1909). LIII. On a collection of mammals from South Africa. 5851
Appendix 5h: Andersen (1912). Catalog of the Chiroptera in the collection of the British Museum. Second Edition. Volume I: Megachiroptera 5852
Appendix 5i: Monard (1935). Contribution à la mammalogie d'Angola et prodrome d'une faune d'Angola. 5868
Appendix 5j: Frechkop (1938). Exploration du Parc National Albert. Mission G. F. De Witte (1933 - 1935). Fascicule 10. Mammifères. 5870
Appendix 5k: Dorst (1948). Les chiroptères du genre Triaenops Dobson (Hipposidérines). 5871
Appendix 5l: Malbrant and Maclatchy (1949). Faune de l'équateur Africain français. 5872
Appendix 5m: Panouse (1951). Les chauves-souris du Maroc. 5877
Appendix 5n: Roberts (1951). The mammals of South Africa 5880
Appendix 5o: Malbrant (1952). Faune du Centre African français (Mammifères et Oiseaux). 5886
Appendix 5p: Sanborn and Hoogstraal (1955). The identification of Egyptian bats. 5888
Appendix 5q: Hoogstraal (1962). A brief review of the contemporary land mammals of Egypt (including Sinai). 1. Insectivora and Chiroptera. 5890
Appendix 5r: Hill (1963). A revision of the genus Hipposideros. 5892
Appendix 5s: Hayman et al. (1966). The bats of the Congo and of Rwanda and Burundi 5896
Appendix 5t: Hayman and Hill (1971). Order Chiroptera: The mammals of Africa 5903
Appendix 5u: Smithers (1971). The mammals of Botswana. 5916
Appendix 5v: Hill (1974). A review of Scotoecus Thomas, 1901 (Chiroptera: Vespertilionidae) 5919
Appendix 5w: Fenton (1975). Observations on the biology of some Rhodesian bats, including a key to the Chiroptera of Rhodesia. 5920
Appendix 5x: Bergmans (1975). On the differences between sympatric Epomops franqueti (Tomes, 1860) and Epomops buettikoferi (Matschie, 1899), with additional notes on the latter species (Mammalia, Megachiroptera). 5924
Appendix 5y: Hill (1977). A review of the Rhinopomatidae (Mammalia: Chiroptera). 5925
Appendix 5z: Jones (1977a). Plecotus rafinesquii 5926
Appendix 5aa: Happold and Happold (1978c). The fruit bats of western Nigeria. Part 3. 5927
Appendix 5ab: Smithers and Wilson (1979). Check List and Atlas of the Mammals of Zimbabwe Rhodesia 5928
Appendix 5ac: El-Rayad (1980). Systematics of African molossid bats of the subgenus Xiphonycteris of the genus Tadarida (Molossidae Chiroptera). 5933
Appendix 5ad: El-Rayah (1981). A New species of bat of the genus Tadarida (Family Molossidae) from West Africa. 5934
Appendix 5ae: Rautenbach (1982). Mammals of Transvaal. 5935
Appendix 5af: Smithers, R.H.N. (1983). The mammals of the Southern African subregion 5938
Appendix 5ag: Wassif et al. (1984). Fauna and Flora of Egypt. 1. On a collection of bats from Egypt. 5943
Appendix 5ah: Qumsiyeh (1985). The bats of Egypt 5945
Appendix 5ai: Aulagnier and Thevenot (1986). Catalogue des mammifères sauvages du Maroc 5947
Appendix 5aj: Meester et al. (1986). Classification of Southern African mammals 5949

Appendix 5ak: Qumsiyeh and Jones (1986). Rhinopoma hardwickii and Rhinopoma muscatellum 5955
Appendix 5al: Happold (1987). The mammals of Nigeria.....5956
Appendix 5am: Boulay and Robbins (1989). Epomophorus gambianus 5961
Appendix 5an: Happold and Happold (1989). The bats (Chiroptera) or Malawi, Central Africa: Checklist and keys for identification....5962
Appendix 5ao: Kowalski and Rzebik-Kowalska (1991). Mammals of Algeria. 5966
Appendix 5ap: Peterson et al. (1995). Faune de Madagascar: Chiroptères....5968
Appendix 5aq: Bergmans (1997). Taxonomy and biogeography of African fruit bats (Mammallia, Megachiroptera).5. The genera Lissonycteris Andersen, 1912, Myonycteris Matschie, 1899 and megaloglossus Pagenstecher, 1.885; General remarks and conclusions; Annex: Key to all species 5970
Appendix 5ar: Gharaibeh (1997). Systematics, distribution, and zoogeography of mammals of Tunisia. 5974
Appendix 5as: Bouchard (1998). Chaerephon pumilus....5976
Appendix 5at: Colket and Wilson (1998). Taphozous hildegardeae....5977
Appendix 5au: Owen-Ashley and Wilson (1998). Micropteropus pusillus....5978
Appendix 5av: Taylor (1998). The smaller mammals of KwaZulu-Natal.....5979
Appendix 5aw: Dunlop (1999). Mops midas 5982
Appendix 5ax: Gray et al. (1999). Nycteris thebaica 5983
Appendix 5ay: Kwiecinski and Griffiths (1999). Rousettus egyptiacus 5985
Appendix 5az: Taylor (2000). Bats of Southern Africa....5986
Appendix 5ba: Russ et al. (2001). Key to the bats of Madagascar 5992
Appendix 5bb: Fahr et al. (2002). A revision of the Rhinolophus maclaudi species group with the description of a new species from West Africa (Chiroptera: Rhinolophidae). 5994
Appendix 5bc: Jacobs and Fenton (2002). Mormopterus petrophilus 5995
Appendix 5bd: Csorba et al. (2003). Horsehoe bats of the World (Chiroptera: Rhinolophidae). 5996
Appendix 5be: Decher and Fahr (2005). Hipposideros cyclops....6000
Appendix 5bf: Bates et al. (2006). A description of a new species of Pipistrellus (Chiroptera: Vespertilionidae) from Madagascar with a review of related Vespertilioninae from the island. 6002
Appendix 5bg: Csorba (2008). Taxonomy of the horseshoe bats of the world (Chiroptera: Rhinolophidae).....6003
Appendix 5bh: Thorn and Kerbis Peterhans (2009). Small mammals of Uganda.....6007
Appendix 5bi: Rambaldini (2010). Glauconycteris variegata 6015
Appendix 5bj: Bol et al. (2011). Introduction à l'inventaire des Chauves-souris (Chiroptères) de la ville de Maroua, Extrême-Nord Cameroun.....6016
Appendix 5bk: Patterson and Webala (2012). Keys to the bats (Mammalia: Chiroptera) of East Africa.....6018
Appendix 5bl: Lanza et al. (2015). The bats of Somalia and neighbouring areas. 6027
Appendix 5bm: Van Cakenberghe et al. (2017). The bats of the Congo and of Rwanda and Burundi revisited (Mammalia: Chiroptera). 6034
Appendix 6: Images of Type Specimens 6045
Appendix 7: Summary of Characteristic Information....6081
Appendix 7a: Echolocation call Parameters from Literature 6081
Appendix 7b: Methods used in Echolocation Literature 6109
Appendix 7c: Karyotype information from Literature....6112
Appendix 8: Abstracts 6115
Appendix 9: Gazetteers....6552
Appendix 9a: Hierarchical Gazetteer....6552
Appendix 9b: General Alphabetical Gazetteer 6904
Appendix 9c: Country Alphabetical Gazetteer 7268
Appendix 9d: Quarter Degree Gazetteer....7612
Appendix 9e: Altitudinal Gazetteer....8129

Introduction

The purpose of the African Chiroptera Report is to collate published information on, and collate specimen records of, African bats. The advent of the internet provides an opportunity for large amounts of information to be easily and economically updated and accessible, which is particularly important for taxonomic information. The electronic, web-based nature of the information is intended to allow information on African bats to be corrected/updated more frequently than a printed format allows, and to be available to users in an affordable form that can be manipulated to their specific requirements. It is hoped this tool will facilitate research and conservation planning, and possibly stimulate interactions across different areas of research. The report is generated from data collated in the African Chiroptera Database and will hopefully grow and develop with the addition of new and corrected information.

The incorporation of information other than taxonomic (see the various section headings in the description of the layout below), is still patchy in its execution across the taxa. Information that may answer specific requirements of a user, i.e. more information about the voucher specimens, or specimen collectors, has been drawn from across the database and is presented in separate appendices. Published identification keys for African bat species, have, where necessary, been updated to include current names, and are presented in appendix 5. In appendix 6 images of type specimens are included as they become available.

TAXONOMY

In 2006 an African Chiroptera Taxonomic Advisory Committee (ACTAC) was established to guide the development of this resource. This Committee has made valuable contributions regarding the incorporation of suggested changes/corrections, in particular in relation to the taxonomy, into this report. The report is currently most comprehensive in the presentation of information on all known synonyms, for presently accepted taxa of African bat species. Having a high Chiroptera diversity, there are currently 18 families (incl. 4 extinct and one indeterminate), 81 genera (23 extinct) and 379 species (48 extinct) recognized as occurring (or having occurred) in Africa. An overview of the number of genera and species per family occurring in Africa is shown in Figure 1. Usually the number of species is larger than the number of genera, but there is one exception: in the Megadermatidae, three genera and two species are mentioned. The reason for this is that only extant taxa are included, and although *Megaderma gigas* is an extinct species, the genus itself still has representatives in Asia. The graph further shows that the Vespertilionidae contain the largest number of both genera and species, followed by the Molossidae and Pteropodidae in number of species, and by the Pteropodidae and Molossidae in number of genera.

The synonym information is still largely based on work by Meester *et al.* (1986), Koopman (1993a), and Simmons (2005). The work of Simmons (2005) is still generally followed in the report for the status of lower taxonomic groups, and we are especially indebted to this publication.

The report also aims to incorporate information on the whereabouts of type specimens, name combinations, and spelling variations and errors/lapsus calami in names.

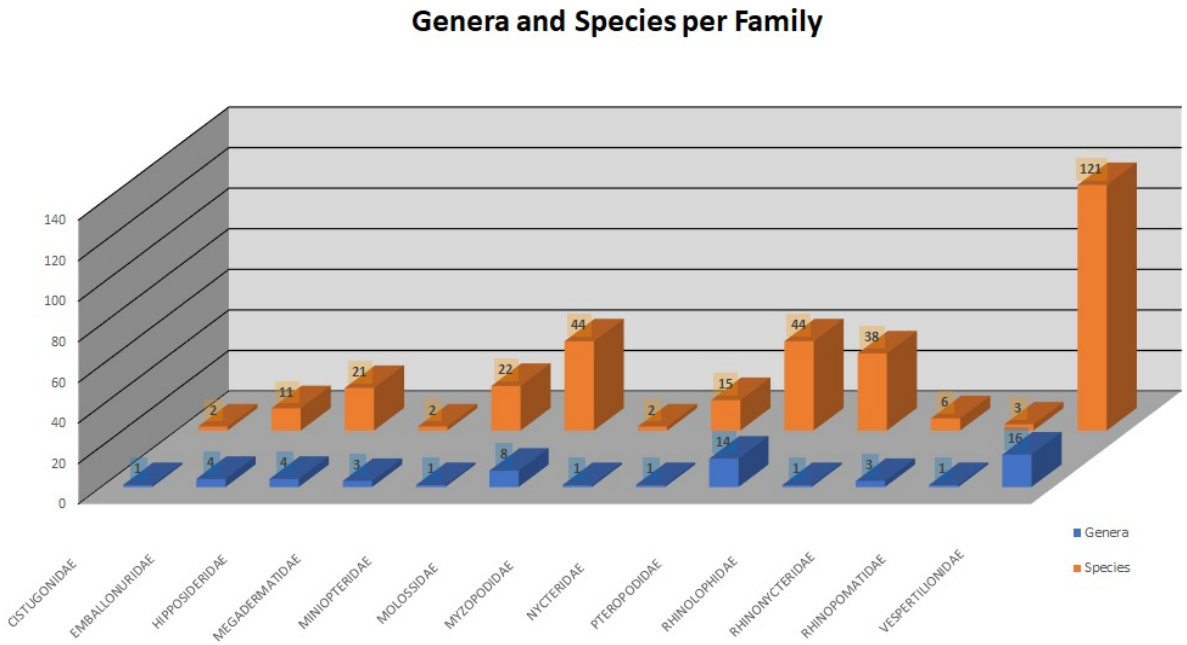


Figure 1. Overview of the number of extant genera and species per family occurring in Africa (Modified after Srinivasulu et al., 2010: 1008).

NEW TAXONOMIC CHANGES SINCE THE 2018 REPORT

Definitions of terms for taxonomic changes:

New taxon - a recently described taxon or a taxon that was for some reason omitted from the previous report.
Revised status – re-establishment of the taxon name.
Removed - a taxon which was previously recognized as occurring within Africa, but has been shown to not exist, for various reasons.
†extinct

New Status	Status change	2018 Status	Reason
Hipposideridae Lydekker, 1891			
†*Macronycteris besaoka* (Samonds, 2007)	Revised status	*Hipposideros besaoka*	Goodman *et al.* (2016: 435) found that the mandibula and lower teeth of *besaoka* are more robust than those of other Madagascan "*Hipposideros*" [=*Macronycteris*], but were in doubt about its generic assignment to either of these genera. More recent investigation by Rakotoarivelo et al. (2019: 14) assigned the species to *Macronycteris*.
Miniopteridae Dobson, 1875			
Miniopterus villiersi Aellen, 1956	Revised status	*Miniopterus schreibersii villiersi*	*Villiersi* was generally considered to be a synonym or a subspecies of either *M. inflatus, M. schreibersii* or *M. natalensis*, but several authors suggested it to be a separate species, which is gaining support as

New Status	Status change	2018 Status	Reason
			detailed genetic analyses indicate the presence of multiple taxa in West Africa.
Vespertilionidae Gray, 1821			
Myotis zenatius Ibáñez, Juste, Salicini, Puechmaille and Ruedi, 2019	New taxon		At the beginning of the year, two publications appeared dealing with the northwest African representatives of "*Myotis nattereri*" (Çoraman *et al.*, 2019 and Juste *et al.*, 2019), and leading to different conclusions. The former authors consider it a separate subspecies, whereas the latter consider it a separate species. Furthermore, there were also some issues with the validity of the description by Çoraman *et al.* (2019), which led us to tentatively use the name proposed by Juste *et al.* (2019) until this issue is solved.
Scotophilus altilis G.M. Allen, 1914	Revised status		Vallo et al. (2019: 148) found a 10 % difference in cyt-*b* between *Scotophilus leucogaster* and a series of specimens from southwestern Ethiopia and southern South Sudan. These latter specimens agreed with the description of *S. altilis* by Allen (1914). These differences were supported by differences in size and in two nuclear markers, which are different enough to consider it a separate species.
Pipistrellus grandidieri (Dobson, 1876)	Revised status	*Neoromicia flavescens* (Seabra, 1900)	Most authors since Thorn *et al*. (2007) consider *flavescens* to be a synonym of *grandidieri*, although the content of the latter taxon is still not fixed (e.g. Decher *et al.* (2016: 273) report *N.* cf. *grandidieri* specimens from Guinea, and Schaer *et al.* (2013a: 17416) and Rosskopf *et al*. (2018: 31, suppl.) as *P*. aff. *grandidieri* from West Africa). Based on the

New Status	Status change	2018 Status	Reason
			above, we tentatively consider *flavescens* as synonym of *grandidieri* pending further investigation.

REFERENCES CITED

Allen, G. M. (1914). Mammals from the Blue Nile Valley. *Bulletin of the Museum of Comparative Zoology*, **58 (7):** 305 - 357.

Çoraman, E., C. Dietz, E. Hempel, A. Ghazaryan, E. Levin, P. Presetnik, M. Zagmajster and F. Mayer (2019). Reticulate evolutionary history of a western Palaearctic bat complex explained by multiple mtDNA introgressions in secondary contacts. *Journal of Biogeography*, **46 (2):** 343 - 354. doi: 10.1111/jbi.13509.

Decher, J., A. Hoffmann, J. Schaer, R. W. Norris, B. Kadjo, J. Astrin, A. Monadjem and R. Hutterer (2016). Bat diversity in the Simandou Mountain Range of Guinea, with the description of a new white-winged vespertilionid. *Acta Chiropterologica*, **17 (2):** 255 - 282 (for 2015). doi: 10.3161/15081109ACC2015.17.2.003.

Juste, J., M. Ruedi, S. J. Puechmaille, I. Salicini and C. Ibáñez (2019). Two new cryptic bat species within the *Myotis nattereri* species complex (Vespertilionidae, Chiroptera) from the Western Palaearctic. *Acta Chiropterologica*, **20 (2):** 285 - 300 (for 2018). doi: 10.3161/15081109ACC2018.20.2.001.

Goodman, S. M., M. C. Schoeman, A. Rakotoarivelo and S. Willows-Munro (2016). How many species of *Hipposideros* have occurred on Madagascar since the Late Pleistocene?. *Zoological Journal of the Linnean Society*, **177 (2):** 428 - 449. doi: 10.1111/zoj.12368.

Rakotoarivelo, A. R., S. M. Goodman, M. C. Schoeman and S. Willows-Munro (2019). Phylogeography and population genetics of the endemic Malagasy bat, *Macronycteris commersoni* s.s. (Chiroptera: Hipposideridae). *PeerJ*, **7:** e5866. doi: 10.7717/peerj.5866.

Rosskopf, S. P., J. Held, M. Gmeiner, B. Mordmüller, P.-B. Matsiégui, I. Eckerle, N. Weber, K. Matuschewski and J. Schaer (2018). *Nycteria* and *Polychromophilus* parasite infections of bats in Central Gabon. *Infection, Genetics and Evolution*, **68:** 30 - 34 (for 2019). doi: 10.1016/j.meegid.2018.11.022.

Schaer, J., S. L. Perkins, J. Decher, F. H. Leendertz, J. Fahr, N. Weber and K. Matuschewski (2013). High diversity of West African bat malaria parasites and a tight link with rodent *Plasmodium* taxa. *Proceedings of the National Academy of Sciences, U.S.A.*, **110 (43):** 17415 - 17419. doi: 10.1073/pnas.1311016110.

Thorn, E., D. Kock and J. Cuisin (2007). Status of the African bats *Vesperugo grandidieri* Dobson 1876 and *Vesperugo flavescens* Seabra 1900 (Chiroptera, Vespertilionidae), with description of a new subgenus. *Mammalia*, **71 (1/2):** 70 - 79. doi: 10.1515/MAMM.2007.013.

Vallo, P., D. M. Reeder, M. E. Vodzak and P. Benda (2019). Resurrection of an East African house bat species *Scotophilus altilis* Allen, 1914 (Chiroptera: Vespertilionidae). *Zootaxa*, **4577 (1):** 148 - 160. doi: 10.11646/zootaxa.4577.1.9.

GEOGRAPHIC SCOPE

This report covers the geographic area of the African continent and adjacent regions, including, Madagascar, and other surrounding islands in the Indian and Atlantic oceans (Figure 3). This and previous issues of the report have focused attention mainly on capturing information from the African continent and the associated islands. The taxa from the Arabian Peninsula are included as far as these are shared with the African continent.

SPECIES RICHNESS AND ESTIMATES

Figure 2 shows the number of families, genera and species occurring in the various African countries. The most diverse country in number of genera and species is The Democratic Republic of the Congo, followed by Kenya, Cameroon and Tanzania (all over 100 species) (see Figure 3 and 4).

Species lists per country together with voucher specimens (evidence) can be located in Appendix 2e.

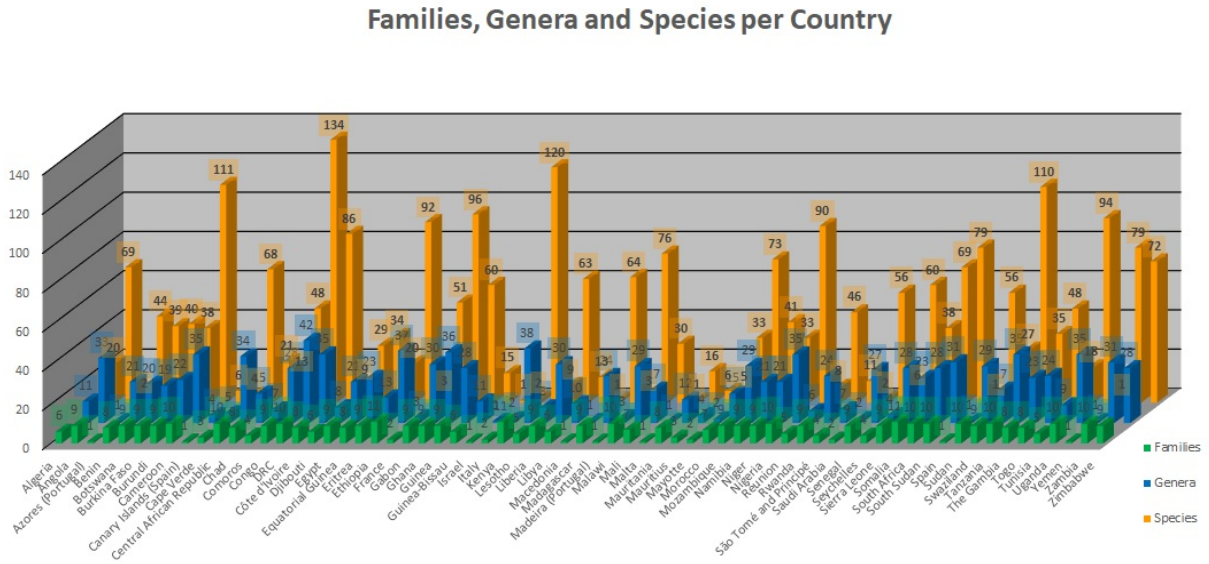


Figure 2. Overview of the number of extant families, genera and species occurring in the various countries in Africa (Modified after Srinivasulu et al., 2010: 1008).

Species richness maps for individual countries showing all known records have been mapped at a quarter degree level (0.25) (Appendix 2h).

Examination of the estimated spatial extent of collection coverage (Figure 4) indicates large areas where there is urgent need for surveys. Within southern Africa – southeastern Angola is in desperate need of preliminary survey work, as well as smaller areas in northern Mozambique, Botswana southwestern Zambia and Northern Cape Province of South Africa. In East Africa - Tanzania and Somalia should be prioritized and in Central Africa - The Democratic Republic of the Congo.

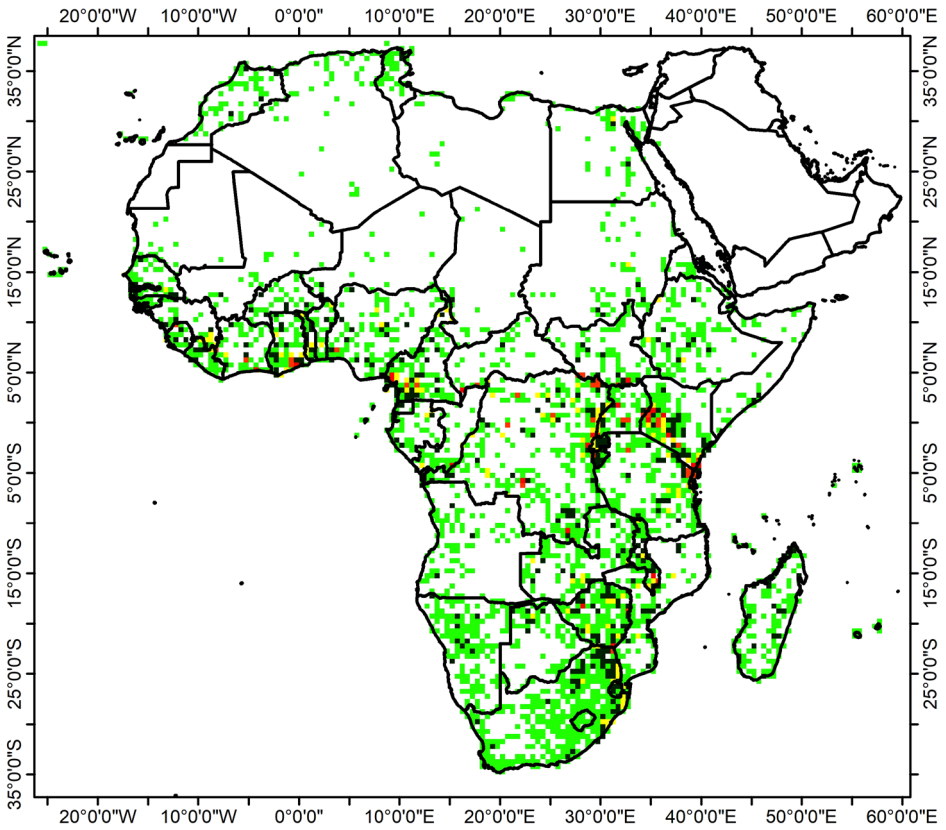


Figure 3. African bat species richness map, calculated in half degree grid (0.5) size from the specimen data in the African Chiroptera Database 2019. Light green = 1- 8 species; dark green / black = 9 – 17 species; yellow = 18 - 25 species; orange = 26 - 34 species; red= 35 - 59 species.

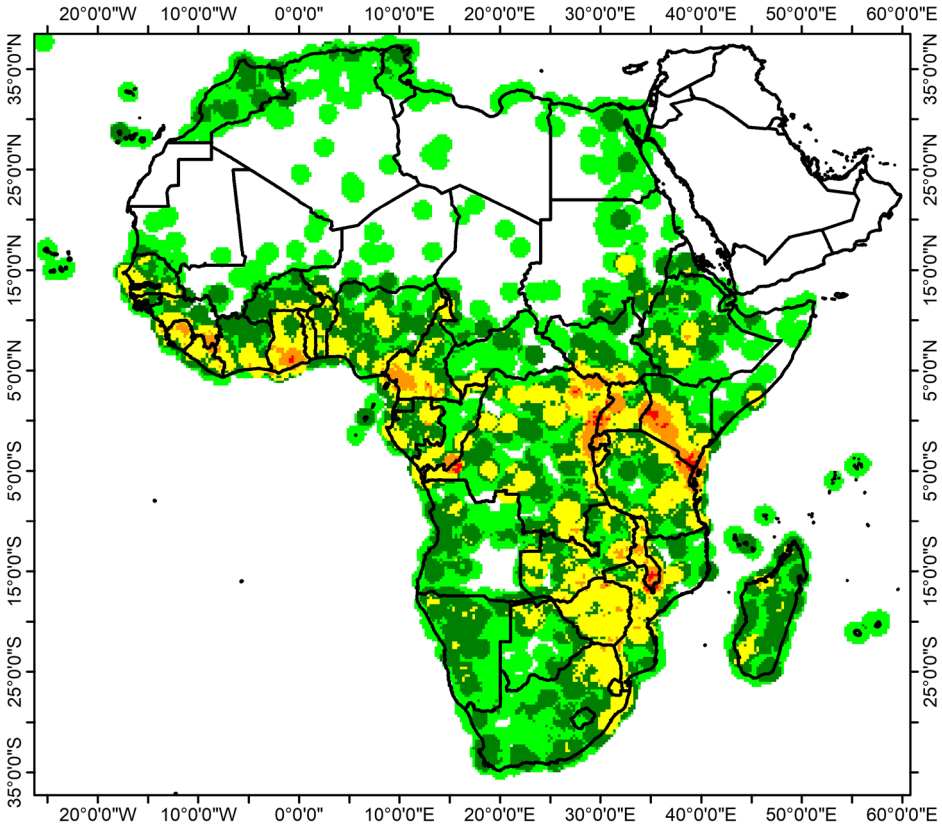


Figure 4. African bat species richness estimator (Chao 2) was used to calculate in quarter degree (0.25) grid size the specimen data in the African Chiroptera Database 2019, using DIVA-GIS 7.4.0.1 (http://www.diva-gis.org) with a nearest neighbor set at 2. Light green = 1 – 10; dark green / black = 11 – 30; yellow = 31 – 65; orange = 66 – 100; red = 101 – 191.

All light green areas in species richness maps should be viewed with some caution as these only represent 1 - 10 species. These areas most likely indicate bat records collected as part of larger mammal fieldwork or were collected opportunistically. Therefore, areas that are light green require surveys that will focus attention of the bat species found at these sites.

For Sub-Saharan Africa, Monadjem and Schoeman (2013: 104) indicate that the highest species richness is recorded in the Albertine Rift, the northern shores of Lake Victoria in East Africa, and the Upper Guinean forest zone of West Africa. Furthermore, eastern South Africa, southern Mozambique, Zimbabwe, Malawi, coastal Kenya and Tanzania, the Ethiopian rift valley, the Congo basin north of the Congo River and the humid Guinean woodlands north of the rainforest in West Africa have a high species richness. The poorest species richness, they found (not unexpectely) in the arid zones of south-western Southern Africa, the entire Sahel zone of North Africa, and the Horn of Africa. But the latter might still be the result of (large) collections in various museums, which are still unreported (as was already indicated by Schlitter and Delany, 1985: 47).

SPECIMENS

At the time the 2019 report was generated the African Chiroptera Database contained 131,890 specimen records of which 114,625 specimens had co-ordinates. This indicates that 87 % of the available records could be plotted.

The species distribution maps created in this report probably indicate biases in relation to the collections from which data has currently been obtained. In previous issues of the ACR, it was estimated that about 100,000 to 150,000 specimen records were available for African Chiroptera in collections around the world. This is now believed to be a serious underestimate of potentially available specimens (many European, African and Asian museum collections have not been captured as yet). We currently suspect that a more realistic number of records is possibly between 150,000 – 250,000. Using these revised estimates, we assume that between 52 – 87 % of available records have been captured in the ACD, for 2019.

LAYOUT OF ACCOUNTS

The taxa are presented in alphabetical order, top down (Order, Suborder, Infraorder…etc.).

In the synonyms list, an asterisk (*) in front of the year indicates that the synonym represents the original name for the taxon. This also reveals instances where it is not necessarily the oldest name that has taken precedence. The use of colours denotes the following: red - first name used; blue - name currently in use; green - valid synonyms; black - name combinations, spelling variations and errors/lapsus calami. A question mark (?) in the position of the year indicates that the first use of a particular name combination has not yet been determined.

Information relating to the following section headings, or citations to relevant publications, may also be presented in an account, if information relating to these sections has been published or communicated (e.g. "*pers. comm.*" or "unpublished report"), and has been entered in the database. Sections marked as "unknown" indicate that literature data explicitly mention that this information is "not known" (contrary to not having found any information on the topic).

Taxonomy:
Provides a brief history of previous studies in systematics, giving a summary of different conclusions arising from different methodologies and the resulting taxonomic debates. Much of this information has been taken from Simmons (2005).

Common names:
Common names used, in a variety of different languages, and found in various sources: e.g. Afrikaans (Roberts, 1951),Chinese (Musila *et al.*, 2018a), Czech (Benda, 2010), Dutch (Dietz, 2017), English (Roberts, 1951; Wilson and Cole, 2000), French (http://www.planet-mammiferes.org; Stéphane Aulagnier, *pers. comm.*), German (Rudi Hasslauer, *pers. comm.*), Greek, Albanian and Macedonian (Papadatou *et al.*, 2011), Italian: (Lanza *et al.*, 2015), Maltese (http://www.geocities.com/RainForest/3096/bats.html), Spanish (UNEP-WCMC, 2003; Fa, 1991), Arabian and Hebrew (Ferguson, 2002), Tamil (Kamalakannan and Nameer, 2019). Lina (2017) provided an overview of common names of Europan bats in every possible European language. As a large number of these bats also occur in (northern) Africa, these vernacular names are included too.

Etymology of name:
Information about the origin/meaning of the name.

Similar species:
Information about other taxa, with which there has been a recorded mistake in identification.

Palaeontological / archaeological records:
Any records identified from palaeontological or archaeological sites.

Conservation status:
This section is split into two categories: Global - provides information on past and present Red data assessments of the global populations of a species and; Regional - provides information on past and present Red data assessments of regional or country specific assessments of a species.

General distribution:
Distribution of the taxa in Africa, and extra-limital to Africa. Much of this information also comes from Simmons (2005). Additional records are indicated by a reference to their source.

Biogeography:
Information about the evolutionary processes that have driven speciation of the taxa and also its possible historical distributions in association with sister taxa.

Geographic variation:
Any known variation within a taxon across its distribution.

General description of external morphology:
Information about the outward appearance that may distinguish a taxon.

General description of cranial and dental morphology:
Information about the skull, mandible and teeth that may be distinguishing characters of a taxon.

Detailed morphology:
More detailed description of some structure of a taxon, i.e. for the baculum, tragus, hyoid, or wingshape.

Functional morphology:
Information on any work that has related morphological structure to function.

Sexual dimorphism:
Any known variation within a taxon between males and females.

Echolocation:
Information about the echolocation call of a taxon.

Molecular biology:
Information in this section is currently divided into three categories for information on DNA, Karyotype, and Protein/allozyme. The following abbreviations are used in the description of the karyotype: **2n -** diploid number, **FN -** fundamental number of autosomal chromosome arms, **BA -** total number of biarmed autosomal chromosomes, **X -** female sex chromosome, and **Y -** male sex chromosome.

Habitat:
Information about the environment in which a taxon has been recorded.

Behaviour:
Information about the timing and actions of a taxon.

Roost:
Indicates where a taxon settles during the day and at night.

Migration:
Any records of period movement from one geographic area to another.

Feeding/diet:
Records of behaviour in relation to feeding, and what is eaten.

Predators:
Records of other species know to eat the taxon in question.

Population:
Information in this section is separated into two categories: structure - in relation to any organization between individuals, and density - in relation to the number of individuals.

Lifespan:
Records relating to how long individuals of a taxon are known to live for.

Reproduction and ontogeny:
Information relating to the biology associated with producing further members of a species, and the growth/development over the course of a lifespan.

Mating:
Information relating to the behaviour associated with producing further members of a species.

Post-natal development:
Information relating to changes that occur after birth.

Parasites:

Information relating to both ectoparasites (parasites living outside the body), and endoparasites (parasites living within the body).

Viruses:
Any known viruses carried by a taxon. The taxonomy followed is that by the ICTV (International Committee on Taxonomy of Viruses - http://www.ictvonline.org/index.asp).

Utilization/significance:
Information about how a taxon may be used or viewed by people.

Distribution map:
The species distribution maps should still be viewed with some caution, since these are based on voucher specimen records currently included in the African Chiroptera Database. Hence, the actual distribution of the taxon might be more extensive than indicated on the maps, and the voucher specimen classification/identification may not be accurate. On the other hand, it might also be possible that the actual distribution is more restricted than indicated on the maps. This might be due to the inclusion of historical data, which indicate localities where the animals might have occurred a 100 (or less) years ago, when the habitat was favorable for the animals, but which currently is no longer the case (e.g. increased desertification, destruction of rain forest…). Additionally, it needs to be pointed out that due to variety of reasons not all voucher specimen localities have been plotted, i.e. no X, Y co-ordinates could be found, or these co-ordinates fall outside the country where this locality is supposed to be located. Voucher specimen localities that were not plotted are, however, indicated in the Appendices dealing with voucher specimens. Similarly the position of the point within a country does not necessarily confirm its presence at that spot on the map, as data has currently only been screened to fall within its associated country of representation. Appendix 2g contains a larger version of the maps displayed in the taxa accounts.

Distribution based on voucher specimens:
This is a calculated paragraph, where information is derived from information in the African Chiroptera Database, and provides a list of countries from which there are voucher specimens. A note of caution in viewing this data is that it is based on voucher specimen information currently in the African Chiroptera Database, hence there may be voucher specimen records that have not yet been included in the database, and voucher specimen classification/identification may not be accurate. Again, if you have any knowledge of omissions or errors in relation to voucher specimens, please send this information to the managing editors of the database (ACD@africanbats.org) for inclusion in the next revision.

An additional, calculated query indicates through the use of colour in the country name, the period of time when voucher specimens were last collected from a country. Green indicates that voucher specimens have been collected within the past 20 years, blue within the past 20-50 years, orange within the past 50-100 years, and red if the last voucher specimens were collected more than 100 years ago. Country names in black represent countries for which voucher specimens currently have no associated date of collection. The purpose of this ranking is to assist researchers and conservation planners to focus attention on species and areas where further collecting needs to be done to ascertain data on current presence in an area.

REFERENCES
In the references section of the report, the author names are colour coded to indicate in which part of the report the reference was mentioned: blue indicates that the reference is used in the main report, green that it is found in the appendices, and red is used for references occurring in both the main report and the appendices. References without colour code have not been used in the main report nor in the appendices, but are included to provide an overview of all publications pertaining to African bats.

GIS AND ESRI SHAPEFILES
GIS shapefile have been release with this 2019 report that contain all the spatial information to date on the bats in Africa. This is the raw information that was used to create the various maps as well as associated information that is used in the calculation of the various appendicies.

Download data: www.africanbats.org/Documents/ACR/2019/ACR_2019_data.zip.

Shapefile has been created using geographic projection. Caution must be used when interpreting the information as the X and Y co-ordinates have been calculated using various co-ordinate systems (e.g. DDMMSS, DDMM.SS or center of Quarter Degree), this level of precision varies and therefore the points also contain this level of error.

FUTURE OF THE REPORT

The current managing editors felt this project may have a better chance of being a successful tool for some time into the future, by encouraging contributions of data and information from interested individuals and organizations. It is hoped the African Chiroptera Report will continue to grow and develop with many more contributions of new and corrected information, i.e. verification of specimens, and specimen voucher records to the database from interested individuals and organizations. Not assigning individual names to authorship/editorship of the report has also been an intentional decision, to try and develop "ownership" of the project among all individuals and organizations who contribute to the database. It is envisaged that each release of the report, being built on the foundation of the previous report, will retain the information of whom and in what capacity they contributed to the project in a particular cycle.

Future funding is being sought for the continued support and development of the African Chiroptera Project and the development of additional tools and resources. Some of the tools and resources being explored are contracting in of additional technical skills to develop web access, GIS integration for spatial queries and information dissemination. The saying goes 'Garbage in garbage out', the African Chiroptera Project will continue to refine, verify and interrogate information contained in the database. This will be achieved through the development of teams who will verify and check all information contained in the database – verification of identifications, spatial accuracy of collection sites, and the entering in of recent and historical information from published sources.

Any mistakes, misrepresentation of data, or omitted publications can be reported to the managing editors of the database (ACD@africanbats.org). This will allow corrections and updates to be made in the next report (2020).

Taxa profiles

ORDER CHIROPTERA Blumenbach, 1779

330BC. *DERMAPTERA* Aristotle. - Comments: ca. 330 B.C. Non-Linnean but noted here for the sake of interest.

1767. *Vespertiliones* Pallas, Vespertiliones in genre. pp. 1–35, in Spicilegia Zoologica quibus novae imprimis et obscurae animalium species iconibus, descriptionibus atque commentariis illustrantur. Tomus 1. Fascicle Tertius. G. A. Lange, Berolini, Germany., 3. - Comments: Jackson and Groves (2015: 227) consider this as a synonym of Chiroptera. Originally, the name was proposed without rank, and included the genus *Vespertilio* Linnaeus, 1758.

*1779. *CHIROPTERA* Blumenbach, Handbuch der Naturgeschichte, 58. - Etymology: Neuter plural scientific Latin substantive made up of the Greek substantives, respectively feminine and neuter "*χείρ*" (kheír) [genitive "*χειρός*" (kheirós)] meaning "hand" and "*πτερόν*" (pterón) meaning "wing", or combined: "with the hand serving as a wing" or "with the hand changed into a wing" (see Lanza *et al.*, 2015: 13). - ZooBank: 06148AD8-596C-45A5-8756-74BCF5758557. (Current Combination)

1806. *Chiropteren* Duméril, Zoologie Analytique, 5, 11. - Comments: Jackson and Groves (2015: 227) indicate that Duméril introduced this "family" name to include the genera: *Galeopithecus* Pallas, 1780 [Order Dermoptera]; *Pteropus* Brisson, 1762; *Noctilio* Linnaeus, 1766; *Vespertilio* Linnaeus, 1758; *Rhinolophen* [= *Rhinolophus* Lacépède, 1799]; and *Phyllostomen* [= *Phyllostomus* Lacépède, 1799].

1815. *Chiropteria* Rafinesque, Analyse de la Nature., 51, 54. - Comments: Jackson and Groves (2015: 227) indicate that the name originally included the families Galeopia Rafinesque, 1815 [= Galeopithecidae Gray, 1821] and *Vespertilia* Rafinesque, 1815 [= Vespertilionidae J. Gray, 1821], and is an unjustified emendation of Chiroptera Blumenbach, 1779. (Emendation)

1816. *Cheiroptères* G. Cuvier, xxx, 121. - Comments: Originally proposed as family name and included the genera *Vespertilio* Linnaeus, 1758; *Pteropus* Brisson, 1762; *Cephalotes* É. Geoffroy, 1810 [= *Nyctimene* Borkhausen, 1797]; *Dysopes* Illiger, 1811: 122 [= *Molossus* É. Geoffroy, 1805]; *Noctilio* Linnaeus, 1766; *Phyllostoma* G. Cuvier, 1800 [= *Phyllostomus* Lacépède, 1799]; Les Megadermes [= *Megaderma* É. Geoffroy, 1810]; *Rhinolophus* Lacépède, 1799; *Nycteris* É. Geoffroy & G. Cuvier, 1795; *Thaphozous* [= *Taphozous* É. Geoffroy, 1818]; and *Plecotus* É. Geoffroy, 1818 (see Jackson and Groves, 2015: 227).

1821. *CHEIROPTERA* Gray, 299. - Comments: Proposed as a class, and originally included the orders Fructivorae J. Gray, 1821)[= Pteropodidae J. Gray, 1821] and Insectivorae J. Gray, 1821 [= Yangochiroptera Koopman, 1985 part] (see Jackson and Groves, 2015: 227). Synonymized with Chiroptera by McKenna and Bell (1997: 295).

1822. *CHEIROPTERA* Fleming, The Philosophy of Zoology, xxxii, 175. - Comments: Originally proposed as order and included the genera *Galeopithecus* Pallas, 1780 [Order Dermoptera (Illiger, 1811)]; *Pteropus* Brisson, 1762; *Cephalotes* É. Geoffroy, 1810b [= *Nyctimene* Borkhausen, 1797]; *Noctilio* Linnaeus, 1766; *Phyllostoma* G. Cuvier, 1800 [= *Phyllostomus* Lacépède, 1799]; *Molossus* É. Geoffroy, 1805; *Stenoderma* É. Geoffroy, 1818; *Rhinopoma* É. Geoffroy, 1818; *Rhinolophus* Lacépède, 1799; *Nycteris* É. Geoffroy and G. Cuvier, 1795; *Megaderma* É. Geoffroy, 1810; *Thaphozus* [sic = *Thaphozous*] Bowdich, 1821 [= *Taphozous* É. Geoffroy, 1818; *Vespertilio* Linnaeus, 1758; and *Plecotus* É. Geoffroy, 1818 (see Jackson and Groves, 2015: 227) . Synonymized with Chiroptera by McKenna and Bell (1997: 295).

1866. *Nycterides* Haeckel, Generelle Morphologie der Organismen., 2: clx. - Comments: *Nomen oblitum*. Jackson and Groves (2015: 227) indicated that this name was proposed as suborder for the "families" Gymnorrhina [= Gymnorhina Giebel, 1855] [= Yangochiroptera Koopman, 1985 part] (including the genera *Vespertilio, Dysopes, Noctilio*) and Histiorrhina [= Histiorhina Van der Hoeven, 1855] [= Rhinolophidae J. Gray, 1825] (including the genera *Rhinolophus, Megaderma, Phyllostoma*). McKenna and Bell (1997: 301) synonymized the name with Chiroptera.

1872. *ANIMALIVORA* Gill, Smiths. Misc. Coll., 11 (1): 16. - Comments: Proposed as a suborder, which originally included the following families: Desmodidae Bonaparte, 1845,

Phyllostomidae J. Gray, 1825, Mormopidae [= Mormoopidae de Saussure, 1860], Rhinolophidae J. Gray, 1825, Megadermidae Gill, 1872 [= Megadermatidae H. Allen, 1864], Vespertilionidae J. Gray, 1821, Molossidae Gervais, 1855 and Noctilionidae J. Gray, 1821 (see Jackson and Groves, 2015: 228). Generally synonymized with the Microchiroptera.

1875. *MICROCHIROPTERA* Dobson, Ann. Mag. nat. Hist., ser. 4, 16 (95): 346. - Comments: Originally included the families Rhinolophidae J. Gray, 1825, Nycteridae Van der Hoeven, 1855, Vespertilionidae J. Gray, 1821, Emballonuridae Gervais, 1855, and Phyllostomidae J. Gray, 1825 (Jackson and Groves (2015: 228). - Etymology: From neuter plural scientific Latin substantive made up of the Greek adjective "*μικρός*" (mikrós) meaning "small" and chiroptera, in opposition to Megachiroptera ("big Chiroptera") (see Lanza *et al.*, 2015: 18).

1883. *Chiropteri* de Rochebrune, Act. Soc. Linn. Bordeaux, 37: 87. - Comments: Unjustified emendation of Chiroptera Blumenbach, 1779. Originally included the families Pteropidae [= Pteropodidae J. Gray, 1821], Megadermidae Gill, 1872 [= Megadermatidae H. Allen, 1864], Nycteridae Van der Hoeven, 1855, Rhinolophidae J. Gray, 1825, Phyllorhinidae de Rochebrune, 1883 [= Hipposideridae Flower & Lydekker, 1891], Taphozoidae Jerdon, 1867 [= Emballonuridae Gervais, 1855b], Molossidae Gervais, 1855, and Vespertilionidae J. Gray, 1821 (see Jackson and Groves, 2015: 228). (Emendation)

1889. *Ptética* Ameghino, Actas Acad. Nac. Cien. Rep. Arg. Cór., 6: xxi, 44, 348. - Comments: Proposed as "Grand Seccion" and included the orders Prochiroptera Ameghino, 1889 and Chiroptera Blumenbach (see Jackson and Groves, 2015: 228). McKenna and Bell (1997: 295) synonymized the name with Chiroptera. Pre-occupied by *Ptetica* Saussure, 1884 (Orthoptera: Acrididae).

1985. *Yinochiroptera* Koopman, Bat Res. News, 25 (3/4): 26 (for 1984). - Comments: Proposed as infraorder and originally included the superfamilies Emballonuroidea Gervais, 1855 and Rhinolophoidea J. Gray, 1825 (Jackson and Groves, 2015: 228).

1994. *Chiropteriformes* Kinman, The Kinman System., 37. - Comments: Proposed as order. McKenna and Bell (1997: 295) synonymized this name with Chiroptera (Jackson and Groves, 2015: 228).

2014. *Vespertilioniformes* Zagorodniuk, Proc. Theriol. School, 12: 8.

TAXONOMY:

Higher classification of the Chiroptera follows Alonso-Zarazaga (2005), Eick *et al.* (2005), Hutcheon and Kirsch (2006), and Teeling *et al.* (2005).

The chiropteran monophyly/diphyly debate that raged over the last decade or so has been quelled by recent molecular studies (Stanhope *et al.*, 1992; Van Den Bussche *et al.*, 1998; Allard *et al.*, 1999; Miyamoto *et al.*, 2000; Murphy *et al.*, 2001a, 2001b; Liu *et al.*, 2001; Butler *et al.*, 2010; Amador *et al.*, 2016) that have unequivocally demonstrated bat monophyly, and thereby dispelled the "flying primate" hypothesis (e.g. Pettigrew, 1986). Molecular analyses reject any close relationship among bats, flying lemurs and tree shrews (once grouped in the cohort Archonta), and instead support a sister-taxon relationship between Chiroptera and Eulipotyphla (Murphy *et al.*, 2001a, 2001b), which together are the sister-group of the Fereuungulata clade (Nikaido *et al.*, 2001, Van Valen, 1979, Feijoo and Parada, 2017: 79), in the supercohort Laurasiatheria (also represented by carnivores, pangolins, cetartiodactyls and perissodactyls) (Murphy *et al.*, 2001a, 2001b; Madsen *et al.*, 2001; Eizirik *et al.*, 2001; Scalley *et al.*, 2001; Nikaido *et al.*, 2001; Springer *et al.*, 2001; Nery *et al.*, 2012; Tsagkogeorga *et al.*, 2013; Foley *et al.*, 2016). On of the most recent reviews (Chen *et al.*, 2017: 1998) suggests a close relationship between Chiroptera and Perissodactyla. The relationship between these two is mentioned as "plausible" by Esselstyn *et al.* (2017: 2308). However, based on neural findings on 38 mammalian species and 82 characters, Dell *et al.* (2010: 177) still suggest a diphyletic origin of Chiroptera with Megachiropterans being a sister-group of the primates.

Jackson and Groves (2015) present the following higher order subdivision for the Chiroptera:

Class Mammalia Linnaeus, 1758
Subclass Theria Parker and Haswell, 1897
Superlegion Trenchnotheria McKenna, 1975
Legion Yangotheria Chow and Rich, 1982
Sublegion Cladotheria McKenna, 1975
Infralegion Zatheria McKenna, 1975
Infraclass Tribosphenida McKenna, 1975
Supercohort Placentalia Bonaparte, 1838
Cohort Laurasiatheria Waddell et al., 1999
Subcohort Scrotifera Waddell et al., 1999
Order Chiroptera Blumenbach, 1779

They also provide an impressive historical overview of the content and synonyms of these divisions.

Studies using molecular techniques to investigate higher level relationships within Chiroptera have challenged the monophyly of Microchiroptera, as supported by morphological characters associated with laryngeal echolocation (see list of references in Simmons, 1994), and altered the traditional subordinal division of bats as Megachiroptera and Microchiroptera. Recent analyses of nuclear and mtDNA gene sequences (Teeling *et al.*, 2000; Springer *et al.*, 2001; Van Den Bussche *et al.*, 2002; Teeling *et al.*, 2002; 2003; Hoofer *et al.*, 2003; Hutcheon and Kirsch, 2004b; Teeling *et al.*, 2005; Eick *et al.*, 2005; Teeling *et al.*, 2000; Hahn and Nakhleh, 2015; Khwanmunee *et al.*, 2015; Amador *et al.*, 2016; Feijoo and Parada, 2017; Hawkins *et al.*, 2019) now strongly support an alliance of megachiropterans and rhinolophoids (excluding Nycteridae) in one suborder, and all other microbats and nycteriids in the other suborder. Although these independent studies identified similar subordinal groups, Teeling *et al.* (2002; 2003; 2005), Springer *et al.* (2001), Amrine-Madsen *et al.* (2003) and Tsagkogeorga *et al.* (2013: 2263) named the two rearranged Chiropteran suborders as: “Yinpterochiroptera” (including Pteropodidae, Rhinolophidae - includes Hipposideridae, Megadermatidae, Craseonycteridae and Rhinopomatidae) [Springer *et al.*, 2001, also include Nycteridae in the Yinpterochiroptera] and “Yangochiroptera” (including Emballonuridae, Nycteridae, Noctilionidae, Mormoopidae, Phyllostomidae, Natalidae, Furipteridae, Thyropteridae, Myzopodidae, Vespertilionidae, Mysctacinidae, and Molossidae), whereas Hutcheon and Kirsch (2004b; 2006) and Eick *et al.* (2005: 1876), following the Principal of Typification (International Code of Zoological Nomenclature, 1999), named the two Chiropteran suborders as: "Pteropodiformes" (including the Pteropodidae, Rhinolophidae, Hipposideridae, Megadermatidae, and Rhinopomatidae) and "Vespertilioniformes" (including Emballonuridae, Nycteridae, Noctilionidae, Mormoopidae, Phyllostomidae, Natalidae, Furipteridae, Thyropteridae, Myzopodidae, Vespertilionidae, Mystacinidae, Miniopteridae and Molossidae). These studies showing microbat paraphyly indicate that the complex suite of morphological innovations for nasal emission of laryngeal echolocation pulses found in rhinolophoid bats either evolved independently at least twice, or once with the subsequent loss in Pteropodidae (Simmons and Geisler, 1998; Springer *et al.*, 2001). This also has implications for the evolution of flight, where many features of flight and ventilation are either directly related or functionally correlated with echolocation (Teeling *et al.*, 2000). Hence, morphological characters previously suggested as synapomorphies of microchiropterans (e.g. features of the inner ear and post-cranial skeleton) have probably also evolved independently, together with the evolution of laryngeal echolocation (Teeling *et al.*, 2000).

Based on transcriptome RNA-seq data, Lei and Dong (2016: 1) estimate the split between Yinpterochiroptera and Yangochiroptera at around 63 MYA.

Teeling *et al.* (2000: 190) suggest two additional considerations that support the hypothesis that rhinolophids and megabats are more closely related: First, a sister-group relationship between these two rather than between megabats and all other chiropterans, reduces the duration of the implied ghost lineage for megabats from the early Eocene to the late Eocene. Second, both groups have distributions that are restricted to the Old World.

The subdivision into suborders "Pteropodiformes" and "Vespertilioniformes" is also supported by cytogentic data (Volleth *et al.*, 2011: 518), as the order of sub-segments in the HSA 4 homologous segment differs between members of both suborders.

Contrary to an earlier suggestion that included Furipteridae, Natalidae, Thyropteridae, and Myzopodidae in the Rhinolophoidea clade (Simmons and Geisler, 1998), the recent molecular studies have confirmed an expanded superfamily, Noctilionoidea, which includes the families Noctilionidae, Furipteridae, Phyllostomidae, Mormoopidae, Mystacinidae, and Thyropteridae (Teeling *et al.*, 2002; Hoofer *et al.*, 2003; Van Den Bussche and Hoofer, 2004b; Teeling *et al.*, 2005; Eick *et al.*, 2005). However, placement of some families is still controversial, since the results of Teeling *et al.*, 2005) showed good support for the basal position of Myzopodidae within Noctilionoidae, while those of (Hoofer *et al.* (2003) did not placed Myzopoda within the Noctilionoidae, but rather in a basal position to all other “yangochiropterans”; Emballonuridae (OR EMBALLONUROIDEA?), Vespertilionoidea, Noctilionoidea. While Eick *et al.* (2005) also indicated Myzopodidae to be basal to the Vespertilionoidea, Noctilionoidea and Emballonuroidea (see figure 1 in Eick *et al.*, 2005: 1874), their finding apparently had no significant nodal support and alternative topologies could not be rejected by the data (Eick *et al.*, 2005).

The other superfamilies recognised by the molecular studies are the Rhinolophoidea (including the families Rhinolophidae, Megadermatidae, Craseonycteridae, and Rhinopomatidae), Emballonuroidea (including the

families Emballonuridae and Nycteridae), and Vespertilionoidea (including the families Vespertilionidae, Molossidae, Natalidae, and Miniopteridae) (Eick *et al.*, 2005; Teeling *et al.*, 2005 [although no miniopterids were included in this study], Springer *et al.*, 2001; Hoofer *et al.*, 2003 [although no miniopterids were included in this study]). Springer *et al.* (2001) also recognised the superfamily Pteropodoidea.

Both Eick *et al.* (2005) and Teeling *et al.* (2005) also found similar sister taxa groups between the families, with Furipteridae and Noctilionidae (probably what was meant by Noctilionoidae in Eick *et al.* (2005)), and Nycteridae and Emballonuridae being sister taxa.

Many families can be diagnosed by unique morphological apomorphies and/or combinations of plesiomorphic and apomorphic features that strongly suggest monophyly (Miller, 1897; 1907; Hill, 1974a; Van Valen, 1979; Koopman, 1984b; 1994; Griffiths and Smith, 1991; Corbet and Hill, 1992; Griffiths *et al.*, 1992; Griffiths, 1994). The principal exception is Vespertilionidae, a diverse group that comprises between five and eight subfamilies in different classifications: Kerivoulinae, Miniopterinae, Murininae, Tomopeatinae, Vespertilioninae, Nyctophilinae (included within Vespertilioninae by Koopman (1994) and Volleth and Heller (1994)), Antrozoinae (named as a subfamily by Miller (1897) but subsequently included either within Nyctophilinae (e.g. Hill and Smith, 1984) or Vespertilioninae (e.g. Koopman, 1993a; 1994), and Myotinae (usually included as a tribe within Vespertilioninae (Koopman, 1994) but here raised to subfamily rank following the suggestion of Volleth and Heller (1994). The molecular work of Hoofer and Van Den Bussche (2003) suggested four subfamilies in the family Vespertilionidae: Vespertilioninae, Myotinae, Kerivoulinae and Murininae, with the subfamily Miniopterinae being elevated to family level, Miniopteridae. However, the intron results of Eick *et al.* (2005) were not able to reject or support alternative hypotheses that Miniopteridae was the sister taxa of Molossidae, and not the sister taxa of Vespertilionidae.

Based on upper molar morphology, Fracasso *et al.* (2011: 422) propose the following tree structure: The Icaronycteridae is positioned at the base, followed by three clades: Yinochiroptera, Noctilionoidea, Yangochiroptera. Within the Yinochiroptera, the Emballonuridae form the basal node, followed by Rhinopomatidae, Nycteridae, Megadermatidae, Rhinolophidae, and Hipposideridae. The Yangochiroptera have a basic split-up between the Nataloidea (including the Myzopodidae [at the base], Thyropteridae, and Furipteridae) and the group formed by the Antrozoinae, Mystacinidae, Molossidae (including Molossinae and Tomopeatinae), and Vespertilionidae (as a poorly supported monophyletic group, including Myotinae, Miniopterinae, Kerivoulinae, and Murininae).

If the suggestion to follow the format proposed for standardization of nomenclature of higher taxa by Alonso-Zarazaga (2005) is accepted for renaming of the suborders, then the suggested typified name for the order would be, VESPERTILIONIFORMES, from the oldest generic name of Vespertilio Linnaeus 1758.

Zagorodniuk (2014: 8) uses an alternative hierarchy, which starts with the Superorder Chiroptera, which contains the order Vespertilioniformes (Chiroptera auct.), which itself contains two suborders: Vespertilionimorpha (Yangochiroptera) and Pteropodimorpha (Yingochiroptera).

Known Chiroptera families:
† **Aegyptonycteridae** Simmons, Seiffert and Gunnell, 2016
† **Necromantidae** Sigé, 2011
† **Philisidae** Sigé, 1985
† Icaronycteridae Jepsen, 1966
† Archaeonycteridae Revilliod, 1917
† Onychonycteridae Simmons, Seymour, Habersetzer and Gunnell, 2008
† Palaeochiropterygidae Revilliod, 1917
† Hassianycteridae Habersetzer and Storch, 1987
† Mixopterygidae Maitre, 2008
† **Tanzanycteridida**e Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003
Pteropodidae Gray, 1821
Hipposideridae Lydekker, 1891
Megadermatidae H. Allen, 1864
Rhinolophidae Gray, 1825
Rhinonycteridae J. E. Gray, 1866
Craseonycteridae Hill, 1974
Rhinopomatidae Dobson, 1872
Emballonuridae Gervais, 1855
Nycteridae Van der Hoeven, 1855
Myzopodidae Thomas, 1904
Mystacinidae Dobson, 1875
Phyllostomidae Gray, 1825
Mormoopidae Saussure, 1860
Noctilionidae Gray, 1821
Furipteridae Gray, 1866
Thyropteridae Miller, 1907
Natalidae Gray, 1866
Molossidae Gervais, 1856
Cistugonidae Lack, Roehrs, Stanley, Ruedi and Van den Bussche, 2010
Miniopteridae Dobson, 1875
Vespertilionidae Gray, 1821

Worldwide, six of the extant families (Pteropodidae, Rhinolophidae, Hipposideridae, Phyllostomatidae, Molossidae and Vespertilionidae) contain about 75 % of all species (see Shi and Rabosky, 2015: 1529).

COMMON NAMES:
Arabian: Bouchaara, Boujlida. Czech: letouni či netopýři, letaunové, ptákossavci, upírové, letouni lysoblaní. Dutch: Vleermuizen. English: Bats. French: Chauves-souris. German: Fledermäuse. Italian: Chiròtreri, Pipistrèlli. isiXhosa: ilulwane, idludaka. Kabyle (Algeria): Imtchaghyeye. Portuguese: Morcegos. Somalian: Fidmer, Fidmair, Auo-rnèr, Kibille, Kibillei, Kibil, Fid Mer, Sodan silli, Sod silli (see Lanza *et al.*, 2015: 13). Spanish (Castillian): Murcielagos. Swahili: Popo. Tanoboase (Ghana): ampane (singular), mmpane (plural) (see Ohemeng *et al.*, 2017: 184). Twi (Ghana): apan (singular), mmpan (plural).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The paleontological record of the Chiroptera in Africa, as in the world, is generally incomplete (Butler, 1978).

The first bats appeared somewhere in the Mid- to Late Cretaceous (about 88.7 million years ago), and the diversification began at about 74.9 to 63 MYA (Bininda-Emonds *et al.*, 2007: 509; Lovegrove, 2011: 152). However, dos Reis *et al.* (2012: 3494) situate the origin of the Chiroptera at 59.1 MYA, hence: after the Cretaceous-Paleogene event. Yu *et al.* (2014: 2204) suggest that the Chiroptera have an Asian origin and that there was rapid adaptive radiation from the emergence of crown bats until the Early Eocene Climatic Optimum. This was followed by a decreased diversification between 49 and 35 MYA, and another period of high diversification between 35 and 25 MYA.

Gunnell *et al.* (2017: 18) indicate that the earliest known bat fossiles came from Europe, India, North Africa and Australia (around 53 - 54 MYA), but they all represent archaic bat groups that have no clear phylogenetic connections with modern taxa. Modern familes of bats began to appear in the late early to middle Eocene of Europe and North Africa. They also pointed out (p. 1) that only 13 placental mammal genera first occurred in the middle to late Paleogene, of which six represented bats, including some extant genera belonging to both Yangochiroptera and Yinpterochiroptera.

The rapid diversification at the Paleocene-Eocene thermal maxiumum might have been the result of the large increase in insect abundance during that period (Eriksson, 2014: 175).

Springer *et al.* (2011: 2493) mention that the oldest bat fossils are from the Early Eocene of North America, and that further Early Eocene bats are also known from Europe, Africa and Australia. Most researchers seem to agree that bats originated in Laurasia, but some see Gondwana as the cradle for the Chiroptera. Teeling *et al.* (2005) [in Springer *et al.* (2011: 2493)] suggested North America or Laurasia as the ancestral area for bats, and Asia, Europe or Laurasia as the ancestral area for both Pteropodiformi (Yinpterochiroptera) and Vespertilioniformi (Yangochiroptera).

The oldest fossil bat described from Africa is: *Vampyravus* (= *Provampyrus*) *orientalis*, from the Oligocene of the Fayum (Egypt). However, in their abstract on an upper molar and two fragments of lower molars from El Kohol (Algeria), Ravel *et al.* (2010: 149) mention these belong to a member of the "Eochiroptera" (sensu Van Valen, 1979), dating back to the Early Eocene. Ravel *et al.* (2016: 359) indicate that these "Eochiroptera" cover six families (Onychonycteridae Simmons, Seymour, Habersetzer and Gunnell, 2008, Icaronycteridae Jepsen, 1966, Archaeonycteridae Revilliod, 1917, Hassianycteridae Habersetzer and Storch, 1987, Palaeochiropterygidae Revilliod, 1917, and Tanzanycteridae Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003), none of which are related to the current day families. The oldest of the current day families start to appear in the lower Eocene of Africa, whereas on the other continents they only appeared in the middle Eocene (and even in the upper Eocene of Australia). This points to the great importance of Africa during the first phase of the development of modern bats (Ravel *et al.*, 2016: 359).

Hildebrand *et al.* (2010: 268, 281) recorded unknown bat species from the Kumali and Koka sites in southern Ethiopia.

CONSERVATION STATUS:
Worldwide, Amori *et al.* (2013: 98) state that 177 out of 1,116 bat species reported by Wilson and Reeder (2005) or 15.39 % have an IUCN status of CR, E, or VU.

MAJOR THREATS:
Sherwin *et al.* (2012: 173) [referring to Ciechanowski *et al.*, 2007] indicate that aerial-hawking species are probably more sensitive to climatic changes as they are dependent of a food supply that is extremely variable in time as well as in space. This is less the case for species foraging above water surfaces, as they rely on stable and spatially concentrated food resources. "Water

Stress" will become an important climatic change risk factor for species living in arid regions, as they depend on permanent water resources close to roosts (see Adams and Hayes, 2008 [in Sherwin *et al.* (2012: 173)]).

For southern Africa, Pio *et al.* (2014: 1543) predict that high concentrations of phylogenetic diversity (PD) will contract considerably by 2080, but that climate change will not result in higher nor lower PD losses, on average, compared to random extinction simulations. They also indicated (p. 1546) that the Kalahari will become very barren in terms of future surviving bat PD.

For the Mediterranean area, Maiorano *et al.* (2011: Table S2) predict that none of the presently occurring species will be extinct by the end of the century, but up to five of the Vespertilionid species might encounter a projected range loss of over 80 %. Between two and fifteen species will probably see a loss between 50 and 80 %, which will also be the case for four of the Rhinolophid species. Between four and eleven of the Vespertilionid species will encounter a loss of between 30 and 50 % of their range, which will also be the case for up to two of the Rhinolophid species. All bat families will contain species which will have a range loss of up to 30 %. One of the Hipposiderid species, one or both of the Rhinopomatid species, and one or two of the Vespertilionid species, however, will gain from the changing.

O'Shea *et al.* (2016) reviewed multiple mortality events in bats and identifed nineteen events for Africa: Intentional killing (n = 11), Biotic (n = 5), Accidental (n = 1), Wind Turbines (n = 1), Viral or bacterial disease (n = 1).

Some bat populations are killed to prevent them spreading viral diseases. However; Plowright *et al.* (2016: 16) mention that "culling bats may decrease spillover risk if transmission of the virus increases as population size increases (SIR [susceptible-infectious-recovered] dynamics), whereas culling may increase spillover risk if pulses are driven by viral reactivation after stress (SILI [susceptible-infectious-latent-infectious] dynamics)."

BIOGEOGRAPHY:
Maas *et al.* (2015: 1086) indicate that the Afrotropics (roughly Africa south of the Sahara) is certainly not the most specious zoogeographical region (the Neotropics has 100 species more), but it has with 211 out of 237 species the highest percentage of endemics (89 %), versus 75 % in the second region (Neotropics).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Lucati and López-Baucells (2016: 117) provided a summary of chromatic disorders reported in bats and found that this character is underreported for Africa: Albinism (All-white hairs, pale skin and red eyes) is reported from five localities on the African continent and one in Réunion and Piedbaldism (All-white fur/skin patches, eyes always normally coloured) from two on the continent. Other disorders, such as Melanism (Increase in black or brown pigmentation on the whole body), Partial melanism (Increase in black or brown pigmentation on a part of the body), Leucism (All-white or whitish hairs, pale skin, eyes always normally coloured.) and Hypomelanism (Beige, golden, yellowish or reddish fur and skin, eyes always normally coloured) weren't reported from Africa at all.

Delmore *et al.* (2018: 127) studied the pigmentation of the tissues surrounding the testes and suggest that scrotal melanin may protect mature sperm from UV damage, and from oxidative damage in species with male sperm storage.

DETAILED MORPHOLOGY:
Bahlman *et al.* (2016: 118) provide a schematic overview of the wing joints and musculature of the various bat families.

FUNCTIONAL MORPHOLOGY:
Adams and Carter (2017) studied the climbing and walking locomotion of a number of Pteropodids and Vespertilionids and found fundamental differences. The Pteropodids had a far greater ability to climb in a head-up posture than the Vespertilionids, whereas the situation was quite the inverse when walking on the ground was compared. The Pteropodids behaved much more like other arboreal mammals (e.g. two-toed sloths - *Choloepus hoffmanni* Peters, 1858).

ECHOLOCATION:
Fenton (1994: 28) states "Echolocation profoundly affects the biology of bats, their behaviour and ecology and may have been central to their evolution".

MOLECULAR BIOLOGY:
The following statement has been made by Dell *et al.* (2013: 65): "So DNA sequence results in bats may have to be accepted with caution in view of the possibility that DNA is perhaps as susceptible to convergent evolution as morphological systems.", indicating that the results of these state-of-the-art techniques need to be interpreted with caution.

Dool *et al.* (2016a: 196) furthermore suggest: "We caution against the indiscriminate use of mtDNA in phylogenetic studies and advocate for pilot studies to select nuclear introns. The selection of marker type and number is a crucial step that is best based on critical examination of preliminary or previously published data. Based on our findings and previous publications, we recommend the following markers to recover phylogenetic relationships between recently diverged taxa (< 20 My) in bats and other mammals: ACOX2, COPS7A, BGN, ROGDI and STAT5A."

HABITAT:
Reardon and Schoeman (2017: 273) investigated the taxonomic and functional diversity of the assemblage structure of insectivorous bat communities along the Mount Nimba elevational gradient in view of rising global temperatures. They found that there was a taxonomic shift along the gradient, but that functionally, the assemblage remained largely intact.

In their study on the bat fauna of the southern African arid region, Monadjem *et al.* (2017a: 5) found that at a regional scale, landscape features might be more relevant for bats living in arid regions, as oposed to aridity gradients. They also found that open air foragers are restricted in the southern African arid region, although they could not determine the factor behind this. Furthermore, they were unable to determine the ecosystem services provided by bats in arid environment (as opposed to limiting pest insects in agro-ecosystems).

DIET:
Many bats feed on pest insects, e.g. stink bugs. Taylor *et al.* (2017a: 376) indicated that the percentage of Hemiptera in the diet of bats (at Levubu, RSA) varied between 6-20 % in *Nycteris thebaica* to 50 % in *Pipistrellus hesperidus*. They also calculated (p. 378) that the South African madacamia industry (covering about 25,000 ha) avoided a yearly cost between 56.81 and 138.91 USD/hectare as a result of this.

PREDATORS:
Black *et al.* (1979: 19) reported that the prey of a bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) observed in Zambia most likely consisted of *Cloeotis percivali, Rhinolophus simulator, Hipposideros caffer*, and *Nycteris thebaica*.

Mikula *et al.* (2016: Supplemental data) mention the following birds preying on unspecified bats: Frances's sparrowhawk (*Accipiter francesiae* Smith, 1834), Rufous-breasted sparrowhawk (*Accipiter rufiventris* Smith, 1830), Ovambo sparrowhawk (*Accipiter ovampensis* Gurney, 1875) [on large bat], Tawny eagle (*Aquila rapax* (Temminck, 1828)), Mountain buzzard (*Buteo oreophilus* Hartert and Neumann, 1914), African marsh harrier (*Circus ranivorus* Daudin, 1800), Sooty falcon (*Falco concolor* Temminck, 1825) [on insectivorous bats], African hobby (*Falco cuvierii* Smith, 1830), Dickinson's kestrel (*Falco dickinsoni* Sclater, 1864) [on small insectivorous bat], Taita falcon (*Falco fasciinucha* Reichenow & Neumann, 1895); Lilac-breasted roller (*Coracias caudata* Linnaeus, 1766) [on insectivorous bat], Brown-hooded kingfisher (*Halcyon albiventris* (Scopoli, 1786)) [on insectivorous bat], Woodland kingfisher (*Halcyon senegalensis* (Linnaeus, 1766)), Southern grey shrike (*Lanius meridionalis* (Temminck, 1820)), Gabar goshawk (*Micronisus gabar* (Daudin, 1800)), Green wood hoopoe (*Phoeniculus purpureus* (J.F. Miller, 1784)), Long-tailed hawk (*Urotriorchis macrourus* (Hartlaub, 1855)).

Tapanes *et al.* (2016: 405, 406) indicate that several primates prey on bats: *Pan paniscus* Schwarz, 1929 (Bonobo); *Papio anubis* (Lesson, 1827) (olive baboon, Anubis baboon); *Perodicticus potto* (Statius Müller, 1766) (Potto); *Cercopithecus mitis* Wolf, 1822 (Blue monkey) and a *C. mitis* x *C. ascanius* hybrid. These observations suggest an alternative pathway for bat-*Cercopithecus* disease transmission that has implications for zoonotic disease transmission to humans. Of the 13 bat predations they observed, three were on Pteropodidae and one on Molossidae. In four addional events, the bats were small (13 - 18 cm body length) and one large (ca. 50 cm wingspan).

ACTIVITY AND BEHAVIOUR:
Schoeman (2015: 122, 125) classified South African insectivorous bats in three functional urban groups (based on wing and echolocation characteristics and foraging and/or roosting characteristics):

1) **urban avoiders** - slow-flying bats that typically hunt prey in forests or dense vegetation and have specific roosting requirements such as obligate cave roosters (e.g. *Nycteris thebaica, Rhinolophus simulator*);

2) **urban adapters** - bats that forage mainly along forest edges and adjacent open areas, and readily utilize favorable conditions provided by humans, for example, forage at wastewater treatment plants and/or roost in man-made structures or plants in gardens (e.g. *Miniopterus natalensis, Neoromicia capensis, Neoromicia nana, Pipistrellus hesperidus/Hypsugo anchietai, Taphozous mauritianus*).

3) **urban exploiters** - fast-flying, open-air bats often recorded in urbanized landscapes that depend to a certain degree on urban resources such as houses that provide suitable roosting sites and can sustain large bat colonies (e.g. *Chaerephon pumilus, Mops condylurus, Otomops martiensseni, Scotophilus dinganii, Tadarida aegyptiaca*).

PARASITES:

HEMOSPORIDIA:

Perkins and Schaer (2016: 776) provide an overview of the malaria parasites of bats, which include nine genera, of which the most important ones are: *Hepatocystis, Polychromophilus, Nycteria*, and *Plasmodium* (the others are: *Bioccala*, Biguetiella*, Sprattiella*, Johnsprentia**, and *Dionisia* - *: not in Africa).

Killick-Kendrick (1973: 647) mentions *Plasmodium* (*Vinckea*) *voltaicum* Van Der Kaay, 1964 from a non-specified bat. Makanga *et al.* (2017: Suppl.) refers to an *Anopheles marshalli* infected with *Polychromophilus melanipherus*, which it could only have received from sucking blood of a bat.

Rudoler *et al.* (2018: 392) found four species of *Plasmodium* in pools of blood from various Ugandan bats: *P. berghei* Vincke and Lips, 1948 , *P. falciparum* Welch, 1897, *P. yoelii* Landau, Michel and Adam, 1868 and *P. chabaudi* Landau, 1965.

TREMATODA

Richard (1966: 416) described *Acanthatrium (Acaisthatrium) houini* from an unidentified bat from Ranomafana (Madagascar).

HEMIPTERA

Cimicidae: *Loxaspis miranda* Rothschild 1912 from Gogrial, Sudan, but no host given (Haeselbarth *et al.*, 1966: 10). *Cacodmus ignotus* Rothschild 1912 described from a single female without locality data, and a subsequent collection is reported from Uganda (Haeselbarth *et al.*, 1966: 10). In the British Museum there are also specimens of *Cacodmus sparsilis* Rothschild 1914 from Pietermaritzbrug, South Africa, without host records (Haeselbarth *et al.*, 1966: 10). *Aphrania barys* Jordan and Rothschild 1912 described from Maseru, Lesotho, host is not known (Haeselbarth *et al.*, 1966: 11). *Aphrania recta* Ferris and Usinger 1957 described from Mutir, Uganda, and another record from Mabal, Congo, but hosts unknown (Haeselbarth *et al.*, 1966: 11-12). *Leptocimex boueti* (Brumpt 1910) has been recorded from a few places in Guinea, the northern Gold Coast, Upper Volta, Dahomey and the former French Sudan, where it was found biting humans, the hosts are bats but no definite species (Haeselbarth *et al.*, 1966: 13). *Stricticimex antennatus* Ferris and Usinger 1957, found in the Cape Province, South Africa in caves at Bredasdorp and Three Sister's Rocks, the host-bat not recorded (Haeselbarth *et al.*, 1966: 14). *Strictimex brevispinosus* Usinger 1959, found in a cave near Lake Victoria, Urundi associated with unidentified bat (Haeselbarth *et al.*, 1966: 14). *Strictimex intermedius* Ferris and Usinger 1959, was recorded from a cave near Mombasa, Kenya, the host not recorded (Haeselbarth *et al.*, 1966: 14). *Stricticimex transverses* Ferris and Usinger 1957 was originally described from an unknown bat from Bloemfontein, South Africa (Haeselbarth *et al.*, 1966: 14).

Polyctenidae: *Eoctenes intermedius* (Speiser 1904) found on an unidentified bat in the Sudan (Haeselbarth *et al.*, 1966: 16). *Androctenes horvathi* Jordan 1912 described form an unidentified bat in Somalia (Haeselbarth *et al.*, 1966: 17).

DIPTERA

Streblidae: *Raymondia huberi* Frauenfeld 1856 from unidentified bat in the Rukwa Valley, Tanzania (Haeselbarth *et al.*, 1966: 102). *Raymondia setosa* Jobling 1930 collected from a "broad-eared bat" at Aden (Haeselbarth *et al.*, 1966: 104). *Raymondiodes leleupi* Jobling 1954 described form a poorly identified bat (*Hipposideros caffer* or *Miniopterus* sp.) from Thysville, Congo (Haeselbarth *et al.*, 1966: 104). Shapiro *et al.* (2016: 255) indicates that Kessel (1925: 24) mentions *Raymondia lobulata* Speiser, 1900 "off *Megaderma lyra* from Ceylon, from bats in Madras and British Somaliland".

Nycteribiidae: *Nycteribia hoogstraali* Theodor 1957 from the Congo and Tanzania host unidentified (Haeselbarth *et al.*, 1966: 109). *Basilia meridionalis* Theodor 1956 host and exact locality not recorded from South Africa (Haeselbarth *et al.*, 1966: 111). *Basilia bouvieri* (Falcoz, 1924) originally described without exact locality (West Africa) or host (Haeselbarth *et al.*, 1966: 111). *Basilia glabra* Theodor 1957 from Aruwimi province in the Congo, but no host is given (Haeselbarth *et al.*, 1966: 112). *Dipseliopoda arcuata* Theodor 1955, collected from an unknown bat at Addis Ababa, Ethiopia (Haeselbarth *et al.*, 1966: 115).

When studying the Nycteribiid abundance on fruit bats and insectivorous bats, Luguterah and Lawer (2015: 4) found that fruit bats were much more infested than insectivorous bats. This could be the result of fruit bats being poorer in nitrogen, which leads to a lack of protein, which in turn inhibits the proper functioning of the immune system. Another explanation might be that insectivorous bats

capture their prey on the wing and as such minimize contact with contaminated surfaces.

Szentivanyi *et al.* (2017: 182) found that bat fly species showed a higher diversity towards the equator, and also that bat species assigned to the IUCN LC category hosted a larger number of bat fly specimens than bats assigned to the VU category.

SIPHONAPTERA
Pulicidae: *Echidnophaga aethiops* Jordan and Rothschild 1906 host recorded as unidentified Chiroptera and locality not mentioned (Haeselbarth *et al.*, 1966: 135).
Ischnopsyllidae: *Dampfia grahami equatoris* Smit 1954 found on a 'small insectivorous bat' in the Kivu district of the Congo (Haeselbarth *et al.*, 1966: 187).

ARACHNIDA
Argasidae: Morel and Mouchet (1965: 492) report the presence of *Carios vespertilionis* Latreille, 1796 and *Carios boueti* Roubaud and Colas-Belcour 1933 on non-specified bats in Cameroun.

ACARI
Trombiculidae: Stekolnikov (2018a: 33) reported *Schoengastiella vattierae* (Taufflieb, 1964) from unidentified bats from the Central African Republic. He also indicated (p. 116) that *Trisetica aethiopica* (Hirst, 1926) was described from a non specified bat, and that he found (p. 157) *Microtrombicula machadoi* Taufflieb, 1965.

VIRUSES:
Luis *et al.* (2013, 2015) and O'Shea *et al.* (2014: 741) indicate that bats are more likely to be infected with more zoonotic viruses per host species than were rodents, and therefore adding weight to the suggestion that bats might in some way be unique as sources of emerging zoonoses. Luis *et al.* (2015) found that gregarious bats are more likely to share more viruses and regionally migrating bats are important for spreading viruses through the "viral sharing network". O'Shea *et al.* (2014: 742) also indicate that body temperatures of flying bats are elevated (in the range of typical fever temperatures), and they suggest that these daily high temperatures might arm bats against some pathogens during the early stages of infection. This hypothesis, however, was rejected by Schountz *et al.* (2017: 2) as fever response to a virus infection is much more complex than simply raising the body temperature. These authors also point to the "allways on" IFN (interferon) system and the immunoglobulin repertoires of bats.

Reusken and Heyman (2013: 99) [referring to Weiss *et al.* (2012b)] indicate that bats might be the primordial reservoir for the majority of viruses pathogenic to humans. Brierley *et al.* (2016: "5") report that - based on viral richness alone - the risk of bat-human virus sharing showed prominent hotspots in Central/South America, sub-Saharan Africa, and parts of Southeast Asia. Yinda *et al.* (2019) analysed the gut virome of Cameroonians and found a genetic relatedness between orthoreovirus, picobirnavirus and smacovirus found in humans and those of bats and/or other animals.

The accounts below represent only viruses where the host (e.g. bat) is unknown. For further information see taxa accounts where the virus is associated with a particular taxon. Also see Chen *et al.* (2014: 1) for an online database on bat-associated viruses. Furthermore, Moratelli and Calisher (2015: suppl. Table II) provide an overview of bat host genera and their associated virus genera, and Young and Olival (2016: suppl. Table S2) provide details on species level for both bat hosts and viruses.

Astroviridae
From a study on 962 bats (*Hipposideros* cf. *ruber, Hipposideros gigas, Coleura afra, Miniopterus inflatus*, and *Rousettus aegyptiacus*) from Gabon, Rougeron *et al.* (2016: 386) found that bat astroviruses form a group that is genetically distinct from astroviruses infecting other mammals (including humans). These viruses also showed an important genetic diversity and low host restriction in bat species.

Bunyaviridae
Hantavirus
Gu *et al.* (2014: 1904) argue that primordial hantaviruses may have emerged in an early common ancestor for all bats as bat species hosting these viruses belong to both currently accepted suborders of the Chiroptera (Pteropodiformi [Hipposideridae + Rhinolophidae] and Vespertilioniformi [Nycteridae + Vespertilionidae]). This led Yanagihara *et al.* (2014: 9) to suggest that primordial hantaviruses may have infected an early common ancestor of bats. Yanagihara *et al.* (2014: 9) also indicate that the five known bat hantaviruses are among the most genetically diverse described to date.

Coronaviridae - Coronaviruses
Severe Acute Respiratory Syndrome-associated coronavirus (SARS-CoV or hu-SARS-CoV) - Balboni *et al.* (2012: 8) indicate that SARS-like CoVs have possibly originated in Africa as the viruses themselves has been found in several species of the genera *Hipposideros* and *Chaerephon*, and antibodies against SARS-CoV antigens have been found in *Hypsignathus,*

Lyssonycteris, Miniopterus, Mops, Myonycteris, Rhinolophus and *Rousettus* species.

Specifically for Coronaviruses worldwide, Anthony *et al.* (2017b: 7) found that a large number of bat host species were not infected by these viruses, but they also remarked that none of these species were sampled extensively. They found that all species with sample sizes >110 individuals were positive for one or more CoVs, suggesting that CoVs may be detected in some of the negative species if sampling effort were increased. They also calculated (p. 9) that with 154 host individuals, an average of one CoV would be detected, and with 397 individuals, up to five CoVs would be detected. As they did not find any bat species with more than five viral sequence clusters, sampling 397 bats should capture all of the CoVs in a specific bat species.

Filoviridae - Filo viruses

Han *et al.* (2016) reported on traits that discriminate host and non-host (=filovirus-positive) bat species, and they provide a list of bat species most likely to be filovirus-positive on the basis of intrinsic trait similarity with known filovirus-positive bats (See also Sylla *et al.*, 2015).

In their study, Schuh *et al.* (2017c) point to the accumulating number of links between filovirus hemorrhagic fever (FHF) index cases and prior exposure to environments inhabited by bats.

Marburgvirus

Peterson and Holder, 2012: 1831) analyzed fifteen Marburg virus sequences from bats, and found no indication from the topology of the tree or the branch lengths that the bat-derived filoviruses represent a population distinct from viruses collected from human outbreaks. They suggest that bat sequences do not form a monophyletic group, nor are they associated with long or “deep” branches in the tree. This situation could indicate that the bats are the reservoir population, or that high gene flow exists between virus populations in bats and those in some other taxon (see Towner *et al.*, 2009). Given the short sequence lengths obtained from bat filovirus (about 302 nucleotides of the VP35 gene for most samples), it is also possible that Peterson and Holder, 2012: 1831) lacked the power to detect subtle evidence for population structuring. Thus, firm conclusions about gene flow between the "bat" filovirus populations and the true source of human infections will require more data.

Ebola virus

Most papers related to Ebola (e.g. Alexander *et al.*, 2015) do not provide any details on the bat species involved ("fruit bats", "possibly fruit bats") or refer to the "usual suspects" (*Myonycteris torquata, Hypsignathus monstrosus, Eidolon helvum*". Murray (2015: 802) indicates that the transmission of Ebola virus from bats to humans must be uncommon because the potential reservoir of Ebola virus is huge. Buceta and Johnson (2017) provide a model of the Ebola zoonotic dynamics suggesting a bidirectional coupling between the available resources and the dynamics of the bat population, and indicating that environmental pressure is the main driving force for bats' migration. Based on the fact that the human sero-positive zone is wider than the distribution area of *M. torquata, H. monstrosus* and *E. franqueti*, Formella and Gatherer (2016: 3125) suggest that *E. helvum*, which has a wider distribution, may be involved. They also point out that some (early) Ebola outbreaks, which lie beyond the distribution range of the fruit bats, may have been overlooked.

An extensive survey of Ebola viruses in 4,022 bats from Guinea, Cameroon and the DRC by De Nys *et al.* (2018) showed antibodies in *Mops* sp., *Eidolon helvum*, *Epomophorus* sp., *Hypsignathus monstrosus, Lissonycteris angolensis, Micropteropus pusillus* and *Rousettus aegyptiacus*. No antibodies were found in *Hipposideros* sp., *Miniopterus* sp., *Chaerephon* sp., *Nycteris* sp., *Rhinolophus* sp., *Glauconycteris* sp., *Kerivoula* sp., *Myotis bocagii*, *Neoromicia* sp., *Scotophilus* sp., *Epomops* sp., *Megaloglossus woermanni*, *Myonycteris torquata* or *Scotonycteris zenkeri*.

A phylogenetic analysis, combined with phylogeographical data led Hassanin *et al.* (2016: 518) to conclude that only three bat species are able to disperse directly ZEBOV (Zaire Ebola) from the Congo Basin to Upper Guinea: *E. helvum, H. monstrosus*, and *R. aegyptiacus*.

de La Vega *et al.* (2015: 6) [referring to Biek *et al.* (2006)] indicate that the L gene of bat-derived EBOV showed that it could have recently experienced a genetic bottleneck-type event. Biek *et al.* (2006) proposed a number of scenario's, of which the first suggests that the bat population (around 1999 when the most recent common ancestor to all currently known Ebola viruses existed) decreased significantly, causing a reduction in the viral population size. A second scenario suggested that infected bats could have introduced EBOV in the region near Congo and Gabon circa 1999, and a final scenario is that the the fruit bat species identified by Leroy *et al.* (2005) is not the primary reservoir, and that EBOV was possibly introduced by another (bat) species.

Analysing the outbreak data and the distribution area of the various bat species, made Pigott *et al.*

(2016: 2) select four species of bats as explaining more of the variation than the rest: *Hypsignathus monstrosus, Epomops franqueti* (from both of which Ebolavirus RNA has been isolated), *Otomops martiensseni* and *Epomophorus labiatus* (both identified through trait-based machine learning approaches as being similar to species already reporting filoviral infection, as suggested by Han *et al.* (2016)).

However, Leendertz (2016: 1) finds it questionable whether these viruses are circulating regularly in bat populations as both fruit and insectivorous bats have a long lifespan and can fly over large distances, which means that seropositive specimens could be sampled for a long period of time and at large distances from the place where they could have been exposed to the Ebolavirus. Furthermore, the various types of Ebola seem to be linked with different river basins, which do not form barriers for fruit bats. She furthermore suggests to look at insects (e.g. mayflies) as possible vectors. Additionally, Spengler *et al.* (2016: 958) point out that EBOV has yet to be isolated in nature from any bat species (or non-human primates). Furthermore, EFSA AHAW Panel (EFSA Panel on Animal Health and W (2017: 6) remark that natural shedding of the virus has not been reported and that the suspected links between bats and human outbreaks have not been confirmed and further research is necessary to confirm or identify reservoir species. A similar conclusion is drawn by Holmes *et al.* (2016: 198), who indicate that it is likely that other host species exist, which may have a major bearing on epidemiological dynamics.

Gale (2017: 1678) argues that although previous studies failed to detect the presence of EBOV in arthropods, these studies might not have included the correct arthropod species: "This is because filoviruses are not 'arboviruses' in the sense that arboviruses are transmitted in a defined cycle which alternates between the vertebrate host and the arthropod vector. Instead, filovirus transmission pathways appear to be more random in terms of host species. Indeed, if these arthropod species were the reservoir for EBOV, then EBOV would be an arbovirus with a vertebrate host defined by the host preference of the arthropod." If an arthropod is the intermediate host, then an insectivorous bat would rather be the host than any of the Pteropodids. Gale (2017: 1678) also indicates that the higher body temperature of the bat (40°C in *Mops condylurus*, compared to that of an arthropod, which is the ambient temperature) would activate the virus reproduction in the bat, and hence, its increased probablity to infect humans. However, the bats will still need to ingest a large quantity of the virus to start off with, but this could happen during an ephemeral mass emergence of mayflies.

Li *et al.* (2016: 127) also pointed out that as large quantities of bat meat are consumed every year, the virus must be very rare in its reservoir, otherwise more frequent outbreaks of the virus would be observed, which led them to the suggestion that strict restrictions on bushmeat are not recommended for local citizens.

Leendertz *et al.* (2015: 22) suggest that bats are intermediate hosts, which are occasionally exposed via another intermediate host or unknown reservoir and that viral emergence might be more related to environmental factors and other hosts than bats themselves. See also Caron *et al.* (2018: 5) who discuss a number of hypothetical transmission pathways between a maintenance host of EBOV and bats: Air-borne, vector-borne, food-borne (insects or fruits), water-borne, direct and environmental.

Dick and Dittmar (2014: 150) indicate that nycteribiid and streblid bat flies are known to infest the above mentioned fruit bats. These flies readily move from bat to bat, feeding on multiple individuals during the course of days and weeks. Possibly, the flies can uptake viral pathogens, which might remain viable within bat flies. If this is the case, host-specific flies can transfer such viruses among host bats within a population.

Babayan *et al.* (2018: 578) worked out a model that analyses virus genomes and links these to probable reservoir hosts. For the four Ebolavirues, the model showed greater support for Pteropodiformi as reservoir than Vespertilioniformi, but Bundibugyo and Tai Forest ebolaviruses had equal or stronger support for primate reservoirs.

Analysing the literature data, Ponce *et al.* (2019: 3133) pointed out that for only three of the 23 outbreaks (13.0 %) the source animal was confirmed in a laboratory. Of the suspected source animals, 10 were primates and six bats (with three fruit bats and three insectivorous bats).

On 24 January 2019, a series of newspaper articles was published, where several scientists from EcoHealth Alliance were quoted (Simon J. Anthony, Jonathan Epstein) stating that in a mouth swab one Liberian *Miniopterus inflatus* (out of 150 tested) RNA material of the Zaire Ebolavirus was found. Epstein, however, pointed out that if the bat was a natural host for the virus, it would have been found in more than one bat. He also pointed out that the bat could have become infected by another bat species living in the same habitat.

Fabian Leendertz (veterinary epidemiologist at the Robert Koch Institute - not involved in the study) indicated that the virus itself wasn't isolated but only about one-fifth of its genome (Grady, 2019; Kupferschmidt, 2019; Su, 2019).

Rhabdoviridae
Lyssavirus - Rabies related viruses
Munang'andu *et al.* (2011: 23) summarize rabies status in Zambia for the period 1985-2004, where only one single case is reported from an unidentified bat. See Adedeji *et al.* (2010) for an overview of the history, and epidemiology of rabies and rabies-like viruses.

DUV - In 2007 a bat flew against the face of a Dutch woman in Tsavo West National Park in Kenya. She noticed two superficial bleeding wounds. Twenty-three days after the incidence she presented herself with symptoms in a hospital in the Netherlands and died of rabies. The virus was identified as Duvenhage virus (Van Thiel *et al.*, 2009).

UTILISATION:
Kamins *et al.* (2011b: S102) report that in southeastern Ghana nearly one half of the population may eat bats, although bats do not appear in other studies on wildlife meat markets.

ANTHROPOPHILOUS:
Willett (1988) discusses the use of bat symbols in West African art.

ZOOBANK:
06148AD8-596C-45A5-8756-74BCF5758557

†Family AEGYPTONYCTERIDAE Simmons, Seiffert and Gunnell, 2016

*2016. *Aegyptonycteridae* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 4, 8. Publication date: 9 May 2016. - Comments: Type genus *Aegyptonycteris* Simmons, Seiffert and Gunnell 2016.

TAXONOMY:
The supra-familial relationships for this family are yet unknown.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
These fossil bats have a late Eocene (Priabonian, ca. 37 Mya) age.

†Genus *Aegyptonycteris* Simmons, Seiffert and Gunnell, 2016

*2016. *Aegyptonycteris* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 6, 8. Publication date: 9 May 2016. - Etymology: From *Aegyptus*, Latinized Greek for "Egypt," and nycteris, Greek for "bat." The genus name refers to the country in which this new taxon was discovered (Simmons *et al.*, 2016: 8).

†*Aegyptonycteris knightae* Simmons, Seiffert and Gunnell, 2016

*2016. *Aegyptonycteris knightae* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 6 8, figs 3 - 5. Publication date: 9 May 2016. Type locality: Egypt: Western Desert: Fayum Depression, Birket Qarun Formation: Fayum Quarry BQ-2: 23 m level [Goto Description]. Holotype: CGM 83740: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Fragment of right maxilla with M2 and M3 (see: Simmons *et al.*, 2016: 8). - Etymology: Named in honour of Mary Knight, Managing Editor of the American Museum of Natural History Scientific Publications, in recognition of the enormous contributions she has made to dissemination of the results of scientific research over the years, as well as her lifelong devotion to the people and culture of Egypt (Simmons *et al.*, 2016: 8).

COMMON NAMES:
Dutch: Knight's Egyptische vleermuis. English: Knight's Egyptian bat

†Family NECROMANTIDAE Sigé, 2011

*2011. *Necromantidae* Sigé, Bull. Soc. Hist. Nat. Toulouse, 147: xxx.. - Comments: Type genus †*Necromantis* Weithofer, 1887.

†Genus ***Necromantis*** Weithofer, 1887

1888. *Necromanter* Lydekker, Zool. Rec., London, 71 - 56 [for 1887].
*1888. *Necromantis* Weithofer, Sber. Akad. Wiss. Wien, math. naturw. Kl., 96 (1) 5: 353 (for 1887).
1903. *Necronycteris* Palmer, Science, N.S. 17: 873.. Publication date: 29 May 1903.

†***Necromantis fragmentum*** (Ravel, 2016)

*2016. *?Necromantis fragmentum* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 363, figs 4, 5. Publication date: 30 September 2016. Type locality: Tunisia: Kassérine province: Djebel Chambi National Park: Chambi [35 14 03 N 08 45 29 E, 630 m] [Goto Description]. - Etymology: From the Latin "fragmentum" meaning fragment or debris, referring to the fragmented character of the material attributed to this species (see Ravel *et al.*, 2016: 364).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Late lower Eocene to early middle Eocene.
Timeframe:

SUBORDER PTEROPODIFORMI Van Cakenberghe, Kearney and Seamark, 2007

1821. *FRUCTIVORAE* Gray, London Med. Repos., 15 (1): 299. - Comments: Proposed as order and originally included the families Pteropidae J. Gray, 1821 and Cephalotidae J. Gray, 1821, both currently representing Pteropodidae J. Gray, 1821. Jackson and Groves (2015: 230) included it as synonym of the Pteropodidae.

1855. *FRUGIVORA* Giebel, Die Säugethiere …, xii, 991. - Comments: Originally included the genera *Hypoderma* É. Geoffroy, 1828 [= *Dobsonia* Palmer, 1898]; *Harpyia* Illiger, 1811 [= *Nyctimene* Borkhausen, 1797]; *Macroglossus* F. Cuvier, 1824 [1821-1825]; and *Pteropus* Brisson, 1762 (see Jackson and Groves, 2015: 229). McKenna and Bell (1997: 295) synonymized it with Megachiroptera.

1866. *Pterocynes* Haeckel, Generelle Morphologie der Organismen., 2: clx. - Comments: *Nomen oblitum*. Proposed as suborder and originally included the "families" Pteropodida (including the genera *Pteropus* and *Macroylossus*) and Hypodermida (including the genus *Hypoderma*) Jackson and Groves, 2015: 229). McKenna and Bell (1997: 295) synonymized it with Megachiroptera.

1875. *MEGACHIROPTERA* Dobson, Ann. Mag. nat. Hist., ser. 4, 16 (95): 346. - Comments: Originally included the groups Pteropi (containing the genera *Pteropus* Brisson, 1762; *Cynopterus* F. Cuvier, 1824 [1821-1825]; *Cynonycteris* Peters, 1852 [= *Rousettus* J. Gray, 1821]; *Harpyia* Illiger, 1811 [= *Nyctimene* Borkhausen, 1797]; *Epomophorus* E. Bennett, 1836; and *Cephalotes* É. Geoffroy, 1810 [= *Nyctimene* Borkhausen, 1797]) and Macroglossi (containing the genera *Macroglossus* F. Cuvier, 1824 [1821-1825]; *Eonycteris* Dobson, 1873; and *Notopteris* J. Gray, 1859) (see Jackson and Groves, 2015: 228). - Etymology: From the neuter plural scientific Latin substantive made up of the Greek adjective "*μέγα*" (mega) "big" and chiroptera, i.e. "big Chiroptera", in opposition to Microchiroprera ("small chiroptera") (see Lanza *et al.*, 2015: 18).

2001. *YINPTEROCHIROPTERA* Springer, Teeling, Madsen, Stanhope, and De Jong, Proc. Natl. Acad. Sci. USA, 98 (11): 6423. - Comments: In part.

2004. *PTEROPODIFORMES* Hutcheon and Kirsch, J. mamm. Evolut., 11 (1): 44. - Comments: Originally included the families Pteropodidae J. Gray, 1821, Hipposideridae Flower & Lydekker, 1891, Rhinolophidae J. Gray, 1825, Megadermatidae H. Allen, 1864, and Craseonycteridae Hill, 1974 (see Jackson and Groves, 2015: 229)..

*2007. *PTEROPODIFORMI* Van Cakenberghe, Kearney and Seamark, African Chiroptera Report. Publication date: July 2007. - Comments: The name of the suborder is based on *Pteropus* Brisson, 1762 (type of Pteropodidae Gray, 1821). (Current Combination)

2014. *Pteropodimorpha* Zagorodniuk, Proc. Theriol. School, 12: 8.

TAXONOMY:
The suborder name follows the typified name used by Hutcheon and Kirsch (2004b, 2006), but with the ending changed to follow the format proposed for standardization of nomenclature of higher taxa by Alonso-Zarazaga (2005). '-formes' indicates ordinal level, while ending '-formi' indicates subordinal level.

Ao *et al.* (2007: 257) provide the first cytogenetic signature rearrangement that supports the grouping of Pteropodidae and Rhinolophoidea in a common clade (i.e. Pteropodiformes or Yinpterochiroptera).

In their phylogenetic study on *Bartonella*, McKee *et al.* (2016: 390) estimated the posterior state transition rate for *gltA* sequences in this bacterium and found a very high median rate between the superfamilies Pteropoidea and Rhinolophoidea (2.77) and between the families Pteropodidae and Rhinolophidae (2.32).

Based on transcriptome RNA-seq data, Lei and Dong (2016: 2) estimated the split between Rhinophoidea and Pteropoidae at about 60 MYA.

Currently two Infraorders are recognized within the suborder PTEROPODIFORMI from Africa: **PTEROPODIFORMACEI** Van Cakenberghe, Kearney and Seamark, 2007 and **RHINOLOPHIFORMACEI** Van Cakenberghe, Kearney and Seamark, 2007.

COMMON NAMES:
Czech: kaloňotvaří.

DETAILED MORPHOLOGY:
The echolocating bats belonging to the Pteropodiformi can be distinguished from the

Vespertilioniformi by the presence of a pectoral ring. This bony structure is formed by the fusion of the top bone of the breast bone (manubrium), the first two ribs and the last cervical and first two thoracic vertebrae (Jacobs (2016: 66-67).

MOLECULAR BIOLOGY:
Volleth (2010: 308) reports the detection of two cytogenetic characters serving as synapomorphies for Pteropodiformi (i.e. Rhinolophoidea plus Pteropodidae), and indicates that the cytogenetic basis is a small paracentric inversion hardly detectable with banding techniques, but clearly detectable with FISH (fluorescence in-situ hybridization) techniques.

VIRUSES:
Osborne *et al.* (2011: 8) indicate that "Yinpterochiroptera" [=Pteropodiformi] is the only suborder in which Betacoronaviruses are found, but they indicate that their conclusion might be biased as they only examined a subset of species of the New World, where no representatives of this suborder are occurring.

INFRAORDER PTEROPODIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007

*2007. *PTEROPODIFORMACEI* Van Cakenberghe, Kearney and Seamark, African Chiroptera Report. Publication date: July 2007. - Comments: The name of the Infraorder is based on *Pteropus* Brisson, 1762 (type of Pteropodidae Gray, 1821). (Current Combination)

TAXONOMY:
Currently only a single superfamily is recognised within the infraorder PTEROPODIFORMACEI: **PTEROPODOIDEA** Gray, 1821.

Superfamily PTEROPODOIDEA Gray, 1821

*1821. *PTEROPODOIDEA* Gray, London Med. Repos., 15 (1): 229. - Comments: The name of the superfamily is based on *Pteropus* Brisson, 1762 (type of Pteropodidae Gray, 1821), and originally included the genera *Pteropus* Brisson, 1762; and *Rousettus* J. Gray, 1821. (Current Combination)
2008. *Pteropoidea* Serra-Cobo, López-Roig, Bayer, Amengual and Guasch, Ratpenats. Ciència i mite., 31.

TAXONOMY:
Known families of the superfamily PTEROPODOIDEA: **PTEROPODIDAE** Gray, 1821.

COMMON NAMES:
Czech: kaloňovci, kaloni.

Family PTEROPODIDAE Gray, 1821

1821. *Cephalotidæ* Gray, London Med. Repos., 15 (1): 299. - Comments: Type genus: *Cephalotes* É. Geoffroy, 1810b [= *Nyctimene* Borkhausen, 1797].
*1821. *Pteropidæ* Gray, London Med. Repos., 15 (1): 299. Publication date: 1 April 1821. - Comments: Jackson and Groves (2015: 230) explains that the stem of the Greek *pous* (=foot) is *pod-*, so the stem of the latinised *Pteropus* is 'pteropod-', leading to the corrected name Pteropodidae introduced by Bonaparte (1837-41: 112).
1825. *Pteropina* Gray, Ann. Philos., 10 (5): 338. Publication date: November 1825. - Comments: Proposed as tribe and originally included the genera *Pteropus* Brisson, 1762; *Cynopterus* F. Cuvier, 1824 [1821-1825]; *Macroglossum* [sic = *Macroglossus*] F. Cuvier, 1824 [1821-1825]; *Cephalotis* [sic = *Cephalotes*] É. Geoffroy, 1810b [= *Nyctimene* Borkhausen, 1797]; and *Harpyia* Illiger, 1811 [= *Nyctimene* Borkhausen, 1797] (see Jackson and Groves, 2015: 230). McKenna and Bell (1997: 295) synonymized it with Pteropodidae. Jackson and Groves (2015: 236) also mention it in the synonymy of the subfamily Pteropodinae.

1838. *PTEROPODIDAE* Bonaparte, Syn. Vert. Syst., in Nuovi Ann. Sci. Nat., Bologna, 2: 111. - Comments: Type genus: *Pteropus* Brisson, 1762. (Alternate Spelling)

1842. *Harpyidae* C. H. Smith, An introduction to the Mammalia, 15: 115. - Comments: Type genus: *Harpyia* Illiger, 1811 [=*Nyctimene* Borkhausen, 1797). Originally included the genera *Pteropus* Brisson, 1762; *Pachysoma* I. Geoffroy, 1828 [= *Cynopterus* F. Cuvier, 1824 [1821-1825]; *Macroglossus* F. Cuvier, 1824 [1821-1825]; *Harpyia* Illiger, 1811 [= *Nyctimene* Borkhausen, 1797]; and *Cephalotes* É. Geoffroy, 1810 [= *Nyctimene* Borkhausen, 1797] (see Jackson and Groves, 2015: 230). Simmons (2005: 313) synonymized this name with Pteropodidae.

1866. *Hypodermida* Haeckel, Generelle Morphologie der Organismen., clx. - Comments: Originally included the genus *Hypoderma* É. Geoffroy, 1828 [= *Dobsonia* Palmer, 1898] (see Jackson and Groves, 2015: 230). McKenna and Bell (1997: 295) synonymized it with Pteropodidae.

1866. *Pteropi* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1865: 256. - Comments: Proposed as family name and originally included the genera *Pteropus* Brisson, 1762; *Cynonycteris* Peters, 1852 [= *Rousettus* J. Gray, 1821]; *Pterocyon* Peters, 1861 [= *Eidolon* Rafinesque, 1815]; *Cynopterus* F. Cuvier, 1824 [1821-1825]: 248; *Megaerops* Peters, 1865; *Epomophorus* E. Bennett, 1836; *Macroglossus* F. Cuvier, 1824 [1821-1825]; *Harpyia* Illiger, 1811 [= *Nyctimene* Borkhausen, 1797]; *Cephalotes* É. Geoffroy, 1810b [= *Nyctimene* Borkhausen, 1797]; and *Notopteris* J. Gray, 1859.

1866. *Pteropodida* Haeckel, Generelle Morphologie der Organismen., clx. - Comments: Originally included the genera *Pteropus* Brisson, 1762; and *Macroglossus* F. Cuvier, 1824 [1821-1825] (see Jackson and Groves, 2015: 230). McKenna and Bell (1997: 295) synonymized it with Pteropodidae.

1893. *Pteropi* Winge, Samling af Afhandlinger. E Museo Lundii, 2 (1): 53. - Comments: Proposed as tribe(?) and originally included the genera *Cynonycteris* Peters, 1852b: 25 [= *Rousettus* J. Gray, 1821]; *Pteropus* Brisson, 1762; *Pteralopex* Thomas, 1888; *Epomophorus* Bennett, 1836; *Cephalotes* É. Geoffroy, 1810 [= *Nyctimene* Borkhausen, 1797]; *Cynopterus* F. Cuvier, 1824 [1821-1825]; and *Harpyia* Illiger, 1811 [= *Nyctimene* Borkhausen, 1797] (see Jackson and Groves, 2015: 231).

TAXONOMY:

The taxonomy of the Pteropodidae follows that of Bergmans (1988, 1989, 1991, 1994, 1997) and Simmons (2005: 313 - 350).

Corbet and Hill (1992: 55) refer to Handley (1980) for a discussion on the correct formation of the family name.

Between two and six subfamilies of Pteropodidae have been recognized (Simmons, 2005: 313) including: Cynopterinae K. Andersen, 1912, Epomophorinae K. Andersen, 1912, Harpionycterinae Miller, 1907, Nyctimeninae Miller, 1907, Macroglossinae Gray, 1866, Rousettinae Andersen, 1912, and Pteropodinae Grey, 1821 (Bergmans, 1997; Corbet and Hill, 1980, 1991, 1992; Hill and Smith, 1984; Koopman, 1993a, 1994; McKenna and Bell, 1997).

Recent phylogenetic studies agree that Macroglossinae and Pteropodine *sensu* (Koopman, 1993a, 1994; McKenna and Bell, 1997) are not monophyletic (Álvarez *et al.*, 1999; Giannini and Simmons, 2003; Hollar and Springer, 1997; Hood, 1989; Juste B. *et al.*, 1997; Kirsch *et al.*, 1995; Romagnoli and Springer, 2000; Springer *et al.*, 1995). Monophyly of cynopterines and empomophorines has also been questioned (Álvarez *et al.*, 1999; Hollar and Springer, 1997; Kirsch *et al.*, 1995; Romagnoli and Springer, 2000). Phylogenetic studies based on DNA hybridization and DNA sequences have found support for a large clade of endemic African taxa including genera previously placed in several different subfamilies/tribes based on traditional taxonomic groupings (Álvarez *et al.*, 1999; Giannini and Simmons, 2003; Hollar and Springer, 1997; Kirsch *et al.*, 1995; Romagnoli and Springer, 2000). Relationships among pteropodid genera are not yet fully resolved, however, and questions remain concerning the position of *Nyctimene*; *Paranyctimene*, *Eidolon*, and several SE Asian endemic genera (Simmons, 2005) . Based on a phylogenetic study of newly generated sequences of four nuclear loci, Almeida *et al.* (2011b: 86) found a basal split of Pteropodidae into 7 (maybe 8) main clades, but the relationships between them are not well resolved. The analyses performed by Almeida *et al.* (2011a: 7) revealed six principal clades and one independent lineage (for *Eidolon*). Some of their principal clades agree with previously proposed subfamilies: Cynopterinae, Harpyionycterinae, and Nyctimeninae. The other clades agree with Macroglossini, Epomophorinae + Rousettini, and Pteropodini + *Melonycteris*.

Almeida *et al.* (2016: 73) recognize four main African clades: *Eidolon*, Scotonycterini (including the genera *Casinycteris* and *Scotonycteris*), African *Rousettus* (with three species) and the previously identified 'endemic African clade' (with nine genera: (*Stenonycteris, Plerotes, Myonycteris, Megaloglossus, Hypsignathus, Nanonycteris, Epomops, Epomophorus*, and *Micropteropus*), and suggest that a new classification on subfamilial and tribal levels is probably needed.

Simmons (2005: 313) suggests the relationships among the pteropodid genera are not yet fully resolved, and no subfamilial or tribal groups were recognized pending a thorough reevaluation of pteropodid classification.

Almeida *et al.* (2016: 83) provide the following classification: Harpyionycterinae (including the genera *Dobsonia, Aproteles, Boneia, Harpyionycteris*, Rousettinae (including the tribes Rousettini (*Rousettus*), Eonycterini (*Eonycteris*), Scotonycterini (*Scotonycteris, Casinycteris*), Epomophorini (*Epomophorus, Epomops, Hypsignathus, Nanonycteris, Micropteropus*), Stenonycterini (*Stenonycteris*), Myonycterini (*Myonycteris* (incl. *Lissonycteris*), *Megaloglossus*), and Plerotini (*Plerotes*)), and Eidolinae (*Eidolon*).

Hassanin *et al.* (2016: 521) indicate that two subfamiles occur in Africa: Pteropodinae (with one genus: *Eidolon*) and Rousettinae. The latter subfamily is subdivided in three tribes: Scotonycterini (*Scotonycteris* and *Casinycteris*), Rousettini (*Rousettus*), and Epomophorini, which is further divided in four subtribes: Epomophorina (*Epomophorus, Epomops, Hypsignathus, Micropteropus*, and *Nanonycteris*), Myonycterina (*Myonycteris* and *Megaloglossus*), Plerotina (*Plerotes*), and Stenonycterina (*Stenonycteris*). They also estimate that the three tribes diversified about 7 - 8 Mya. They also indicate (p. 524) that this family has its origin in Southeast Asia, which is supported by: **1)** More than half of the species (94) are found in this region, **2)** The highest species density is found on the islands of Sumatra, Borneo and Sulawesi, **3)** the oldest fossil of fruit bats has been described in the Late Eocene/Early Oligocene of Thailand, and **4)** The molecular analyses indicate that all African species have a derived position with respect to their congeners from Asia and Oceania.

Currently recognized genera of Pteropodidae: *Acerodon* Jourdan, 1837, *Aethalops*, Thomas, 1923, *Alionycteris* Kock, 1969, *Aproteles* Menzies, 1977, *Balionycteris* Matschie, 1899, ***Casinycteris*** Thomas, 1910, *Chironax* K. Andersen, 1912, *Cynopterus* F. Cuvier, 1824, *Desmalopex* Miller, 1907, *Dobsonia* Palmer, 1898, *Dyacopterus* K. Andersen, 1912, ***Eidolon*** Rafinesque, 1815, *Eonycteris* Dobson, 1873, ***Epomophorus*** Bennett, 1836, ***Epomops*** Gray, 1870, *Haplonycteris* Lawrence, 1939, *Harpyionycteris* Thomas, 1896, ***Hypsignathus*** H. Allen, 1861, *Latidens* Thonglongya, 1972, *Macroglossus* F. Cuvier, 1824, *Megaerops* Peters, 1865, ***Megaloglossus*** Pagenstecher, 1885, *Melonycteris* Dobson, 1877, ***Micropteropus*** Matschie, 1899, *Mirimiti* Helgen, 2005, ***Myonycteris*** Matschie, 1899, ***Nanonycteris*** Matschie, 1899, *Neopteryx* Hayman, 1946, *Notopteris* Gray, 1859, *Nyctimene* Borkhausen, 1797, *Otopteropus* Kock, 1969, *Paranyctimene* Tate, 1942, *Penthetor* K. Andersen, 1912, ***Plerotes*** K. Andersen, 1910,† Propotto Simpson, 1967, *Ptenochirus* Peters, 1861, *Pteralopex* Thomas, 1888, ***Pteropus*** Brisson, 1762, ***Rousettus*** Gray, 1821, ***Scotonycteris*** Matschie, 1894, *Sphaerias* Miller, 1906, *Stenonycteris* Gray, 1870, *Stylocteniu*m Matschie, 1899, ***Syconycteris*** Matschie, 1899, *Thoopterus* Matschie, 1899.

COMMON NAMES:
Czech: kaloňovití, upírové, létací psi, bejložraví netopýři, létací lišky. Dutch: Grote fruitvleermuizen, Vliegende honden. English: Old World Fruit bats. Finnish: Hedelmälepakot. French: Prétopodidés. German: Flughunde, Flederhunde. Italian: Pteropòdidi; Pteròpidi. Norwegian: Flyvende hunder, kalong. Russian: Крылановые. Vietnamese: Họ dơi qụa.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Gunnell and Simmons (2013: 63) indicate that fossil records for Pteropodid bats are extremely poor. There are hardly any records older than Late Pleistocene-Holocene, although molecular data suggest that Pteropodids diverged from other bats no later than in the Early Eocene (ca. 50 million years ago). They suggest that this is probably due to the fact that most of the Pteropodid fossils are concidered to be from Primates rather than from bats.

The family's stem and crown ages were reported by Shi and Rabosky (2015: 1537) to be respectively 56.6 and 40.2 mya.

Foley *et al.* (2014: 320) indicate that the Rhinolophoidea and Pteropodidae diverged approximately 59 Ma.

DETAILED MORPHOLOGY:
Dentition - See Adeniyi *et al.* (2010).
Tongue - Morphological studies on the tongue structure of Old World fruit bats suggest that these bats are highly adapted to fruit and nectar diets and are able to change between a fruit and nectar

diet when their preferred food is not available (Morrison, 1980; Birt *et al.*, 1997). Old World fruit bat species possess filiform papillae at the tip of the tongue, which is thought to increase the surface area for nectar collection (Birt *et al.*, 1997). Filiform papillae increase the gripping of food on the tongue surface, thus efficiently moving food toward the pharynx (Birt *et al.*, 1997). Bats feeding on fruit also have a large tongue surface area, but generally lack tongue tip filiform papillae, and possess tridentate papillae (Birt *et al.*, 1997). Tridentate papillae are thought to be valuable when piercing through the skin of soft fruits (Birt *et al.*, 1997). Morrison (1980) suggested that fruit bats have a widened tongue and consequently larger tongue surface area that is used to squeeze fruit against the hard upper palate, thus releasing fruit juices.
See also Adeniyi *et al.* (2010).

SEXUAL DIMORPHISM:
Dobson (1873: 251) suggests that the hairs of the male's epaulettes of the Epomophori are long due to glandular excretions, similar to beard of male *Taphozous melanopogon*. The different colour, however, can (probably) not be explained by this.

ECHOLOCATION:
Although the use of clicking sounds as means of echolocation by *Rousettus aegyptiacus* has become well accepted over the past few years, Boonman *et al.* (2013a: 23) showed that this type of clicks were also produced by representatives of other genera they investigated: (*Eonycteris, Cynopterus* and *Macroglossus*, which convinced Boonman *et al.* (2013a) that the use of echolocation is more widely distributed than previously believed.

Boonman *et al.* (2014: 2962) provided evidence that suggests that all Old World fruit bats can produce clicks with their wings, resulting in a rudimentary echolocation system.

MOLECULAR BIOLOGY:
Jiao *et al.* (2018: 4477) found that the bitter taste receptor genes (*Tas2rs*) in the Old World fruit bats underwent a massive loss (-11 genes out of the ancestral 27) in their common ancestor, but the remaining ones underwent subsequent diversification leading to an average number of genes in the present day species (e.g. 23 in *Eidolon helvum* and 31 in *Rousettus aegyptiacus*).

DIET:
In their study on figs as resources for tropical frugivorous vertebrates, Gautier-Hion and Michaloud (1989: 1826) concluded that these fruits are occurring in such distant patches, that only large frugivorous bats can use them as staple food.

Pettersson *et al.* (2004: 166) state that African pteropodid bats apparently feed more commonly from nectar sources visually observable from above the canopy (as compared with pollinating species from the New World). They also suggest that the absence of sulphur compounts in the floral scent of West African *C. pentandra* (as opposed to South-America) is the result of the different selective regimes of the pollinating bats.

Djossa *et al.* (2015: 286) found that the baobab tree (*Adansonia digitate* L.) needs pollinators (= fruit bats) to reach its optimal pollination success. They also concluded that the involvement of fruit bats is beneficial as they travel over long distances, which may help conserve the genetic diversity of this plant species, especially keeping in mind that the baobab tree is a multipurpose socioeconomically relevant plant for Sub-Saharan African rural communities.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) report the following birds predating on "Pteropodidae": Chestnut-flanked sparrowhawk (*Accipiter castanilius* Bonaparte, 1853), Little sparrowhawk (*Accipiter minullus* (Daudin, 1800)), Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850), African harrier-hawk (*Polyboroides typus* Smith, 1829), Crowned eagle (*Stephanoaetus coronatus* (Linnaeus, 1766)).

PARASITES:
Fain (1994: 1279) indicated that the Pteropodidae are hosts for two or three genera of Myobiidae: *Binuncus* (with subgenus *Probinuncus*) including 19 species of which 18 occur on Pteropodinae only, and one on Macroglossinae. The second genus is *Pteropimyobia* with five species of which 3 live on Macroglossinae and two on Nyctimeninae. The third genus - *Ugandobia* - contains nine species occuring on Emballonuridae and one species each occurring on Hipposideridae (*U. euthrix*) and on Pteropodinae (*U. balionycteris*). However, he believes that these two latter species were reported from the wrong host species due to "contamination of museum jars". Fain (1994: 1280) also mentions that the Myobiidae found on Megachiroptera are more evolved than those found on the Microchiroptera, indicating that the Myobiidae have probably originated on a primitive genus of the Microchiroptera and subsequently have passed to the Megachiroptera. He also reported this as peculiar since mites belonging to the Mesostigmata and Sarcoptidae are more primitive on Megachiroptera than on Microchiroptera.

HEMIPTERA
Cimicidae: Haeselbarth *et al.* (1966: 8) recorded *Afrocimex leleupi* Schouteden 1951 from fruit-bats in the "Grotte de Kakontwe" and "Grotte Dufrenne", Katanga, DRC.

DIPTERA
Streblidae: *Ascodipteron semirasum* Maa 1965 from a fruit bat in Kenya (Haeselbarth *et al.*, 1966: 106).

VIRUSES:
Nesi *et al.* (2012: 126) suggest that the high nucleotide distance between Ebola virus Côte d'Ivoire and Ebola virus Zaire can be correlated with the Plio/Pleistocene divergence between their putative reservoir host species, i.e., *Myonycteris leptodon* and *Myonycteris torquata*, respectively.

Akani *et al.* (2015: 614 - 615) state "... the first Ebola outbreak in Guinea in 2014 occurred in a site where there was recent deforestation due to the planting of massive oil palm plantations (Wallace *et al.*, 2014), exactly as it also occurred in the Democratic Republic of Congo in 2007 (see Leroy *et al.*, 2009). Therefore, it is likely that there is a direct noncasual link between oil palm plantations, fruit bats and Ebola outbreaks (Wallace *et al.*, 2014). Fruit bats may shift from using rainforest to utilizing oil palm plantations as foraging grounds once the forests became disturbed, especially where plantations are adjacent to rainforest patches. The intensified use of oil palm plantations by fruit bats may be due to the high food resource available due to the palm fruits"
[**Note** (26 July 2015): As far as the editors are aware, no proof has yet been provided that fruit bats are indeed the culprits.]

Subfamily Eidolinae Almeida, Giannini and Simmons, 2016

*2016. *Eidolinae* Almeida, Giannini and Simmons, Acta Chiropt., 18 (1): 83, 84. Publication date: June 2016 [Goto Description].

TAXONOMY:
This subfamily was created by Almeida *et al.* (2016: 84) to distinguish monophyletic groups within the Pteropodidae.

Currently recognized genera of Eidolinae: *Eidolon* Rafinesque, 1815.

Genus ***Eidolon*** Rafinesque, 1815

*1815. *Eidolon* Rafinesque, Analyse de la Nature, 45. - Comments: Type species: *Pteropus stamineus* E. Geoffroy Saint-Hilaire, 1803 (= *Vespertilio vampyrus helvus* Kerr, 1792). - Etymology: From the Greek "*ειδωλον*", meaning "image" or "phantom", evidently in allusion to its movements (see Palmer, 1904: 252; DeFrees and Wilson, 1988: 4). (Current Combination)

1862. *Pterocyon* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1861: 423. - Comments: Type species: *Pterocyon paleaceus* Peters, 1861 (=*Vespertilio vampyrus helvus* Kerr, 1792). - Etymology: From the Greek "*πτερόν*", meaning wing and "*κύων*", meaning dog (see Palmer, 1904: 595).

1881. *Leiponyx* Jentink, Notes Leyden Mus., 3 (15): 60. Publication date: April 1881 [Goto Description]. - Comments: Type species: *Leiponyx büttikoferi* Jentink, 1881 (=*Vespertilio vampyrus helvus* Kerr, 1792). - Etymology: From the Greek "*λείπω*", meaning to leave or to be wanting and "*ονυξ*", meaning claw, referring to the absence of a claw on the index finger (see Palmer, 1904: 367).

1882. *Liponyx* Forbes, Zoological Record, 18 Mamm.: 13 (for 1881). - Comments: Emendation of *Leiponyx* Jentink, 1881. Preoccupied by *Liponyx* Vieillot, 1816; a bird (see Andersen, 1912b: 2; Meester *et al.*, 1986: 27). (Emendation)

TAXONOMY:
Revised by Bergmans (1991). See Simmons (2005: 320).

Almeida *et al.* (2011a: 11) suggest that *Eidolon* should be included in a subfamily of its own.

Known species of *Eidolon*: ***dupreanum*** (Pollen, 1866); ***helvum*** (Kerr, 1792).

COMMON NAMES:
Czech: plaví kaloni. English: Straw-coloured Fruit-bats, Eidolon fruit bats. French: Roussettes des palmiers. German: Palmenflughunde. Italian: Èidoli, Ptèropi fantasrna.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Shi *et al.* (2014: 285) refer to Howell and Coppens (1974), who reported the only fossil record for *Eidolon* from the Pliocene (ca. 3 mya) of Ethiopia. They also indicate (p. 279) that the two taxa (*helvum* and *dupreanum*) diverged in the mid-to-late Miocene. Almeida *et al.* (2016: 85) place the origin of the genus in the Miocene or Oligocene.

VIRUSES:
Flaviviridae
Luis *et al.* (2013: suppl.) mention the following Flaviviridae from "*Eidolon*": Entebbe bat virus, Uganda S virus, Usutu virus, West Nile virus, Yellow fever virus, and Zika virus.

Togaviridae
Alphavirus - (Luis *et al.*, 2013: suppl.) mention "from *Eidolon*".
Chikungunya virus - (Luis *et al.*, 2013: suppl.) mention "from *Eidolon*".

Eidolon dupreanum (Schegel, 1867)

*1867. *Pteropus dupréanus* Schlegel, in: Schlegen and Pollen, Proc. zool. Soc. Lond., 1866, III: 419. Publication date: April 1867. Type locality: Madagascar: Nossi Bé island [ca. 13 20 S 48 15 E] [Goto Description]. - Comments: Andersen (1912b: 8) mentions two cotypes in the Leyden Museum collected by Fr. Pollen and C.C. van Dam (see Schlegel, 1867: 419).
2014. *Eidolon duprenum:* Gunnell, Simmons and Seiffert, PLoS ONE, 9 (2): e86712: 3. Publication date: 4 February 2014. (Lapsus)
? *Eidolon dupreanum:* (Name Combination, Current Combination)
? *Eidolon helvum dupreanum:* (Name Combination)

TAXONOMY:
Koopman (1993a: 140) mentioned Schlegel, 1867 as author, but Allen (1939a: 54), Peterson *et al.* (1995: 22) and Russ *et al.* (2001) mention Pollen, 1866, in Schlegel and Pollen, Proc. Zool. Soc. Lond., 1866: 419. Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1) mention Schlegel and Pollen, 1867 as authors, but in the references of the latter only Schlegel is mentioned as author. Reviewed by Bergmans (1991) and Peterson *et al.* (1995). See Simmons (2005: 321 and comments under *E. helvum* pg. 321).

COMMON NAMES:
Czech: kaloň malgašský. English: Madagascan Straw-coloured Fruit-bat, Madagascan Fruit Bat, Malagasy Straw-colored Fruit Bat. French: Roussette des palmiers malgache, Roussette malgache couleur paille, Roussette jaune de Madagascar. German: Madagaskar-Palmenflughund. Malagasy: Angavo.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Samonds (2007: 43) found samples in deposits dated at 10,000 yrs old or younger from within the Anjohibe cave, Madagascar. Gunnell *et al.* (2014: 3) also refer to Goodman and Jungers (2013), who report material from the Andrahomana cave.

CONSERVATION STATUS:
Global - This species is listed as Vulnerable (VU A2ad ver 3.1 (2001)) because it is estimated to have undergone a decline exceeding 30% over the past 20 years mainly from extreme pressure from hunting, causing it to abandon roosts, with known examples of local extirpation of roosts sites (Andriafidison *et al.*, 2008b; IUCN, 2009).

Assessment History -
2008 - VU A2ad ver 3.1 (2001) (Andriafidison *et al.*, 2008b; IUCN, 2009). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is subject to harvesting for bushmeat across its range and hunting occurs both at roosting and foraging sites (Jenkins and Racey, 2008). It is classed as a game species under Malagasy law and although it can only be legally hunted between the first of May and the first of September (Anonymus, 2007b: 6; Durbin, 2007; Randrianandrianina *et al.*, 2010: 412), this legislation is widely ignored and the bats are hunted throughout the year. Its roosts tend to be well protected from bushfires and it is able to survive in landscapes with severely depleted natural food supplies as long as alternative plants are available (Ratrimomanarivo, 2007). Hunting is therefore the main threat and was reported to account for a 30% desertion rate from 60 roosts (MacKinnon *et al.*, 2003). Although hunters report that deserted roosts are recolonized after a few years, there are several confirmed examples

where this species has been extirpated at roost sites (MacKinnon *et al.*, 2003).

Randrianandrianina *et al.* (2010: 413) observed that at least 14 *E. dupreanum* specimens were captured each night at fruiting voandelaka tree (*Molinaea* sp.).

Cardiff and Jenkins (2016: 99) indicate that fires are used to expel *E. dupreanum* from their rocky roost sites.

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008b) [in IUCN (2009)] report this species is known from a number of protected areas (Goodman *et al.*, 2005a) including, Parc National d'Isalo, Parc National de Namoroka, Réserve Spéciale d'Ankarana and Réserve Spéciale de Cape Sainte Marie; however, hunting has been reported from within Réserve Spéciale d'Ankarana (Cardiff, 2006). Fernández-Llamazares *et al.* (2018: 273), similarly, reported hunting in and outside the Tsimanampetsotsa National Park, even in sacred caves. Roosts that are located in inaccessible rock outcrops pose significant challenges to hunters are relatively protected. Cave roosts are probably subject to highest hunting pressure and conservation measures should be focused at these sites (Andriafidison *et al.*, 2008b; IUCN, 2009).

Additional research is needed on natural history and in particular roosting ecology and movements (Andriafidison *et al.*, 2008b; IUCN, 2009).

GENERAL DISTRIBUTION:
Eidolon dupreanum is endemic to the island of Madagascar where it is widespread, albeit with a patchy distribution (MacKinnon *et al.*, 2003). It is found both along the coast and on the central high plateau and areas from where there are no records probably reflect inadequate survey coverage rather than a genuine absence. There are some areas within its range where the lack of crevices means there are no roosting opportunities (Goodman *et al.*, 2005a).

Native: Madagascar.

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 52) describe the baculum as a large flat structure, with the distal tip having a serrated or tooth-like structure that is wider than the proximal base; length: 6.59 ± 0.225 (6.41 - 6.84) mm, width: 4.21 ± 0.671 (3.48 - 4.80) mm.

ECHOLOCATION:
Schoeman and Goodman (2012) identified three distinct call types: social calls 1, social calls 2 and echo clicks. Bats produce the echo clicks while flying towards the entrance of the cave, while the other two calls were emitted at roost sites and near the cave entrance. Based on the preliminary results, Schoeman and Goodman (2012) suggest that the social calls 1 and 2 were employed for social communication, whilst echo clicks may have been used in a sensory context, potentially as incipient echolocation to navigate in the dark cave.

HABITAT:
Eidolon dupreanum has a patchy distribution which includes humid, dry deciduous and spiny forest is probably related to the availability of suitable roost sites and is rare or absent from a number of forests without rocky outcrops (Goodman *et al.*, 2005a; Jenkins *et al.*, 2007b; Schmid and Alonso, 2007). It continues to survive in highly modified landscapes with very little native vegetation remaining (Ratrimomanarivo, 2007), but appears to use native forest vegetation for food in preference to introduced plants (Picot *et al.*, 2007).

Dammhahn and Goodman (2013: 108) indicate that mid- to upper-canopy in forest and trees growing in open areas form the foraging habitat of this species.

HABITS:
Baum (1995: 337) reported that fruit bats (probably *E. dupreanum*) intensively visited *Adansonia suarezensis* trees in the forest at Beantely in the hour after dark, but also during the remainder of the night at a much lower frequency. Peak rates were about 14 visits per tree per hour (or ca. 0.5 visits / flower / hr), each lasting between 20 and 30 seconds. During each of the tree stopovers, up to nine flowers were visited.
While exiting roost, individuals flew within 50–100 cm of the ceiling, often settling and perching every 5–10 m along their flight patch and displacing in a leapfrog manner towards the cave entrance (Schoeman and Goodman, 2012).

ROOST:
It is known to roost in tree foliage, but is more usually found in rock fissures and caves (MacKinnon *et al.*, 2003). Its roost sites are usually very high and located in cliffs and rock faces (Jenkins and Racey, 2008). In the Réserve Spéciale d'Ankarana, it used caves that were high and long with a good buffering capacity for temperature and humidity (Cardiff, 2006).
See habits for roosting behaviour.

MIGRATION:
MacKinnon *et al.* (2003) suggested that *E. dupreanum* might be migratory because of regular variation in the occupancy and abundance of roosts.

DIET:
In a study, during three months (February, July and December), at four sites on the central Malagasy highlands, Ratrimomanarivo (2007) found the seeds of 13 plant species. Picot *et al.* (2007) reported that *E. dupreanum* ate mainly fruits (65%), although *Eucalyptus* spp. flowers were also consumed. Thirty plant species (14 identified and 16 unidentified), including six introduced species were utilized in the corridor of rainforest between Ranomafana and Andringitra National Parks, south-eastern Madagascar (Picot *et al.*, 2007). *Polyscias* spp. fruit (seeds) were the most frequently recorded plant in 70 % of the faecal samples (Picot *et al.*, 2007). Fruit is the main dietary component, but it also eats leaves and other plant parts (Picot, 2005; Picot *et al.*, 2007). Through the ingestion of pollen and small seeds, a significant ecological role is inferred (Picot, 2005; Ratrimomanarivo, 2007). *E. dupreanum* may be an important pollinator of threatened baobab trees (Baum, 1995).

Baum (1995: 339) mentions that *E. dupreanum* is believed to be one of the major pollinators of endemic baobabs *Adansonia grandidieri* and *Adansonia suarezensis* of Madagascar.

Picot *et al.* (2007) suggest that the alimentary tract is one intrinsic factor that influences seed dispersal, as they found a maximum seed size of 7 mm and mean size of 3.2 mm for *E. dupreanum* and the ecological services provided by this species appear to be limited by the dimensions of its intestinal tract.

Jenkins *et al.* (2007b: 213) [referring to Rakotonirainy (2001)] mention these bats visit fruiting trees of *Ficus soroceoides, F. pyrifolia*, and *F. guatteriifolia*.

Based on stable isotope analyses, Reuter *et al.* (2016) found that *Pteropus rufus*, *Eidolon dupreanum* and *Rousettus madagascariensis* have broadly overlapping diets, although there are differences between *P. rufus* and *E. dupreanum*. Furthermore, they found that the diet shifted when these two species occurred sympatrically.

POPULATION:
Structure and Density - The population size and local abundance of this species are not well known. Estimates of colony size are difficult to obtain because the bats are hidden during the day, but is usually in the range of between 10 and 500, with a median of 200 individuals (MacKinnon *et al.*, 2003). The maximum colony size of 1,400 is from Réserve Spéciale d'Ankarana (S. G. Cardiff unpubl. [in Andriafidison *et al.* (2008b)]).

Given the estimated adult survival, Brook *et al.* (2019: 165) found that the population of *E. dupreanum* will only be able to persist if the field-based fecundity estimates were replaced by higher values reported in the literature for related species.

Trend - 2008 - Decreasing (Andriafidison *et al.*, 2008b; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Kaudern (1914: 11 - 12) reported that he was unable to shoot any pregnant female or females with young during his travels on Madagascar, which took place in the dry season (May to September), so he assumed they had their reproductive season in Spring or Summer.

PARASITES:
Brook *et al.* (2015: 4) found *E. dupreanum* to be the host of *Cyclopodia dubia* (Westwood, 1835) (Nycteribiidae) and *Thaumapsylla* sp. fleas. In the bat flies (and the bats), DNA of a new *Bartonella* was found. The bat flies were also reported by Wilkinson *et al.* (2016) and Ramasindrazana *et al.* (2017: Suppl). Szentiványi *et al.* (2019: Suppl.) indicated that thes bat flies were also carrying Enterobacteriales and *Wolbachia* sp. bacteria.

VIRUSES:
Reynes *et al.* (2011: 3) were able to isolate Ife virus from *E. dupreanum*.

Coronaviridae - Coronaviruses
BtCoVMAH051F/E. dupreanum/2011 - In Madagascar, identified in faecal material (Razanajatovo *et al.*, 2015).

Herpesviridae
Alphaherpesvirinae
Simplexvirus
Alphaherpesvirus CS730G - In Madagascar 2006, isolated in Vero cells from throat swabs (Razafindratsimandresy *et al.*, 2009).

Paramyxoviridae
Henipavirus
Nipah (NiV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) found Nipah virus with an infection rate of 19.2%. Kuzmin *et al.* (2011a: 5) suggest that their exposure to NiV might be the result of contact with infected *Pteropus rufus* specimens.

Hendra (HeV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) found Hendra virus with an infection rate of 19.2%.
Tioman (TiV) - In Madagascar during 2003 - 2004, this virus was not detected (Iehlé *et al.*, 2007).

Rhabdoviridae – Rabies like viruses
Lyssavirus - Rabies related viruses
Andriamandimby *et al.* (2013: 3) reported that 17 bats testes positive for the detection of antibodies agains Lagos Bat Virus (LBV) in two areas close to Antananarivo. Five of these also tested positive against European Bat Lyssavirus type 1 (EBLV-1).

UTILISATION:
E. dupreanum is hunted for meat in many parts of Madagascar (Ranivo, 2001; MacKinnon *et al.*, 2003). Hunting is undertaken by specialists (due to the roosting high in cliffs) who either access the roosts with wooden ladders (Jenkins and Racey, 2008) or light fires directly underneath the roosts and net or swat flying bats as they emerge (Ranivo, 2001). Alternatively, a hunter is lowered on a rope and hits the bats with a stick (Jenkins and Racey, 2008). Jenkins and Racey (2008) also indicate that guns and slingshots are used.
In the rainforests between PN de Ranomafana and PN d'Andringitra, a number of accounts of bat hunting were collected from villages (Picot, 2005). Although familiar with the location of the bat roosts, the local people rarely hunted or consumed the bats. Professional hunters visited a few times a year and occasionally offered bat meat to the village but most of the animals were taken to larger towns and sold for $ 0.4 US to restaurants and hotels. In this area oil residue from cooked bats is used as medicine for whooping cough (Jenkins and Racey, 2008). Further north in the highlands, Ranivo (2001) investigated the hunting of *E. dupreanum* at roost sites near Ambositra, Antsirabe and Ankazobe, where villages reported purchasing one and four times per year.
Pteropus rufus and *Eidolon dupreanum* appear to be the only species sold in restaurants, where they are either served individually, complete with head and wings, jointed, or are diced up into small pieces and accompanied by rice (Jenkins and Racey, 2008).
Ranivo (2001) found that hunting caused the bats to abandon traditional roost sites and local people noted declines in hunting returns.

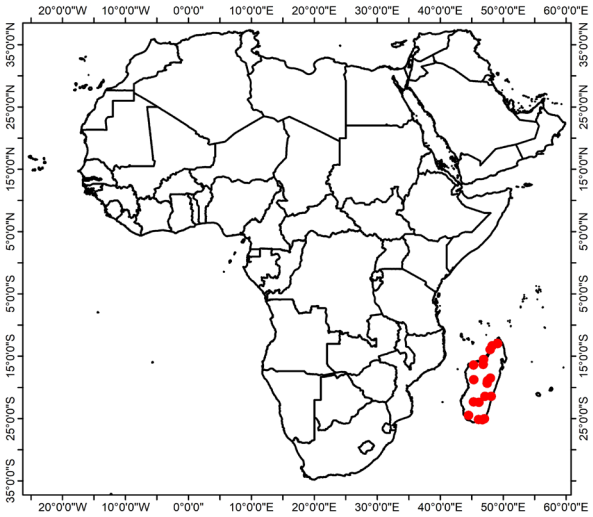


Figure 5. Distribution of *Eidolon dupreanum*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar.

Eidolon helvum (Kerr, 1792)

*1792. *Vespertilio vampyrus helvus* Kerr, in: Linnaeus, Animal Kingdom, 1 (1): xvii, 91. Publication date: February 1792. Type locality: Senegal: "Senegal". - Comments: Type locality fixed by Andersen (1907a: 504); see Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1), Harrison and Bates (1991). Andersen (1912b: viii) indicates that the type was once in the Museum Leverianum, but is probably no longer in existence. - Etymology: From the Latin "helvus" (=dun-coloured), referring to the straw colour on their shoulders; the back, rump and hind limbs are normally various shades of brown (see DeFrees and Wilson, 1988: 4; Taylor, 2005). Lanza *et al.* (2015: 27) translate "helvus" to "dull-yellow".
1862. *Xantharpyia stramineus:* Gerrard, Catalogue of the bones of Mammalia in the collection of the British Museum, 58. (Name Combination)
1866. *Xantharpyia leucomelas* Heuglin, in: Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54: sect. 1, pt. 10, p. 544. Type locality: Sudan: Kordofan: Bahr-el-Azrak: Bahr-el-Abiad: Sennaar. - Comments: Originally "Upper Nile lands", but subsequently fixed to Senaar by Koopman (1975): see Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1).
1867. *Cynonycteris straminea:* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 866. - Comments: see Pousargues (1896: 257). (Name Combination)
1895. *Cynonicteris straminea:* Bocage, J. Sci. mat. phys. nat., ser. 2, 4 (8): 4. Publication date: December 1895. (Name Combination, Lapsus)

1906. *R[oussettus (Xantharpyia)] stramineus:* Johnston, Liberia, Volume II: 690. (Name Combination, Lapsus)
1920. *Rousettus stramineus:* Haagner, South African mammals, 23. (Name Combination)
2015. *Pterocyon palaeaceus:* Lanza, Funaioli and Riccucci, The bats of Somalia and neighbouring areas, 27. (Lapsus)
2019. *Eidolon hevlum:* Debata, Panda and Palita, Biodivers. Conserv., 28 (8-9 SI): 2386. Publication date: 13 February 2019. (Lapsus)
? *Eidolon helvum:* (Name Combination, Current Combination)

TAXONOMY:
Includes *sabaeum* see Hayman and Hill (1971), Bergmans (1991), Harrison and Bates (1991), Simmons (2005: 321). Does not include *dupreanum*; see Bergmans (1991), Peterson *et al.* (1995) and Simmons (2005: 321), but also see Hayman and Hill (1971) who treated *dupreanum* Schlegel, 1866, from Madagascar and *sabaeum* Andersen, 1907, from Arabia as subspecies of *E. helvum* (Meester *et al.*, 1986).
African forms reviewed in part by Juste *et al.* (2000); Palearctic forms reviewed by Horácek *et al.* (2000). The taxonomic status of populations in the Anr Mountains of Niger is unclear (Simmons (2005: 321).

E. dupreanum is here retained as a separate species and *sabaeum* is considered an extralimital subspecies of *E. helvum* not occuring in Africa.

Juste *et al.* (2000) found that the population from Annobón is significantly smaller than the continental forms (and the specimens from the other islands in the Gulf of Guinea) and created a new subspecies for these: *Eidolon helvum annobonensis*.

Currently recognized subspecies of *Eidolon helvum*:
E. h. helvum (Kerr, 1792) - Afrotropics.
E. h. annobonensis Juste et al. 2000 - islands off Gulf of Guinea.
E. h. sabaeum K. Andersen, 1907 - Oriental.

COMMON NAMES:
Afrikaans: Geel vrugtevlermuis. Chinese: 黄毛果蝠. Czech: kaloň plavý, upír bledý, kaloň palmový, kaloň úzkokřídlý. English: African Straw-coloured Fruit-bat, Straw-colored Fruit Bat, Straw-coloured Flying Fox, Pale Xantharpy, Yellow-haired fruit bat. French: Roussette jaune, Roussette des palmiers africaine, Roussette paillée, chauve-souris paillée. German: Afrikanischer Palmenflughund, Palmenflughund, Afrikanischer strohfarbener Flughund. Italian: Èidolo paglierìno, Ptèropo fantàsma paglierìno. Kinande (DRC): Mulima. Portuguese: Morcego frugivoro gigante. Spanish (Castillian): Zorra Voladora Amarilla. Tanoboase (Ghana): ampane ankasa.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Hildebrand *et al.* (2010: 268) recorded this species from the Kumali site in southern Ethiopia.

CONSERVATION STATUS:
Global - Listed as Near Threatened (NT ver 3.1 (2001)) because this species is in significant decline (but at a rate of less than 30% over three generations (approximately fifteen years)) because it is being seriously over-harvested for food and medicine, making the species close to qualifying for Vulnerable, Under criterion A2d (Mickleburgh *et al.*, 2008dc; IUCN, 2009).

The subspecies *E. h. sabaeum* (Andersen, 1907) is known only from Yemen and Saudi Arabia and is possibly threatened (see Bergmans, 1999).

Assessment History -
2008 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2008dc; IUCN, 2009). 2004 - LC (Mickleburgh *et al.*, 2004bh; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016e). 2004 - considered a vagrant not assessed, doesn't breed in SA (Friedmann and Daly, 2004).

MAJOR THREATS:
In general there are no major threats to this widespread and adaptable species. It is, however, locally threatened in parts of its range by severe deforestation, and more generally across West and Central Africa by hunting for food and medicinal use. It is the most heavily harvested bat for bushmeat in West and Central Africa, and one of the most frequently consumed mammals in this region (P. Racey *pers comm.* in Mickleburgh *et al.* (2008dc)). Large pre-migration colonies are considered particularly vulnerable to any threats. In some areas it is considered to be a pest species and roosting locations may be restricted by cutting down trees. Trees are also cut down in order to catch bats for the market (P. Racey *pers comm.* [in Mickleburgh *et al.* (2008dc)]). Kamins *et al.* (2010: 190) report that 41 hunters, they interviewed, killed about 35,000 bats in one year in southeastern Ghana. 95 meat vendors indicated that they sold

over 100,000 bats as food in one year. These bats were captured in an area up to 200 km away from the markets where they were sold. Kamins *et al.* (2011a: 3000) update these figures, based on interviews with 551 Ghanaians, to a minimum 128,000 bats being sold yearly, up to 400 km away from the markets. MacDonald *et al.* (2011: Suppl. Table 1) indicate that, in rural markets in Cameroon and Nigeria, fresh bats were sold at 2.96 US$, or about 10.6 US$/kg, and smoked bats at 1.63 US$ or 5.82 US$/kg. In Côte d'Ivoire, Niamien *et al.* (2015a: 233) found that poachers only ate 5 % of their catch themselves, the rest was sold for 0.6 US$ per animal, leading to a daily revenu of 15 US$. They estimated that some 30,600 were killed each month, but luckily for the bats, they made some major calculation errors.

On São Tomé, these bats are extensively harvested for household consumption (see Carvalho *et al.*, 2015: 1). Hayman and Peel (2016: 132) indicate that the smaller island populations [from São Tomé, Príncipe and Annobón] may more likely suffer from additive mortality in response to harvesting than populations from the nearby Bioko as these latter can still mix freely with the continental populations.

Musaba Akawa *et al.* (2017) followed the sale of *E. helvum* at a market in Kisangani (DRC) for one year and found that most of the bats were sold during one of the wet seasons (September-October), but low during the second wet season (March-April). They also found that while hunting was allowed from December through July, only 47 % of the total number of bats were sold during that period; 53 % was sold during the period that the hunt was closed.

Anonymus (2004f: 51) indicates that their colonies are unwelcome in towns and cities through fruit feeding, defoliation of roost trees, defecation on (commercial) buildings.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dc) [in IUCN (2009)] report that there are no known direct conservation measures in place, but in view of the species extensive range it seems probable it is present in some protected areas during migration. There is a need to identify and protect important roosting sites, and a better understanding of the migratory patterns of this species would be beneficial to any conservation activities. The highest priority is to limit the harvesting of this species to sustainable levels.

GENERAL DISTRIBUTION:
Eidolon helvum is broadly distributed across the lowland rainforest and savanna zones of Africa from Senegal in the west, through to South Africa in the south and Ethiopia in the east (possibly ranging into Djibouti and southern Eritrea). It is also present on the extreme southwest Arabian Peninsula, where it has been recorded from Yemen and Saudi Arabia (Harrison and Bates, 1991). Populations of this bat occur on several offshore islands including the Gulf of Guinea islands (Peel *et al.*, 2013a: 296) and Zanzibar, Pemba and Mafia (off Tanzania) (Bergmans, 1991; Simmons, 2005; O'Brien, 2011: 285). It has also been recorded at sea, 250 km from the nearest land (Anonymus, 2004f: 50). There is a possibly disjunct population in the Air Mountains of Niger. Distribution at northern and southern extremes of the range is patchy and erratic. It is also sparse or absent in large areas of the Horn of Africa, central East Africa, and elsewhere (Bergmans, 1991). *Eidolon helvum* is a migratory species in parts of its range; populations migrate from the West African forest north into the savanna zone during the major wet season. It ranges from sea level to around 2,000 m asl (Ruwenzori Mountains). In South Africa, its distribution is mostly affected by precipitation seasonality (Babiker Salata, 2012: 49).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,091,925 km^2.

It has also been reported from the Cape Verde Islands (Jiménez and Hazevoet, 2010: 116).

Native: Angola (Crawford-Cabral, 1989; Lopes and Crawford-Cabral, 1992; Bergmans, 1991; Monadjem *et al.*, 2010d: 551); Benin (Capo-Chichi *et al.*, 2004: 161); Botswana; Burkina Faso (Kangoyé *et al.*, 2015a: 605); Burundi; Cape Verde Islands (Jiménez and Hazevoet, 2010: 116); Cameroon; Central African Republic; Chad; Congo (Bates *et al.*, 2013: 333); Congo (The Democratic Republic of the) (Schouteden, 1944; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 551); Côte d'Ivoire (Henry *et al.*, 2004: 24); Equatorial Guinea; Ethiopia; Gabon; Gambia (Kock *et al.*, 2002: 78); Ghana; Guinea (Fahr and Ebigbo, 2003: 128; Decher *et al.*, 2016: 259); Guinea-Bissau (Bocage, 1892b; Veiga-Ferreira, 1948; Bergmans, 1991; Corbet, 1984: 30) ; Kenya; Lesotho; Liberia (Fahr, 2007a: 103); Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988: 28; Bergmans, 1991; Monadjem *et al.*, 2010d: 551); Mali (Meinig, 2000: 104); Mauritania; Mozambique (Smithers and Lobão Tello, 1976; Cotterill, 2001e: 54; Monadjem *et al.*, 2010d: 551); Namibia (Bergmans, 1991; Monadjem *et al.*, 2010d: 551); Niger (Bergmans, 1991 in Cotterill, 2001e, 2001e: 55); Nigeria; Rwanda; Sao Tomé and Principe (Rainho *et al.*, 2010a: 24); Saudi Arabia; Senegal; Sierra Leone;

South Africa (Monadjem *et al.*, 2010d: 551); Sudan; Swaziland; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 58); Yemen; Zambia (Ansell, 1974; Cotterill, 2001e: 54; Monadjem *et al.*, 2010d: 551); Zimbabwe (Monadjem *et al.*, 2010d: 551). Presence uncertain: Djibouti; Eritrea.

GEOGRAPHIC VARIATION:
Peel *et al.* (2010b: 245) indicate that the non-migratory populations on the islands in the Gulf of Guinea (São Tomé and Príncipe, and Bioko and Annobón) show evidence of genetic differentiation from the continental (migratory) populations. They also indicate that two or three colonisation events to the islands have taken place.

Juste *et al.* (2000) found that the population from Annobón is significantly smaller than the continental forms (and the specimens from the other islands in the Gulf of Guinea) and created a new subspecies for these: *Eidolon helvum annobonensis*.

DENTAL FORMULA:
Popa *et al.* (2016: 847) described the replacement of the deciduous (milk) teeth by the permanent ones. The dentition consists of: Upper deciduous dentition: incisors i^1, i^2; canines c^1; premolars pm^1, pm^2, pm^3. Lower deciduous dentition: incisors i_1, i_2; canines c_1; premolars pm_1, pm_2, pm_3. Upper permanent dentition: incisors I^1, I^2; canines C^1; premolars PM^2, PM^3; molars M^1, M^2. Lower permanent dentition: incisors I_1, I_2; canines C_1; premolars PM_2, PM_3; molars M_1, M_2, M_3.

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 54) refer to Nwoha *et al.* (2000: 154), who found that the baculum in juvenile bats consists of two small paddlestone pieces located longitudinally close to each other at the distal third of the penis. In adult bats, the baculum consists of a large distal portion and a narrow proximal portion.

The average brain mass for this species is 4.30 g [n = 2, Chawana *et al.* (2013: 160)].

Huggel (1959) studied the blood pressure in the wings of *E. helvum* from Côte d'Ivoire. The normal pressure varied between 23 and 30 cm H_2O. This pressure was the same for the two types of bloodvessels that are present in the wing (contracting or non-contracting). If there is some blocking, the pressure can double very quickly, and in one case it even trippled.

Nwoha (2000: 291) examined the pelvis of this bat and found sexual dimorphism both in the shape and size of these bones as well as in its development. In males, the ossification of the interpubic ligament already start in the juvenile stage, whereas in females this only begins with puberty.

Odukoya *et al.* (2009b: 175) investigated the biochemical differences in the two uterine limbs during pregnancy and found that the uterine limbs actively utilized different metabolic pathways according to the functions they subserve during pregnancy.

Adeniyi *et al.* (2012: 118) compared the lateral geniculate bodies (LGB) of *E. helvum* with those of *Rattus norvegicus* and *Manis tricuspis* and found some differences, which they attributed to the feeding habits, lifestyle as well as the nature of their habitat.

The morphometrics of the reproductive tract of male bats were examined by Danmaigoro *et al.* (2014a), whereas Danmaigoro *et al.* (2014b) examined the histology and the histometric anatomy.

Abedi-Lartey *et al.* (2016: 18) found that the average gut passage time for small seeds was 116 ± 112 minutes (4 - 1,143 min). The dispersal distances for the small and large seeds were longer in rural areas than in urban areas, and for large seeds and small seeds in urban areas, they were also longer in the dry season than in the wet season. For small seeds in rural areas, they found that the distances were longer in the wet season than in the dry season.

FUNCTIONAL MORPHOLOGY:
Church and Warren (1968) indicate that wing membranes of *Eidolon helvum* are composed of long, prominent strands of elastin with collagen stretched in between, and that 2 x 2 cm holes in wings heal in 24 days.
Referring to Riskin *et al.* (2010), O'Mara *et al.* (2016: 10) mention that the wing camber of *E. helvum* shows more variation than in non-migrating flying foxes. O'Mara *et al.* (2019a: 1) found that wingbeat frequency has the strongest positive relationship with ODBA (overall dynamic body acceleration) and that there is small, negative correlation between ODBA and airspeed. ODBA is also decreased with increasing tailwind.

Igado *et al.* (2015: 283) studied the tongue, hard palate and buccal cavity of this bat. They found that the overal distribution of lingual papillae was the same for both sexes, but the weight and the length of the tongue was higher in females (although the difference was not significant). Also the number of ridges on the hard palate showed a

sexual dimorphism (see also the sexual dimorphism section).

The eyes of *E. helvum* contain approximately 280,000 retinal ganglion cells. The minimum angle of resolution was approximately 0.122° (ca. 4 mm at 1 m distance).

Based on an histological investigation, Mainoya and Howell (1979: 162) suggest that the neck skin patch in *E. helvum* - consisting of long and coarse hairs, and extending from the ventral surface of the neck to the shoulder area - plays a role in scent emission.

SEXUAL DIMORPHISM:
In Nigeria, Igado *et al.* (2015: 285) examined the heads of 30 adult males and females and found the males to have larger values for overal weight, weight of the head, thickness of the tongue (at the torus), width of the tongue (at the root), width of the hard palate (at the commissures of the mouth), and width of the hard palate (at the anterior region and at the posterior half). Additionally, the number of palatine ridges was higher in males (♂♂: 8.33 ± 0.577; ♀♀: 7.667 ± 0.577). The width of the tongue at the apex was similar in both species, and the width of the tongue at the torus was significantly larger in females. In a previous study, Igado *et al.* (2012: 172) already found that males had higher values for most of the craniofacial and neurometric parameters they examined. The only parameter where females had higher values was the width of the left external nares (♀♀: 5.08 ± 0.55 mm; ♂♂: 5.0 ± 0.39 mm).

MOLECULAR BIOLOGY:
DNA - Peel *et al.* (2010a) developed twenty microsatellite loci, from 142 individuals sampled from nine populations across Africa.

Teeling *et al.* (2017: 32) mention the estimated genome size for *E. helvum* to be 2.03 C, and the assembly size 1.44 Gb.

Karyotype - Mattey (1962) and Rushton (1970: 460) reported 2*n* = 34.

Protein / allozyme - Unknown.

The phosphate and oxygene binding capacity of the bat's haemoglobin was studied by Fodeke (2017).

HABITAT:
This adaptable species has been recorded from a very wide range of habitats. It is commonly found in moist and dry tropical rain forest, including evergreen forest habitats in the form of coastal (including mangrove) and riverine forest, through moist and dry savanna and mosaics of these and similar habitat types. Populations can persist in modified habitats and the species is often recorded in urban areas, such as wooded city parks (Mickleburgh *et al.*, 2008dc).

ROOST:
Roosting trees often become defoliated due to the large number of bats inhabiting them and are therefore only used on a relatively limited temporal scale (Kunz, 1996: 42). The extent of the damage caused by the bats at the Awolowo University Campus, Ile-Ife, Nigeria, was studied by Ayoade *et al.* (2012: 405), who reported that premature defoliation, loss of branches and hence reduction in canopy foliage of the host trees led to the decline in the ability of the trees to provide many environmental and social services that contribute to the quality of life in cities and to serve as effective wind barrier.

Ayensu (1974: 716) mentions that Ghanese *E. helvum* roosting in the palms do not feed on the fruits of the same palm tree, but fly to another palm to feed. In Accra, the bats roost in large mahogany and neem trees at the 37 Military Hospital, the Department of Parks and Gardens and the 37 Military Barracks (Ohemeng *et al.* (2018: 3). Lawson *et al.* (2018: 110) also found them roosting in huge silk cotton trees (*Ceiba pentandra*).

In Côte d'Ivoire, Niamien *et al.* (2017a: 70) found that *E. helvum* prefers to roost in *Hevea brasiliensis* Müll. Arg. (Pará rubber tree - Euphorbiaceae) and *Mangifera indica* L. (Mango - Anacardiaceae) trees.

For western Kenya - the only colony site in Kenya - Webala *et al.* (2012: 3) suggested that tree density was an important factor in roosting-camp selection for *E. helvum*, and the removal of roost trees could have serious ramifications on their conservation in the region. This is especially important as colonies of *E. helvum* are rarely found in protected areas, but rather within human habitation. Webala *et al.* (2014: 85) found that, besides the density of the trees, also the number of branches on a tree was an important factor when selecting a roost site.

Peel *et al.* (2017: 77) provided information on distribution, migration patterns, roost size, age and seks composition of 29 *E. helvum* roosts from nine countries across tropical Africa. They indicate (p. 89) that roosts in urban areas are in zones where hunting is discouraged due to their human usage: hospital grounds, embassies, botanical gardens, hotels, palace gardens, zoos, and military, private or corporate compounds. These zones are usually

locations where sufficient numbers of large, tall trees are present.

MIGRATION:
Cosson *et al.* (1996: 370) reported that *E. helvum* is not a year-round inhabitant of Mauritania, and is likely a migrant species. Lelant and Chenaval (2011d: 14) reported an impressive cloud consisting of thousands of animals in Nouakchott on 9 November 2010.
Hayman *et al.* (2010) who radio tracked an individual (EBOV-seropositive, see viruses below), showed typical migratory movements in this region of West Africa.
The drivers, routes and patterns of migration are unknown (Peel *et al.*, 2010a). It is unclear whether *E. helvum* has a panmictic population structure across a continous distribution that shifts according to seasonal resource availability, or whether a finer substructure and specific migration routes exist (Peel *et al.*, 2010a).

Daïnou *et al.* (2010) report that the distribution of *Milicia excelsa* (Moracea) is largely determined by the migration behaviour of the species main seed disperser *E. helvum*.

Based on stable hydrogen isotopes in the fur of 88 examined museum specimens from Sub-Saharan Africa, Ossa *et al.* (2012: 1) report that 22 % had migrated at least 250 km, with a mean distance of 860 km, and a maximum of over 2,000 km (for seven specimens).
For Zambia, Richter (2004: 70) suggests that trees of the genera *Uapaca* and *Syzygium* may be key in timing this species' migration, although she also indicates that the exact migratory cues for the species are unknown.

Isotopic data captured by Ossa Gómez (2012: 22) suggest that *E. helvum* has a core distribution around the Gulf of Guinea, with migration towards the north (Mauritania, Niger) during the months of May to September and towards the south (Tanzania, Zimbabwe, Zambia) during the months of October and December.

Pakula *et al.* (2017: 2) report on a Straw-coloured fruit bat that was observed on a ship sailing along the coast of West Africa, indicating that these bats can be transported over long distances.

DIET:
Doutre and Sarrat (1973: 280) indicated that in West Africa, *E. helvum* has an outspoken preference for (over)ripe local fruits such as mangos, guavas, figs and bananas. They never saw them eat green fruits.

Ayensu (1974) reports on *E. helvum* visiting the following plants when foraging: *Parkia clappertonia* (Dawadawa), *Ceiba pentandra* (Silk-Cotton tree or Kapop tree), *Adansonia digitata* (Baobab), *Anacardium occidentale* (Cashew tree), *Ficus umbellata* (Fig tree), *Psidium guajava* (Guava tree), *Carica papaya* (Papaya or pawpaw), and *Azadirachta indica* (Neem tree).

Daïnou *et al.* (2010) mention that *E. helvum* feeds on the fruits of the Iroko trees (*Milicia excelsa*) in Cameroon, and suggest that the migratory behaviour of *E. helvum* is the primary mechanisim (seed dispersal) for the distribution of *Milicia excelsa* (Moraceae).

In Accra (Ghana), Dechmann *et al.* (2010: 121) found that seven tracked bats mainly fed on introduced and/or cultivated fruits (primarily neem - *Azadirachta indica*, but also on papaya, mango, oil palm and banana). Only two animals ate wild figs. They also found that the core foraging area was only 3.9 ha (2.2 - 4.9 ha) and included only a few food trees. This area was on average 18.6 ± 11.8 km (max: 37 km) from their roost.
Fahr *et al.* (2015: 1) found that *E. helvum* primarily fed on fruits of introduced trees during the wet season low population numbers, whereas nectar and pollen of native trees made up the major part of their diet during the dry season when population numbers peak.

O'Brien (2011: 264) mentions that *Syzygium* is a staple food for mainland African *E. helvum*, but also refers to DeFrees and Wilson (1988: 4), who indicate that they are also fond of *Ceiba pentandra*.

Investigations by Kankam and Oduro (2011: 22) in the Bia Biosphere Reserve in Ghana showed that *Antiaris toxicaria* [bark cloth tree, antiaris, false iroko, false mvule or upas tree] fruits processed by *E. helvum* still had some fruit pulp around them, and resulted in a far less degree of germination than seeds, which were processed by monkeys and were cleared of fuit pulp.

In Congo, Kipalu (2009: 16) observed *E. helvum* visiting and/or consuming fruits of the African custard-apple (*Annona senegalensis*), Borassus palm (*Borassus aethiopum*), Heart Fruit (*Hymenocardia acida*), African peach (*Nauclea diderichii*), African corkwood tree (*Musanga cecropioides*), and (*Caloncoba welwitschii*)

Lavin *et al.* (2009: 336) report on the prevention of ISD (Iron Storage Disease of hemochromatosis) in captive *E. helvum* specimens, which can result in organ damage and possibly fatalities. The animals might succumb due to the extremely low iron

concentrations in the wild diet as compared with the diet they have in captivity.

In Abidjan, Côte d'Ivoire, Niamien *et al.* (2009: 235) reported the following fruits to be present in the bat's droppings: Anacardiaceae: *Mangifera indica* L. (Mango); Arecaceae: *Elaeis guineensis* Jacq. (African oil palm); Caricaceae: *Carica papaya* L. (Papaya); Mimosaceae: *Parkia biglobosa* (Jacq.) R.Br. ex G.Don (African locust bean) [flowers]; Moraceae: *Ficus benjamina* L. (Weeping fig, Benjamin fig), *Ficus exasperata* Vahl (Sandpaper tree, forest sandpaper fig, white fig, or sandpaper leaf tree), *Ficus lutea* Vahl (giant-leaved fig, Lagos rubbertree), *Ficus polita* Vahl (Heart-leaved fig), *Ficus* spp., *Ficus sur* Forssk (Cape fig, broom cluster fig), *Ficus umbellata* Vahl; Myrtaceae: *Psidium guajava* L. (common guava, yellow guava, lemon guava) as well as leaves of *Araucaria excelsa* (Norfolk Island Pine, Star Pine - Araucariaceae). Niamien *et al.* (2017b: 187) added the fruits of *Eugenia jambos* L. (Rose apple, Malabar plum) and *Eugenia malaccensis* L (Malay apple) (Myrtaceaea) and leaves of *Platycerium* sp. (Polypodiaceae).

In western Kenya, Webala *et al.* (2012: 12) reported that *E. helvum* helped to disperse seeds of over 32 plant species belonging to 17 families: Anacardiaceae: *Mangifera indica* (Mango); Apocynaceae: *Saba comorensis* (Bungo fruit); Canellaceae: *Warburgia ugandensis* (Uganda greenheart); Caricaceae: *Carica papaya* (Papaya); Cucurbitaceae: *Momordica foetida*; Flacourtiaceae: *Flacourtia indica* (Madagascar plum, batoka plum, flacourtia, governor's plum, Indian plum); Guttiferae: *Garcinia buchananii* (Granite Mangosteen); Lauraceae: *Persea americana* (Avocado); Malvaceae *Ceiba pentandra* (Kapok); Meliaceae: *Melia azedarach* (white cedar); Moraceae: *Ficus amadiensis*, *Ficus asperifolia*, *Ficus lutea* (Giant-leaved Fig), *Ficus natalensis* (Natal Fig), *Ficus ovalifolia*, *Ficus ovata*, *Ficus sur* (Cape Fig), *Ficus sycomorus* (Sycamore Fig), *Ficus thonningii* (Strangler Fig, Common Wild Fig, Bark-cloth Fig), *Ficus vallis-choudae*, *Morus alba* (White Mulberry); Myrtaceae: *Psidium guajava* (Apple or common guava), *Syzygium cordatum* (Water berry), *Syzygium guineense* (Water berry); Fabaceae: *Crotolaria lanchnocarpoides*; Rosaceae: *Eriobotrya japonica* (Loquat), *Rubus apetalus*; Rubiaceae: *Vangueria apiculata* (Mutugundo Fruit); Rutaceae: *Teclea nobilis* (Small fruited Teclea), *Teclea trichocarpa* (Furry-fruited Teclea), *Toddalia asiatica* (Orange climber).
Webala *et al.* (2014: 90) removed *Ceiba pentandra* from the above list and added *Allophylus ferrugineus* (Sapindaceae).

Makau (2016: xii) found it to be the most effective disperser of guava seeds in western Kenya.

Seltzer *et al.* (2013: table S2) provides an overview of the plant species found beneath bat feeding roosts. For *E. helvum* these include *Elaeis guineensis* Jacq. (African Oil palm - Arecaceae), *Magnistipula butayei* De Wild (Chrysobalanaceae), *Parinari excelsa* Sabine (Guinea Plum - Chrysobalanaceae), *Antiaris toxicaria* Lesch. (upas tree - Moraceae), *Ficus natalensis* Hochst (Natal Fig - Moraceae), *Milicia excelsa* (Welw.) C. C. Berg (African Iroko - Moraceae), *Psidium guajava* L. (apple guava - Myrtaceae), *Syzygium guineense* (Willd.) D.C. ("water-berry", Snake bean tree - Myrtaceae) and *Maesopsis eminii* Engl. (Umbrella tree - Rhamnaceae).

Corlett (2017: 13) (referring to Abedi-Lartey *et al.*, 2016) reports that gut passage times for small seeds in caged bats had a median of 72 min and a maximum of 19 h. Combined with the long commutes these bats undertake, this results in a potential dispersal distance of 10 to 100 km. However, they also indicate that the estimated median dispersal distances (for larger seeds) is about 50 m. van Toor *et al.* (2019: R238) found that the bats dispersed seeds over distances of up to 95 km, with averages ranging from 12.6 to 21.4 km, depending on colony and season. For the colony in Accra (Ghana), they calculated that during the dry season the 152,000 bats accounted for 338,000 dispersal events during a single night and produced an average seed rain of 26.2 dispersal events per km^2. During the wet season, when only 4,000 bats are present, there are only 5,500 dispersal events per night.

PREDATORS:
Mikula *et al.* (2016: 162) report that the Amur falcon (*Falco amurensis* Radde, 1863) and the Eurasian hobby (*Falco subbuteo* Linnaeus, 1758) were observed chasing *Eidolon helvum* bats in Kasanka forest, Zambia. Furthermore (supplemental data), they mention the following avian predators: Steppe eagle (*Aquila nipalensis* (Hodgson, 1833)), African hawk eagle (*Aquila spilogaster* (Bonaparte, 1850)), Common buzzard (*Buteo buteo* (Linnaeus, 1758)), Greater spotted eagle (*Clanga clanga* (Pallas, 1811)), Lesser spotted eagle (*Clanga pomarina* (Brehm, 1831)), Lanner falcon (*Falco biarmicus* Temminck, 1825) [with "*Eidolon* sp" from countries on the African continent as prey], Palm-nut vulture (*Gypohierax angolensis* (Gmelin, 1788)), White-backed vulture (*Gyps africanus* Salvadori, 1865), African fish eagle (*Haliaeetus vocifer* (Daudin, 1800)), Ayres's hawk-eagle (*Hieraaetus ayresii* Gurney, 1862), Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850),

Black kite (*Milvus migrans* (Boddaert, 1783)), Martial eagle (*Polemaetus bellicosus* (Daudin, 1800)), Crowned eagle (*Stephanoaetus coronatus* (Linnaeus, 1766)), Pied crow (*Corvus albus* Statius Muller, 1776).

POPULATION:
Structure and Density - In general this is a common species forming large colonies of thousands to even millions of individual. Hayman *et al.* (2011b: 1; 2012c: 1393) report on a colony of up to one million individuals being present in Accra, Ghana for approximately 6 months during the dry season, and Sørensen and Halberg (2001: 213) report 1.5 million fruit bats leaving the roost at sunset in the Kasanga National Park, Zambia. Racey (2004a: 2) indicates that the number bats at the same locality peak near the end of November to about 8 million (representing a total mass of 3,000 metric tons in one hectare of forest and consuming nearly 6,000 tons of fruit each night), after which they begin to fall rapidly. Within colonies they form tight clusters of up to 100 animals, although in particularly large colonies this clustering may not be so obvious. Colonies may show extreme roost-site fidelity. During migration this species disperses into small groups. There is evidence of a widespread decline (P. Racey *pers. comm.* in Mickleburgh *et al.*, 2008dc). A well-known colony in Kampala (Uganda) declined in numbers over a forty-year period from ca. 250,000 animals to 40,000 in 2007 (Monadjem *et al.*, 2010d). A trend which continued over the following years (Akite, 2009: 28-29).

Based on emergence data for one roost on Principe (10,500 - 14,200 bats), Dallimer *et al.* (2006: 50) estimated a population density between 82 and 111 bats/km^2 for the entire island.
On Annobón, Peel *et al.* (2012: 3) reported colony sized of up to 1,500 animals.
Wood *et al.* (2012: 2885) indicate that while colonies in West Africa can be very large, these in East Africa appear to be smaller and more fragmented, and also seem to be less migratory.

Magloire *et al.* (2017: 890) reported on a colony from Abidjan (Côte d'Ivoire) counting on average 180,000 bats. They found that the colony size increased from August to November (from 200,000 to 300,000), stabilized from November to February and decreased from March to July (to 12,000). These fluctuations were linked to food diversity and abundance.

For their study on the distribution of Ebola viruses, Fiorillo *et al.* (2018: 8) estimated the density of a *E. helvum* colony to be about 180 bats/km^2.

Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008dc; IUCN, 2009). 2004 - Decreasing (Mickleburgh *et al.*, 2004bh; IUCN, 2004).

LIFESPAN:
Hayman *et al.* (2012c: 1399) examined the tooth cementum annuli, and found three old specimens with an estimated age range from 13 to 15 years. They found that adult bats had a survival probability of about 0.83, whereas this was 0.43 for juveniles.

Szekely *et al.* (2015: Suppl.) reports a maximum longevity of 21.8 years.

Hayman and Peel (2016:134) calculated that the mean life expectancy estimates across the colonies they studied to be ranging from 2.3 to 6.8 years, and that individuals may live up to 30 years of age.

Peel *et al.* (2017: 85) report on regional differences in the livespan of *E. helvum*: Tanzania (Dar es Salaam: mean 6.4 yrs, max 15 yrs, n = 53 adults; Morogoro: 4.5, 8, 24), Ghana (6.0, 14, 76), Bioko (2.4, 6, 16), Príncipé (4.2, 10, 23), and São Tomé (4.8, 13, 57).

ACTIVITY AND BEHAVIOUR:
In Nigeria, *E. helvum* was reported to fly at least 24 km each night and often stopped at a number of locations between leaving the roost and arriving at the foraging site (Okon, 1974). Richter and Cumming (2006) reported flights of over 15 km for *E. helvum* in Kasanka National Park, Zambia. Richter and Cumming (2008: 172) reported that bats foraged as far as 59 km away from their roost. During their migration, one animal travelled 370 km in one night, but on average they travelled 29 km/day. The largest distance travelled by one bat, reported in that study, is 2,518 km in 149 days.

Sapir *et al.* (2014: 1) found that, in Ghana, *E. helvum* modified its flight in response to the wind vector (e.g. they decreased their airspeed in response to tailwinds so that their groundspeed remained nearly constant).

In Ghana too, Fahr *et al.* (2015: 1) found that *E. helvum* foraged locally during the wet season population low (ca. 4,000 animals traveling between 3.5 and 36.7 km) in urban areas with low tree cover. During the dry season population peak, some 150,000 individuals travelled between 24.1 and 87.9 km.

Carpenter (1986: 90) and McGuire and Guglielmo (2009: 1291) reported that the respiratory quotient for this species indicates that fat provided 77 - 92 % of the fuel during flight, and a decline in

respiratory quotient during long flights may prove that fat is indeed the only fuel source following initial carbohydrate use. Carpenter (1986: 93) also indicates that at airspeeds of 5.5 to 6.5 m/s the heart beats at a frequency of 576 - 601 beats per minute, and at airspeeds between 5.5 and 7.0 m/s, these bats take 295 to 316 breadths per minute. From flight corridor tests, Riskin *et al.* (2012: 2946) determined the average flight speed to be 4.24 ± 0.91 m/s.

In captive groups, Carter and Leffer (2015: 3) found that 6 males spent 0.52 % of their awake time with social grooming. A group consisting of six females and two castrated males did not perform any social grooming at all.

REPRODUCTION AND ONTOGENY:
For Uganda, Mutere (1967, 1968) reported pregnancies between October and February and births occurring between February and March.

For Congo, Bergmans (1979a: 165) reported two pregnant females on 6 December 1972.

Krutzsch (2000: 109) reports that various authors found that *E. helvum* has a monoestrous reproduction cycle.

Simbauni and Bernard (2001: 63) indicate that the reproductive cycle of *E. helvum* is characterized by a three-month period of delayed implantation (see also Badwaik and Rasweiler, 2000: 228; Racey and Entwistle, 2000: 383) and that the pregnancy may last for 10 months. At birth, the young has about 18.4 % of the mother's body mass (48.6 g versus 263.5 g; see Kurta and Kunz, 1987: 82).

Peel *et al.* (2013b: 7) indicate that *E. helvum* is panmictic across its continental African range, meaning that all individuals from over the entire range are potential partners. They found no indication that gene flow was more likely to occur among neighbouring populations than among distant populations (> 4,500 km). They conclude that *E. helvum*, therefore, has the largest reported panmictic unit of any mammal.

Szekely *et al.* (2015: Suppl.) report a gestation period of 275 days, and indicate that weaning occurs after 65 days. At birth the young weighs 50 g and after gestation its weight has increased to 135 g.

In their overview, Peel *et al.* (2017: 82) report the estimated start of births in different countries: Annobón (mid-September), Malawi (mid-November), Principé (November-December), Tanzania (mid-December), São Tomé and Ghana (February-March), Uganda (March-April), Bioko (mid-April). They also indicate (p. 83) that females are reproductively active between the ages of 2 and 14 years.

PARASITES:
BACTERIA
Gram-negative bacterium - Pinus and Müller (1980) and Sara (2002: 41) reported *Citrobacter freudii*, *Escherichia coli*, *Klebsiella oxytoca*, and *Klebsiella pneumoniae*.
Nowak *et al.* (2017: 6) tested three bats from the Republic of Congo of which two tested positive for *E. coli*.

Gram-positive bacterium - Akobi *et al.* (2012: 1) found that 500 faecal samples of bats at the university of Ife-Ife, Nigeria were colonized by 107 isolates of *Staphylococcus aureus* strains with genotypic characteristics that are rarely found in humans. Held *et al.* (2016: 118) refer to a report from Nigeria, indicating that *E. helvum* can be colonized by *S. schweitzeri*.

Spirochaetales - Reviewed in McCoy (1974), who listed *Borrelia* sp. Ogawa *et al.* (2015a: 143) report on the presence of at least two other spirochaete bacteria: *Leptospira borgpetersenii* and *L. kirschneri* in *E. helvum* which migrated from the Democratic Republic of the Congo to Zambia.

Bartonellae - Bacteria
Bartonella - Kosoy *et al.* (2010: 1877) and Bai and Kosoy (2012: 58) reported a prelevence of *Bartonella* spp. In *E. helvum* from Kenya of 23/88 (26.1%) cultured from blood samples. The level of *gltA* sequence identified between 16 *Bartonella* genotypes, but varied greatly, eight genotypes (sequence variants) were clustered around 4 clades (Kosoy *et al.*, 2010: 1878). Three novel *Bartonella* species have been isolated from *E. helvum* (Kosoy, 2010: 719). See also Kosoy (2010: 719) for further information.
Morse *et al.* (2012: 1719) refer to Billeter *et al.* (2012) for *Bartonella* sp. found in the bat fly *Cyclopodia greefi*, parasiting on *E. helvum* in Ghana. Billeter *et al.* (2012: 325) collected batflies (*Cyclopodia greefi greefi*) from *E. helvum* specimens from Ghana (see also Morse *et al.*, 2012), Bioko, and Annobón. Of these bat flies, 56.5 % (Ghana) to over 71 % (Bioko, Annobón) were carriers of *Bartonella* bacteria. Genetically, 65.9 % of the *Bartonella* sequences were identical or similar to sequences obtained in other studies (e.g. Kosoy *et al.*, 2010). One sequence was very similar to one obtained from a *E. helvum* specimen collected in Kenya (Billeter *et al.*, 2012: 326 - 327). Kamani *et al.* (2014: 628) tested 79 *E. helvum* specimens from Nigeria and found at least 44 testing positive for *Bartonella* DNA.

79 isolates studied by Bai *et al.* (2015: 7) revealed five genogroups (*E1* to *E5*) for *ribC*. An additional lineage (*Ew*) did not contain a fragment for *ribC*.

Mannerings *et al.* (2016: 923) report that the following *Bartonella* species were already isolated from *E. helvum* bats: *B. henselae, B. quintana, B. clarridgeiae, B. vinsonii vinsonii, B. elizabethae*, and *Bartonella* strain E1–105.

Olatimehin *et al.* (2018: 3) found *Staphylococcus aureus*, *Staphylococcus schweitzeri* and *Staphylococcus argenteus* in feacal samples from bats at the Obafemi Awolowo University, Ile-Ife, Nigeria.

HAEMOSPORIDIA
Boundenga *et al.* (2018: 10581) reported 1 out of six examined *E. helvum* to be infected by *Hepatocystis* (16.67%).
In a study performed in Ibadan (Nigeria), Li *et al.* (2019: 21) found six out of 109 *E. helvum* specimens (5.5%) infected with *Cryptosporidum* sp. and 16 (14.7%) infected by *Enterocytozoon bieneusi*; none were infected by *Giardia duodenalis*.

ACARI
Laelapidae: Taufflieb (1962: 112) indicated that *Chelanyssus aethiopious* Hirst, 1921 was found once on a female *Eidolon helvum*, but this was never confirmed by subsequent findings. He considered this one time occurrence as accidental.
Sarcoptidae: *Nycteridocoptes pteropodi* Rodhain and Gedoelst, 1923 was reported by Fain (1958: 236) from *E. helvum* specimens from Astrida (=Butare), Rwanda.
Spinturnicidae: Taufflieb (1962: 112) reported *Meristaspis kenyaensis* Radford, 1947.

HEMIPTERA
Cimicidae: Haeselbarth *et al.* (1966: 8) recorded *Afrocimex constrictus* Ferris & Usinger, 1957 associated with *E. helvum* near Ruiru, Kenya.

DIPTERA
Nycteribiidae: *Penicillidia fulvida* (Bigot, 1885) (see Haeselbarth *et al.*, 1966: 114). *Eucampsipoda africanum* Theodor, 1955, widely distributed over the Ethiopian region and recorded from localities in Senegal to the Sudan and southwards to the Cape (Haeselbarth *et al.*, 1966: 115). *Dipseliopoda setosa* Theodor, 1955 from Kenya and Tanzania (Haeselbarth *et al.*, 1966: 116). *C. greeffi* was originally described by Karsch (1884) from an *E. helvum* specimen from São Tomé, and the adjacent islet of Rojas (see Urich *et al.*, 1922: 471). Urich *et al.* (1922) furthermore mentioned additional specimens from this bat fly, reported by Rodhain and Bequaert from *E. helvum* specimens from Leopoldville [= Kinshasa], DRC. *Cyclopodia greeffi* are found in a belt across central Africa, between lat. 10° south and north, while in West Africa it occurs further north up to lat. 20° (Haeselbarth *et al.*, 1966: 117). Billeter *et al.* (2012: 325) collected bat flies (*Cyclopodia greefi greefi*) from *E. helvum* specimens from Ghana (see also Morse *et al.*, 2012), Bioko, and Annobón (see above for bacteria results from this study). Szentiványi *et al.* (2019: Suppl.) indicated that these bat flies were also carrying the arthropod *Eupelmus urichi* (on São Tomé) and *Bartonella* bacteria (in Ghana).

SIPHONAPTERA
Ischnopsyllidae: *Thaumapsylla breviceps* Rothschild, 1907, described from Kenya and the DRC (Haeselbarth *et al.*, 1966: 186). *Thaumapsylla dina* Jordan, 1937 from the mountains of the Ruwenzori, Congo and Kenya (Haeselbarth *et al.*, 1966: 186). *Lagaropsylla consularis* Smit, 1957, traditional host being molossid bats, but it has also been recorded from this taxon (Haeselbarth *et al.*, 1966: 190).
Teinocoptidae: *Teinocoptes eidoloni* Fain, 1959 was reported by Fain (1967: 367) from *E. helvum* from Astrida (=Butare), Rwanda.

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Eidolon helvum*: Adenoviruses, Astroviruses, Coronaviruses, Flaviviruses, Paramyxoviruses and Polyomavirus.

Willoughby *et al.* (2017: Suppl.) report the following viruses: Bundibugyo ebolavirus, Bunyamwera orthobunyavirus, Entebbe bat virus, Hendra henipavirus, Ife virus, Influenza A virus, Lagos bat lyssavirus, Mokola lyssavirus, Nipah henipavirus, Ntaya virus, Sudan ebolavirus, Tai forest ebolavirus, Usutu virus, West Caucasian bat lyssavirus, West Nile virus, Yellow fever virus, Zaire ebolavirus, Zika virus.

Yinda *et al.* (2016: 6) identified 5 divergent novel bat RVA strains from faeces collected in Cameroon. Four of these were genetically similar to each other and the last one was related to the Kenyan bat strain. They did not notice any diarrhea or other obvious signs of sickness in the bats.

Peel (2018: 1) estimated that maternally-derived immunity to Lagos bat virus and African henipavirus has a mean duration of about six months, which is much less than the acquired immunity for these viruses: 12 and 4 years respectively.

Yinda *et al.* (2018: 2) pooled 87 fecal samples of *Eidolon helvum* and *Epomophorus gambianus* from Cameroon into 25 groups. One group containing fecal samples of *E. gambianus* only yielded mainly phage viral reads, leading them to conclude that all the eukaryotic viral reads they encountered were from *E. helvum*. The viruses they found belonged to the following families: Alphaflexiviridae, Astroviridae, Baculoviridae, Caliciviridae, Caulimoviridae, Circoviridae, Coronaviridae, Dicistroviridae, Geminiviridae, Hepeviridae, Herpesviridae, Iflaviridae, Marnaviridae, Nodaviridae, Other Picornavirales, Papillomaviridae, Partitiviridae, Parvoviridae, Picobirnaviridae, Picornaviridae, Polydnaviridae, Reoviridae, Retroviridae, Secoviridae, Tombusviridae, Totiviridae, Tymoviridae, Unclassified eukaryotic virus, and Virgaviridae. Most of the identified partitiviruses and densoviruses constitute putative novel genera in their respective families.

In bats from Saudi Arabia, Mishra *et al.* (2019: 5) found evidence for the following viruses: Bat astrovirus, Bat papilloma virus, Bat Coronavirus, Bat polyomavirus, Me Hepe-Astro virus, Parechovirus, Rotavirus, Sapovirus, Teschovirus,

Adenoviridae
Sequences of *Eidolon helvum* adenovirus 1 attributed to the genus *Mastadenovirus* were found by Baker *et al.* (2013a: 98) in samples from bats from Ghana.
Conrardy *et al.* (2014) tested 9 bats from Kenya, none of which tested positive.
Ogawa *et al.* (2017: 2) isolated a new adenovirus from Zambian bats: *E. helvum* adenovirus 06-106 - EhAdV 06-106, which they also tentatively called: *Bat mastadenovirus H*.

Caliciviridae
Sapovirus (SaV)
From Cameroonian bats, Yinda *et al.* (2017a: 2) identified the complete genome of six highly divergent SaVs and one partial SaV, which probably represent two novel genogroups, that are only distantly related to any other known SaVs.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, six individuals for antibody to SARS-CoV in sera from Bandundu Province, DRC, none were found to be positive. In February 2008, Pfefferle *et al.* (2009) tested 212 fecal samples from bats from Ghana and all were negative for coronavirus (CoV) RNA. Tong *et al.* (2009) found 6/10 bats collected in 2006 positive for coronavirus RNA in Kenya (Kenya bat coronavirus BtKY20, Kenya bat coronavirus BtKY23, Kenya bat coronavirus BtKY24). 21 % (38 out of 181) of the Kenyan bats tested by Tao *et al.* (2017: 3) were positive for coronaviruses. In Nigeria during June 2008, Quan *et al.* (2010) screened the gastrointestinal tissue for the presence of coronaviruses by PCRs, none tested positive.
Anthony *et al.* (2017b: Suppl.) mention beta-coronaviruses Eidolon_bat_CoV and Kenya_CoV_BtKY56.
Leopardi *et al.* (2016: 575) report on the first occurrence of CoV outside of Kenya: Nigeria.

Filoviridae - Filoviruses
Olival and Hayman (2014: 1770) found that *E. helvum* has a high seroprevalence of antibodies against several RNA viruses, but not filoviruses, especially when compared to other species in the same locations. They suggest that the migratory lifestyle of this species might prevent filovirus cirulation. Peterson *et al.* (2007: 1547) indicate that the geographic distribution of *E. helvum* covers the entire distribution range of both Ebola and Marburg viruses. Hayman (2015: 6) points to the single, highly synchronous birth pulse per year, which prevents persistence of the virus in *E. helvum*.

Ebolavirus
Hayman *et al.* (2010) tested the blood of 262 individuals from Ghana for Ebola virus using indirect flurescent tests for antibodies against EBOV subtype Zaire [= ZEBOV], one positive was found in a pregnant female. The positive reactivity for EBOV was confirmed using western blot against a recombinant nucleocapsid protein of EBOV-Zaire (Hayman *et al.*, 2010).
Funk and Piot (2014: 2) erroneously refer to Gire *et al.* (2014), who should have claimed that the 2014 Ebola outbreak in West Africa probably originated from a child infected by a straw-coloured fruit bat. However, as indicated by Jakob Fahr in the discussion following this paper, Gire *et al* (2014) never mention bats. The reference was then changed to Baize *et al.* (2014), but that paper (p. 1424) only refers to the "usual suspects": *Hypsignatus monstrosus, Epomops franqueti* and *Myonycteris torquata*. To date, there is no proof that the West African Ebola outbreak is directly related to bats.
In Zambia, Ogawa *et al.* (2015b: "1") found some serum samples that showed distinct specificity for Reston ebolavirus, which has thus far been found only in Asia.
Studying *E. helvum* genes, Ng *et al.* (2015: 2) found that the *NCP1* gene, which encodes a protein that mammals need in order to move cholesterol within their cells, also turns out to be a receptor that the filoviruses must bind to before they can infect the cells.

Marburgvirus
Towner *et al.* (2007) tested 35 individuals from Gabon for Marburg virus RNA by conventional and real-time RT-PCR and 33 individuals for anti-Marburg virus IgG antibodies by ELISA; no positives were found. Hayman *et al.* (2010) tested the blood of 262 individuals from Ghana for Marburg virus using indirect flurescent tests for antibodies against MARV subtype Leiden, no positives were found.

Flaviviridae
Flavivirus - In Uganda, Kading *et al.* (2018: 3) found neutralizing antibodies against West Nile virus (WNV) and non-specific Flaviviruses.
Malmlov *et al.* (2019: 3) refer to Simpson *et al.* (1968) who experimentally inoculated three *E. helvum* specimens with Zika virus, of which two became viremic and seroconverted.

Pegivirus (BPgv) - 0 out of 8 bats from Cameroon, 1 out of 17 from the Democratic Republic of the Congo, 0 out of 11 from Kenya and 1 out of 50 animals from Nigeria examined by Quan *et al.* (2013: Table S5) were infected by clade H type *Pegivirus* (overal 2.3 %). For the same bats examined, they also found 1, 0, 1, and 5 specimens infected by clade K type *Pegivirus*.

Herpesviridae
Alphaherpesvirinae
Simplexvirus
Dak An Y 7 – (3 isolates) Cameroon, 1971, isolated from pooled organs (Razafindratsimandresy *et al.*, 2009).

Betaherpesvirinae
Eidolon helvum herpesvirus 1 and 3 - Baker *et al.* (2013a: 96) identified 539 sequences related to herpesviruses, primarily from throat samples: 366 belonging to *betaherpesvirinae*.

Gammaherpesvirinae
Eidolon helvum herpesvirus 2 - Baker *et al.* (2013a: 96) identified 539 sequences related to herpesviruses, primarily from throat samples: 171 to *gammaherpesvirinae*.

Nairoviridae
Orthonairovirus
Of the 167 specimens from Ghana tested by Müller *et al.* (2016: 3), 1 was positive for Crimean Congo hemorrhagic fever virus (CCHFV)

Orthomyxoviridae
Freidl *et al.* (2015) conducted serological studies on 100 *E. helvum* serum samples collected in Ghana in 2009/10. About 30% of the screened animals showed serological evidence to avian influenza subtype H9. According to Brunotte *et al.* (2016: 117), this suggests that bats can be naturally infected with classical IAV, although they did not find any evidence to support this hypothesis.

Papillomaviridae (PV)
Baker *et al.* (2013a: 97) found 408 sequences belonging to multiple papillomaviruses, of which two represented new forms.
García-Pérez *et al.* (2013: 51) cloned and sequenced the complete genome of a novel PV, EhelPV1, isolated from hair bulbs from a captive straw-colored fruit bat.
Mengual-Chuliá *et al.* (2012) reported on PV sequences from hair follicles of captive bats.

Paramyxoviridae - Paramyxoviruses
Nine individuals from Kenya were tested for paramyxoviruses by Conrardy *et al.* (2014). All nine were negative for paramyxovirus RNA.
Paramyxovirinae
Henipavirus
Hayman *et al.* (2008b) detected antibodies to both Nipah (NiV - 39 %) and Hendra (HeV - 22 %) [both members of the genus *Henipavirus* (see Hayman *et al.* (2011b: 1)] in bats collected in Ghana in 2007. Peel *et al.* (2012: 2) found antibodies against these viruses in bats on Annobón.
Drexler *et al.* (2009) detected henipavirus RNA and three novel viruses were identified. Drexler *et al.* (2012a: Suppl. Table 1) indicated that 42 out of 722 (5.8 %) bats collected in Ghana, the Central African Republic and Gabon tested positive for *Henipavirus*. 4.0 % (29) tested positive for *Rubulavirus* and 1.8 % (13) for *Pneumovirus*.
Pernet *et al.* (2014: 3) screened 44 Cameroonian bat serum samples for anti-NiV cross-neutralizing activity and found 21 (ca. 48 %) testing positive.
Baker *et al.* (2012: 1348) describe two new Rubulaviruses: Achimota virus 1 (AchPV1) and Achimota virus 2 (AchPV2). They developed specific serological assays for these two viruses and found evidence of infection by both in *E. helvum* across sub-Saharan Africa and on islands in the Gulf of Guinea.
Baker *et al.* (2011b: 855) indicate that a co-evolutionary relationship might exist between Chiroptera and *Paramyxoviridae*, based on an analysis of urine samples of *E. helvum* from Accra, Ghana.
Weiss *et al.* (2012a: suppl. 1) report on *Paramyxovirinae* sequences obtained from liver and urine samples from bats collected near Brazzaville (Republic of Congo), organs of one individual presented with two diverse paramyxovirus sequences.
From Zambia, Muleya *et al.* (2013: 611) report five new paramyxoviruses closely related to the genus *Henipavirus* and two related to the unclassified Bat

paramyxoviruses from Ghana and Congo Brazzaville.
With the use of a seroneutralization assay, Pernet *et al.* (2014) found cross-neutralizing antibodies to Nipah virus in 48 % of sampled *E. helvum* bats collected in Cameroon.
Mbu'u *et al.* (2019: "1") mention the presence of Ghanaian bat henipavirus (designated Ghana virus - GhV) in Ghana.

Rubulavirus
Achimota virus: Baker *et al.* (2012) describes two new paramyxoviruses isolated from *E. helvum*: Achimota virus 1 (AchPV1) and Achimota virus 2 (AchPV2).
Several rubulaviruses and rubula-related viruses were reported in several *E. helvum* individuals sampled from several African countries (Drexler *et al.*, 2012). Some of these sequences proved to be closely-related to human mumps virus and simian virus 5.

Kohl *et al.* (2018: 11) indicate that a number of yet unknown rubulaviruses might be present in these bats.

Pneumovirinae
Pneumovirus
Several individuals sampled in Ghana tested positive for a pneumovirus closely related to pneumonia virus of mice, and grouped in a sister clade to human respiratory syncytial virus.

Parvoviridae
Canuti *et al.* (2011: 3) report a new virus (Eidolon-helvum-bat-Parvovirus-1 [Eh-BtPV-1]) from bats captured in Kumasi, Ghana. Baker *et al.* (2013a: 100) found 10 sequences, belonging to both the mammalian-infecting Parvovirinae (related to the genera *Erythrovirus* and *Betaparvovirus*) and the invertebrate-infecting Densovirinae.

Peribunyaviridae
Orthobunyavirus
Fagre and Kading (2019: 4) report that Bunyamwera virus (BUNV) was isolated from this bat or that molecular and serologic evidence of it was found.

Picornaviridae
Eidolon-helvum-Picornavirus-1 contigs related to the genus *Kobuvirus* from 6 urine samples and one contig from a lung sample, and related to the genus *Enterovirus*, were reported by Baker *et al.* (2013a: 100).

In the faeces of Cameroonian bats, Yinda *et al.* (2017b: 3) identified 11 new picorna-like viruses of which some might represent new families [*] within the order Picornavirales: bat sapelovirus, bat kunsagivirus and bat crohivirus, bat iflavirus [Iflaviridae], bat posalivirus [Posa-like virus; *], bat fisalivirus [Fisa-like virus; *], bat cripavirus [Dicistroviridae], bat felisavirus [fesa-like virus; *], bat dicibavirus [bat dicistrovirus; *] and bat badiciviruses 1 and 2 [anagram from bat dicistrovirus; *].

Polyomaviridae
Baker *et al.* (2013a: 100) assembled a sequence from a throat sample. Eckerle *et al.* (2014: 4) mention the presence of several, unassigned viruses of this family. Conrardy *et al.* (2014: 259) reported that one of the nine specimens tested in the Vihiga district (Kenya) tested positive for *Polyomavirus*. Tao *et al.* (2012) identified two novel species termed *Eidolon* PyV1 and 2, from Kenya in 2006.

Poxviridae
38 contigs related to *Molluscum contagiosum* [MC]), a human contagion were reported by Baker *et al.* (2013a: 99). Baker and Murcia (2014: 1567) indicate that the bats do not show any clinical signs.

Reoviridae - Rotaviruses
Rotavirus
Esona *et al.* (2010: 1844) reported genetic characterization of a bat rotavirus (Bat/KE4852/07) detected in the feces of *E. helvum*, which is a novel *Rotavirus A* species. This isolate contained a VP4 gene that probably originated from a human rotavirus, an NSP4 gene of likely human or animal rotavirus origin, and otherwise a unique genetic background requiring establishment of new genotypes for at least 7 genes (Esona *et al.*, 2010: 1845).
Sasaki *et al.* (2018: 104) compared genome segments of RVA from bats from Cameroon and Zambia and found these to be 97 to 99 % identical, suggesting that *E. helvum* is capable of dissimating RVA across long distances.

Orbivirus
Ife virus - In Nigeria 1971, the virus was isolated from the salivary glands, brain and blood (Kemp *et al.*, 1988). Also reported by de Jong *et al.* (2011: 11). Fagre *et al.* (2019: 2) indicated that this virus was also found in bats from Cameroon and the Central African Republic.

Retroviridae
Baker *et al.* (2013a: 100) reported on 292 sequences related to retroviridae, that were recovered from lung samples.

Rhabdoviridae
No rhabdoviruses were detected from 9 *E. helvum* bats sampled in Kenya Conrardy *et al.* (2014).

Lyssavirus - Rabies related viruses
2006 in Nigeria, Dzikwi *et al.* (2010: 269) tested 223 brains by direct fluorescent antibody (DFA) and mouse inoculation test (MIT) which tested negative for lyssavirus antigens. In Nigeria during June 2008, Quan *et al.* (2010) did not detect any lyssavirus-specific antigens from the brains by use of direct fluroescent antibody testing.

Lagos bat virus (LBV) - Isolated in Nigeria (Boulger and Porterfield, 1958: 424 [1st detection]; Shope *et al.*, 1970; Kemp, 1975: 616; Hayman *et al.*, 2011a: 88; Fisher *et al.*, 2018: 242) and Senegal (Institute Pasteur, 1985; Hayman *et al.*, 2011a: 88). Antibodies detected in Ghana (Hayman *et al.*, 2008a); Kenya (Kuzmin *et al.*, 2008a; Kuzmin *et al.*, 2011b: 1467; Nadin-Davis *et al.*, 2011: 238), Annobón (Peel *et al.*, 2012: 3). In 2006, 105 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), where 24 tested positive (22.86 %) for neutralizing antibodies (Dzikwi *et al.*, 2010: 269).
Hayman *et al.* (2010), who found an individual which tested positive for EBOV, also tested positive for LBV, but no antibodies against Mokola (MOKV).
Restif *et al.* (2012: 1091) report on how emerging infectious disease research can be undertaken when little prior knowledge exists, based on the occurrence of LBV in a population of *E. helvum* in Accra, Ghana.
Freuling *et al.* (2015: 44) point out that Lagos bat viruses belong to two phylogenetic lineages and that the presence of neutralizing antibodies might be missed if the test is performed with the most commonly used isolate.
Kalemba *et al.* (2017: 409) reported that out of 18 bats examined from the DRC, six tested positive for lyssavirus neutralizing antibodies (LBV).
Hayman *et al.* (2018: 1) constructed a model to determine how host traits (e.g. maternally-derived antibodies, seasonal birthing) and viral traits (e.g. incubation periods) interact to allow LBV viruses to persist within bat populations.

Mokola virus (MOKV) - King *et al.* (1990 168) found monoclonal antibodies for MOKV in bats from Nigeria and Senegal.
In 2006, 105 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), where 2 tested positive (1.9 %) for neutralizing antibodies (Dzikwi *et al.*, 2010: 269).

Shimoni bat virus (SHIBV) - Kuzmin *et al.* (2011b: 1467) found 2 individuals testing seropositive on 9 animals tested between 2009 and 2010 in Kenya.
Kalemba *et al.* (2017: 409) found four out of 19 bats examined from the DRC tested positive for SHIBV neutralizing antibodies.

Horton *et al.* (2014: Table S1) tested 8 Kenyan *E. helvum* specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

Kumasi Rhabdovirus (KRV) - This new virus was detected by Binger *et al.* (2015: 4588) in the spleen and sera of *E. helvum* specimens from Kumasi in Ghana.

By means of Capture-Mark-Recapture (CMR) procedures, Hayman *et al.* (2012b: 2163) found that survival probabilities for lyssavirus seronegative and seropositive *Eidolon helvum* in Ghana were not significantly different.
King *et al.* (1990: 168) reported monoclonal antibodies for Duvenhage and Denmark bat virus from bats from Nigeria and Senegal.

???:
Kemp (1975: 616 - 617) also mentions IbAn 67204 being isolated on 9 April 1971 from this species in Nigeria, and Herpes (YV6) virus in April 1971 and Dakar YV 177 in May 1971, both latter in specimens from Cameroon.

In their overview table, Maganga *et al.* (2014a: 8) report the following viruses were found on *E. helvum*: Lagos bat virus (LBV), Mokola virus, West Caucasian (WC) virus, Zaire Ebola virus (ZEBOV), Ife virus (Orbivirus), Hendra virus, Nipah virus (NPHV), Rubulavirus, Coronavirus, Rotavirus related, Simplexvirus, Parvovirus.

Peel *et al.* (2016) examined 2,827 bats from 9 countries over 8 years and focused on four viruses: Lagos bat virus (LBV), African henipaviruses, Achimota virus 1 (AchPV1) and Achimota virus 2 (AchPV2).

The genomic mining study by Cui and Wang (2015: 5793) revealed bornaviral elements built in the genome of *E. helvum*

UTILISATION:
In Ghana *E. helvum* is a food source (Hayman *et al.*, 2008a). *Eidolon helvum* is the most heavily harvested bat for bushmeat in West and Central Africa, and this is believed to be a major factor in reported population declines (P. Racey *pers. comm.* in Mickleburgh *et al.*, 2008dc). Kamins *et al.* (2014) investigated the sociological characteristics of communities who interact with bats (specifically *E. helvum* in Ghana) to assess their attitudes and perceptions regarding bats and disease. Ohemeng *et al.* (2017: 184) indicated that local (Ghanese) people prefered eating *E.*

helvum over other bat species, because of their delicious taste.

In Benin, Dougnon *et al.* (2012: 85 - 86) found an average carcass weight of 89.27 ± 11.41 g (about 43 % of the body mass). The quality of the meat was evaluated (for 100g meat): Total mineral matter: 13.2 g, Lipids: 23.11 g, Protein: 56.8 g, Calcium: 55 mg, Sodium: 39 mg, Phosphore: 83 mg and Potassium: 75 mg, making it more fatty than *E. gambianus* meat (Lipids: 13.36 g). The authors suggest that the higher fat content is a result of the longer foraging distance covered by *E. helvum*.

See also threats section for additional information on utilization.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Principé, Senegal, Sierra Leone, South Africa, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

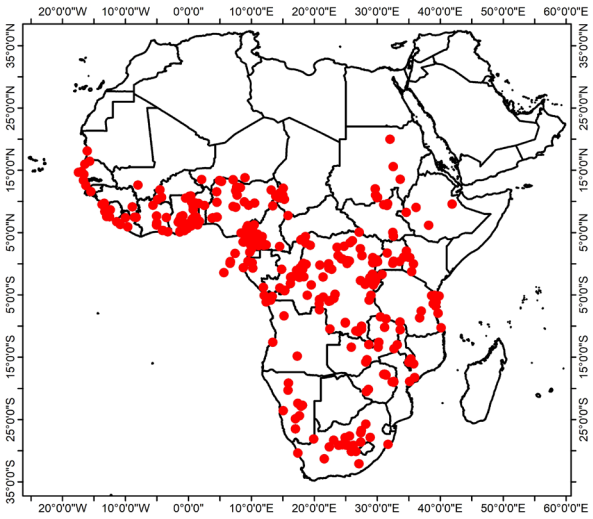


Figure 6. Distribution of *Eidolon helvum*

Eidolon helvum helvum (Kerr, 1792)

*1792. *Vespertilio vampyrus helvus* Kerr, in: Linnaeus, Animal Kingdom, 1 (1): xvii, 91. Publication date: February 1792. Type locality: Senegal: "Senegal". - Comments: Type locality fixed by Andersen (1907a: 504); see Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1), Harrison and Bates (1991). Andersen (1912b: viii) indicates that the type was once in the Museum Leverianum, but is probably no longer in existence. - Etymology: From the Latin "helvus" (=dun-coloured), referring to the straw colour on their shoulders; the back, rump and hind limbs are normally various shades of brown (see DeFrees and Wilson, 1988: 4; Taylor, 2005). Lanza *et al.* (2015: 27) translate "helvus" to "dull-yellow".

1803. *Pteropus stramineus* E. Geoffroy Saint-Hilaire, Catalogue des Mammifères du Muséum national d'Histoire naturelle, Paris, 48. Type locality: Sudan: Sennaar [15 35 N 33 38 E, 425 m] [Goto Description]. - Comments: Harrison (1964a: 44) refers to Sherborn to indicate that the 1803 paper has never been published. The next available date for this name is 1810: Ann. Mus. Nat. Hist., Paris, 15: 95.
Andersen (1912b: 12) mentions that the description in Geoffroy's 1813 paper was based on three specimens in the Paris Museum (nos 92 and 93 from an unknown locality, presented by Professor Fourcroy, and no 94 "de la collection du Stathouder") but these could not be traced by him. The description in the 1810 paper was based on two specimens, one believed to be from Timor (Péron and Lesueur), and the other without details (and possibly one of the cotypes of the 1803 description). Andersen (1912b: 12) also pointed out that "The 'Cat. Mamm. Mus. Nation. d'Hist. Nat.' (1803) was suppressed by Geoffroy himself, and the name *Pteropus stramineus* is therefore usually dated from his well-known paper in Ann. Mus. d'Hist. Nat. XV. (1810)."
Originally, the type locality was not specified, but it was subsequently fixed as Senaar by Koopman (1975: 357): see Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1).
Harrison (1964a: 44) indicates that the type locality has been fixed by Temminck (1837b, Mon. Mamm. 2: 84), and Andersen (1912b: 12) mentions that the original type locality was "Timor" (based on the 1810 description), but that Temminck already corrected this to "Africa".

1809. *Vespertilio caninus var. b* Goldfuss, Vergl. Naturbeschr., Säugethiere, 98. - Comments: Preoccupied by *V. caninus* Blumenbach, 1797: see Meester *et al.* (1986: 28).

1815. *Pteropus flavus* Illiger, Abh. Ak. Berlin, 90, 98. - Comments: *Nomen nudum* (see Andersen, 1912b: 809).

1862. *Pterocyon paleaceus* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1861: 423. Type locality: Sudan: Sennaar [15 35 N 33 38 E, 425 m]. - Comments: Type locality originally as "Africa", but restricted to Senaar by Matschie (1899b: 62): see Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1).

1862. *Pteropus mollipilosus* H. Allen, Proc. Acad. nat. Sci. Philad., 13 (11): 159 (for 1861). Type locality: Gabon: "Gabon" [Goto Description]. - Comments: Originally mentioned as "Western Africa" by Allen (1861: 160), but restricted to Gabon (see Andersen, 1912b: 12). The type specimen was collected by Mr. Duchaillu, and is presumably in the Philadelphia Museum (see Andersen, 1912b: 12).

1865. *Pteropus palmarum* Heuglin, Leopoldina (Halle), 5 (3 & 4): 34. Publication date: June 1865. Type locality: Sudan: Sennaar [15 35 N 33 38 E, 425 m]. - Comments: Type locality originally as "Middle and Upper White Nile and between Senaar and Fazogli along the Blue Nile", but subsequently fixed as Senaar by Koopman (1975: 360): see Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1). Andersen (1912b: 12) mentions that the type is probably no longer in existence.

1866. *Xantharpyia leucomelas* Fitzinger, in: Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 544. Type locality: Sudan: Kordofan province: Bahr-el-Azrak, Bahr-el-Abiad: Sennaar [15 35 N 33 38 E, 425 m]. - Comments: Type locality originally as "Upper Nile lands", but subsequently fixed to Senaar by Koopman (1975): see Meester *et al.* (1986: 28), DeFrees and Wilson (1988: 1). Andersen (1912b: 13) mentions that the specimen on which Fitzinger based himself is probably in the Munich Museum, and that a specimen belonging to the same series as the type is in the BM (1847.5.27.28; ad ♀; SK; purchased Parreys, from Sennaar).

1881. *Leiponyx büttikoferi* Jentink, Notes Leyden Mus., 3: 59, 60. Publication date: April 1881. Type locality: Liberia: St. Paul's river: Millsburg [06 33 N 10 38 W] [Goto Description]. - Comments: Type in RMNH.

1906. *R[oussettus (Xantharpyia)] buettikoferi:* Johnston, Liberia, Volume II: 690. - Comments: Bakwo Fils (2012: 690 - footnote) indicates that this name refers to the "very doubtfull *Leiponyx buettikoferi*" from Jentink. (Name Combination, Lapsus)

1906. *Roussettus buttikoferi:* Johnston, Liberia, Volume II: 690 - footnote. (Name Combination)

1953. *Pterocyon palaeceus:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 44. - Comments: Lapsus: see Meester *et al.* (1986: 28). (Lapsus)

1975. *Pterocyon palaceus:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 357. - Comments: Lapsus: see Meester *et al.* (1986: 28). (Lapsus)

2000. *Eidolon helvum annobonensis* Juste, Ibáñez and Machordom, Biol. J. Linn. Soc., 71: 373. Type locality: Equatorial Guinea: Annobón Island [01 24 N 05 38 E].

? *Eidolon helvum helvum:* (Current Combination)

GENERAL DISTRIBUTION:
See species, with the exception of SW Arabia.

†Subfamily Propottininae Butler, 1984

*1984. *Propottininae* Butler, Palaeovert., 14 (3): 118, 175. Publication date: 15 November 1984 [Goto Description]. - Comments: Recognized as a subfamily. (Current Combination)

TAXONOMY:
Currently recognized genera of Propottininae: *Propotto* Butler 1984.

†Genus ***Propotto*** Simpson, 1967

*1967. *Propotto* Simpson, Bull. Mus. comp. Zool., 136: 50 [Goto Description]. - Etymology: Meant to imply an antecedent but not necessarily ancestral relative of the potto. Although the valid generic name of the potto too is probably *Perodicticus*, *Potto* has also been used. The valid specific name of the potto is probably *Perodicticus potto* although several other names are also in use (Simpson, 1967). (Current Combination)

TAXONOMY:
Simpson (1967) originally described this as a new genus of primates, within the Lorisiforms. Walker (1969) reexamining the type, noted that it was not a Lorisiform, but rather a fruit bat.

Butler (1984: 178) believed it to be unlikely that *Propotto* is ancestral to any of the living Pteropodid genera.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
If *Archaeopteropus*, from the Oligocene of Italy, is removed from the Megachiroptera following Russell and Sigé (1970), *Propotto* becomes the oldest known member of the suborder (Butler, 1978).

†***Propotto leakeyi*** Simpson, 1967

*1967. *Propotto leakeyi* Simpson, Bull. Mus. comp. Zool., 136: 50 [Goto Description]. - Etymology: Named for Dr. Louis Seymour Bazett Leakey, "in gratitude and admiration" (Simpson, 1967). (Current Combination)

TAXONOMY:
Simpson (1967) originally described this as a new species of primate, within the Lorisiforms. Walker (1969) reexamining the type, noted that it was not a primate, but rather a fruit bat.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Early Miocene, Songhor (Simpson, 1967; Walker, 1969), probably Rusinga (Butler, 1978).

Subfamily Pteropodinae Gray, 1821

*1821. *Pteropodinae* Gray, London Med. Repos., 15: 299. (Current Combination)
1831. *Pteropodina* Bonaparte. - Comments: Introduced as tribe in the Vespertilionidae. Recognized as subtribe by Koopman and Jones (1970: 23) (see Jackson and Groves (2015: 236).
1835. *Pteropodae* Bonaparte, Iconogr. Fauna Ital. (Fascicolo 14 under *Dysopes cestonii*, second of four unnumbered pages). - Comments: Introduced as family (see Jackson and Groves, 2015: 236).
1866. *Epomophorina* Gray, Proc. zool. Soc. Lond., 1866, I (v): 65. Publication date: May 1866. - Comments: Not included in Simmons (2005) since it was not proposed as family name, but as a subdivision within the Pteropodidae (Simmons, pers. comm.).
1891. *Pteropodinae:* Flower and Lydekker, Mammals Living and Extinct, 650. - Comments: Proposed as subfamily. Originally included the genera *Epomophorus* E. Bennett, 1836; *Pteropus* Brisson, 1762; *Xantharpyia* J. Gray, 1843 [= *Rousettus* J. Gray, 1821]; *Boneia* Jentink, 1879 [= *Rousettus* J. Gray, 1821]; *Cynopterus* F. Cuvier, 1824 [1821-1825]; *Harpyia* Illiger, 1811 [= *Nyctimene* Borkhausen, 1797]; *Cephalotes* É. Geoffroy, 1810 [= *Nyctimene* Borkhausen, 1797]; *Pteralopex* Thomas, 1888 (see Jackson and Groves, 2015: 236).
1897. *Pteropinae* Trouessart, Cat. Mamm. Viv. Foss., 1: v, 77. - Comments: Bergmans (1997: 64) assigned it to Gray, 1821. Jackson and Groves (2015: 236) assigned it to Trouessart, 1897, but also mention a misspelling by Simpson (1945).
1912. *Cynopterinae* K. Andersen, Cat. Chiroptera Brit. Mus. Publication date: 23 March 1912. - Comments: Bergmans (1997: 69) considers this a valid subfamily in which he includes the genera *Cynopterus, Ptenochirus, Megaerops, Dyacopterus, Balionycteris, Chironax, Thoopterus, Sphaerias, Aethalops, Penthetor, Latidens, Alionycteris, Otopteropus, Haplonycteris*.
1970. *Cynopterini* Koopman and J.K. Jones Jr., Classification of Bats. - Comments: Not included in Simmons (2005) since it was not proposed as family name, but as a subdivision within the Pteropodidae (Simmons, pers. comm.).

TAXONOMY:
Currently recognized genera of Pteropodinae: *Acerodon* Jourdan, 1837, *Desmalopex* Miller, 1907, *Macroglossus* F. Cuvier, 1824, *Melonycteris* Dobson, 1877, *Mirimiri* Helgen, 2005, *Neopteryx* Hayman, 1946, *Notopteris* Gray, 1859, *Pteralopex* Thomas, 1888, ***Pteropus*** Brisson, 1762,

Styloctenium Matschie, 1899, *Syconycteris* Matschie, 1899.

Genus ***Pteropus*** Brisson, 1762

*1762. *Pteropus* Brisson, Regnum Animale, 2nd ed: 13, 53 [Goto Description]. - Comments: Type species: *Vespertilio vampirus niger* Kerr, 1792. Allen (1939a: 59), Corbet and Hill (1992: 57), and Simmons (2005) mention Brisson, 1762 [Règne Animal, ed. 2, pp. 13, 153] as author. This name was long time considered to be "not available" (see Hopwood, 1947). However, Opinion 1894 (ICZN, 1998: 64) ruled that the name (and authorship) is available.

Not *Pteropus* Thunberg, 1815 (Insecta, Phasmatodea, Phylliidae - leaf insects); not *Pteropus* Jennings, 1828 (Aves, Gruiformes, Heliornithidae); not *Pteropus* Canestrini and Fanzago, 1878 (Arachnida, Mesostigmata, Spinturnicidae) (see Jackson and Groves, 2015: 238). - Etymology: From the Greek "*πτερόπους*", meaning wing-footed, referring to the wing membrane which arises from the side of the back and the back of the second toe (see Palmer, 1904: 596; Jones and Kunz, 2000: 5). (Current Combination)

1799. *Spectrum* Lacépède, Tabl. Div. Subd. Orders Genres Mammifères, 15. - Comments: Type species: *Vespertilio vampirus* Linnaeus, 1758 (according to Miller and Wilson, 1997: 1; Jackson and Groves (2015: 238) or *Vespertilio vampirus niger* Kerr, 1792 (according to Andersen, 1912b: 61). Preoccupied by *Spectrum* Scopoli, 1777 [Lepidoptera, Sphingidae] (see Allen, 1939a: 59; Corbet and Hill, 1992: 57; Pavlinov *et al.*, 1995: 62; Miller and Wilson, 1997: 1; Jones and Kunz, 2000: 1). Not *Spectrum* Stoll, 1787 (Insecta, Orthoptera, Phasmatidae) (see Jackson and Groves (2015: 238). - Etymology: From the Latin "*spectrum*", meaning apparition or specter (see Palmer, 1904: 638).

1866. *Eunycteris* Gray, Proc. zool. Soc. Lond., 1866, I (v): 64. Publication date: May 1866. - Comments: Type species: *Pteropus phaiops* Temminck, 1837 (=*Pteropus melanopogon* Peters, 1867).

1870. *Pselaphon* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 110. - Comments: Type species: *Pteropus pselaphon* Layard, 1829, by monotypy. Not *Pselaphus* [= *Pselaphon*] Herbst, 1792 (Insecta, Coleoptera, Psephalidae) (Jackson and Groves, 2015: 238). - Etymology: From the Greek "*ψηλαφάω*", meaning to grope about (see Palmer, 1904: 588).

1899. *Sericonycteris* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 6, 30. - Comments: Type species: *Pteropus rubricollis* E. Geoffroy Saint-Hilaire, 1810 (= *Pteropus subniger* Kerr, 1792), by original designation (according to Miller and Wilson, 1997: 1) or subsequent designation (Palmer, 1904: 629; according to Jackson and Groves, 2015: 238). Originally described as a subgenus of *Pteropus*. Matschie dated his introduction on 14 May 1899. - Etymology: From the Greek "*σηρικόν*", meaning silk and "*νυκτερίς*", meaning bat (see Palmer, 1904: 627).

1907. *Desmaplex* Miller, Bull. U.S. natl. Mus., 57: vii, 60. Publication date: 29 June 1907. - Comments: Type species: *Pteropus leucopterus* Temminck, 1853, by original designation (see Jackson and Groves, 2015: 238).

2011. *Pterocarpus* Mishra, Rout and Panda, Afr. J. Pharm. Pharmacol., 5 (1): 6. Publication date: January 2011. - Comments: Not of Jacquin, 1763, which is a pantropical genus of trees in the family Fabaceae (see http://en.wikipedia.org/wiki/Pterocarpus). (Lapsus)

TAXONOMY:

See Bergmans (1991) and Simmons (2005: 334). The International Commission on Zoological Nomenclature ruled in favor of rejecting Brisson (1762), but conserved several of the generic names including *Pteropus* (Opinion 1894; ICZN, 1998). Formerly included *arquatus* and *leucotis* which were transferred to *Acerodon* by Musser et al. (1982a).

O'Brien *et al.* (2009) examined the western Indian Ocean member of the genus *Pteropus*, based on three mitochondrial genes – cytochrome *b*, 12S rRNA, and a portion of the control region. The combined data set indicates the lack of reciprocal monophyly in western Indian Ocean *Pteropus*. With the expetion of *P. livingstonii* and *P. voeltzkowi*, the other regional taxa demonstrate little genetic differentiation. The resulting poytomy indicates rapid and presumably recent divergence. Almeida *et al.* (2014: 83) studied the cytochrome *b* and the 12S rRNA mitochondrial genes sequences for all *Pteropus* species and some additional sequences of the nuclear RAG1, vWF, and

BRCA1 genes for a subsample of taxa. Their conclusions were that the genus as a whole is monophyletic (originating in the Miocene), but also that the monophyly of the traditional species-groups could not be substantiated. They subdivided the genus in 13 species groups, where *livingstonii* and *voeltzkowi* are the only members of the "*livingstonii*" group. *aldabrensis, niger, rodricensis, rufus*, and *seychellensis* are part of the "*vampyrus*" group, whereas the extinct *subniger* could not be tested and is tentatively placed in an "*incertae sedis*" group.

Known species of *Pteropus*: *admiralitatum* Thomas, 1894 – Solomon Isls; Admiralty Isls, New Britain, and Tabar Isl (Bismarck Arch.) (Simmons, 2005: 334); ***aldabrensis*** True, 1893; *alecto* Temminck, 1837 – Sulawesi, Saleyer Isl, Lombok, Bawean Isl, Kangean Isls, Sumba Isl, and Savu Isl (Indonesia); north and east Australia; south New Guinea (Simmons, 2005: 335); *allenorum* Helgen, Helgen and Wilson, 2009; *anetianus* Gray, 1870 – Vanuatu including Banks Isls (Simmons, 2005: 335); *argentatus* Gray, 1844; *aruensis* Peters, 1867 – Aru Isls (Indonesia) (Simmons, 2005: 335); *banakrisi* Richards and Hall, 2002 – Moa Isl (Australia) (Simmons, 2005: 335); *brunneus* Dobson, 1878 – Percy Isl., Queensland (Australia) (Simmons, 2005: 335); *caniceps* Gray, 1870 – Halmahera (Indonesia) (Simmons, 2005: 335); *capistratus* Peters, 1876 – Bismarch Arch. (Papua New Guinea) (Simmons, 2005: 336); *chrysoproctus* Temminck, 1837 – Ambon, Buru, Seram, and small islands east of Seram (Indonesia) (Simmons, 2005: 336); *cognatus* K. Andersen, 1908 – Makira and Uki Ni Masi Isls (Solomon Isls) (Simmons, 2005: 336); *conspicillatus* Gould, 1850 – north Moluccas (Indonesia), New Guinea and West Papuan Isls (Raja Ampat Isl, off northwest coast of New Guinea), northeast Queensland (Australia) (Simmons, 2005: 336); *coxi* Helgen, Helgen and Wilson, 2009; *dasymallus* Temminck, 1825 – Taiwan, Ryuku Isls, and extreme southern Kyushu (Japan), Batan, Dalupiri, and Fuga Isls (Philippines) (Simmons, 2005: 337); *faunulus* Miller, 1902 – Nicobar Isls (India) (Simmons, 2005: 337); *fundatus* Felten and Kock, 1972 – Banks Isls (Vanuatu) (Simmons, 2005: 337); *giganteus* (Brünnich, 1782) – Maldive Isls, India (incl. Andama Isl), Sri Lanka, Pakistan, Bangladesh, Nepal, Burma (Simmons, 2005: 337); *gilliardorum* Van Deusen, 1969 – New Britain and New Island (Bismarck Arch., Papua New Guinea) (Simmons, 2005: 337); *griseus* (E. Geoffroy, 1810) – Timor, Samao Isl, Dyampea Isl, Bonerato Isl, Saleyer Isl, Paternoster Isls, Pelang Isl, Sulawesi, and Banda Isls (Indonesia) (Simmons, 2005: 337); *howensis* Troughton, 1931 – Ontong Java Isl (Solomon Isls) (Simmons, 2005: 338); *hypomelanus* Temminck, 1853 – Andaman and Maldive Isls, New Guinea through Indonesia to Vietnam and Thailand, and adjacent islands, Philippines (Simmons, 2005: 338); *insularis* Hombron and Jacquinot, 1842 – Truk Isls (Micronesia) (Simmons, 2005: 338); *intermedius* K. Andersen, 1908 – southern Burma and western Thailand (Simmons, 2005: 338); *keyensis* Peters, 1867 – Kai Isls (Indonesia) (Simmons, 2005: 339); *leucopterus* Temminck, 1853 – Luzon, Catanduanes, and Dinagat Isls (Philippines) (Simmons, 2005: 339); ***livingstonii*** Gray, 1866; *lombocensis* Dobson, 1878 – Lombok, Sumbawa, Komodo, Flores, Lembata, Pantar, Alor and Timor Isls (Indonesia) (Simmons, 2005: 339); *loochoensis* Gray, 1870 – Okinawa Isl, Ryûkyû Isls (Japan) (Simmons, 2005: 339); *lylei* K. Andersen, 1908 – Thailand, Vietnam, Cambodia (Simmons, 2005: 339); *macrotis* Peters, 1867 – New Guinea, Aru Isls (Indonesia), Boigu Isl (Australia) (Simmons, 2005: 340); *mahaganus* Sanborn, 1931 – Bougainville Isl (Papua New Guinea), Ysabel Isl and Choiseul Isl (Solomon Isls) (Simmons, 2005: 340); *mariannus* Desmarest, 1822; *melanopogon* Peters, 1867 – Amboina, Buru, Seram, Banda Isls, Yamdena (= Timor Laut), and adjacent islands (Indonesia) (Simmons, 2005: 340); *melanotus* Blyth, 1863 – Nicobar and Andaman Isls (India), Engano Isl and Nias Isl (Indonesia), Christmas Isl. (Simmons, 2005: 340); *molossinus* Temminck, 1853 – Pohnpei (= Ponape) and possibly Mortlock Isls (Caroline Isls, Micronesia) (Simmons, 2005: 341); *neohibernicus* Peters, 1876 – Bismarck Arch. and Admiralty Isls (Papua New Guinea), New Guinea, Misool and Gebi Isls, Gag Isl (Simmons, 2005: 341); ***niger*** (Kerr, 1792); *nitendiensis* Sanborn, 1930 – Nendö and Tömotu Neo (in the Santa Cruz Isls, Solomon Isls) (Simmons, 2005: 341); *ocularis* Peters, 1867 – Seram and Buru (Indonesia) (Simmons, 2005: 341); *ornatus* Gray, 1870 – New Caledonia and Loyalty Isls (Simmons, 2005: 342); *pelagicus* Kittlitz, 1836; *pelewensis* K. Andersen, 1908 – Pelew Isls (Micronesia) (Simmons, 2005: 342); *personatus* Temminck, 1825 – North Molucca Isls (Halmahera and Obi Isl groups), and Gag (Simmons, 2005: 342); *pilosus* K. Andersen, 1908 – Pelew Isls (Micronesia) (Simmons, 2005: 342); *pohlei* Stein, 1933 – Yapen, Biak-Spiori, Numfoor, and Rani Isls (off northwestern New Guinea) (Simmons, 2005: 342); *poliocephalus* Temminck, 1825 – Eastern Australia, from southern Queensland to Victoria (Simmons, 2005: 342); *pselaphon* Lay, 1829 – Bonin and Volcano Isls (Japan) (Simmons, 2005: 342); *pumilus* Miller, 1911 – Philippines (except Palawan region), Talaud Isls (Indonesia) (Simmons, 2005: 343); *rayneri* Gray, 1870 – Bougainville and Buka Isls (Papua New Guinea), Solomon Isls (Simmons, 2005: 343); *rennelli* Troughton, 1929 – Rennell Isl (Solomon Isls) (Simmons, 2005: 343); ***rodricensis***

Dobson, 1878; ***rufus*** E. Geoffroy, 1803; *samoensis* Peale, 1848 – Fiji Isls, Samoan Isls (Simmons, 2005: 344); *scapulatus* Peters, 1862 – Australia, southern New Guinea, accidental on New Zealand (Simmons, 2005: 344); ***seychellensis*** Milne-Edwards, 1877; *speciosus* K. Andersen, 1908 – Philippines, Besar and Mata Siri (Java Sea), Talaud Isls (Simmons, 2005: 344); ***subniger*** (Kerr, 1792); *temminckii* Peters, 1867 – Buru, Ambon, Seram (Indonesia), nearby small islands, perhaps Timor Isl (Indonesia) (Simmons, 2005: 345); *tokudae* Tate, 1934 – Guam (Mariana Isls, USA) (Simmons, 2005: 345); *tonganus* Quoy and Gaimard, 1830 – Karkar Isl (off northeastern New Guinea) and Rennell Isl (Solomon Isls), south to New Caledonia, east to Cook Isls (Simmons, 2005: 345); *tuberculatus* Peters, 1869 – Vanikoro Isl (Santa Cruz Isls, Solomon Isls) (Simmons, 2005: 345); *ualanus* Peters, 1883 – Kosrae (Micronesia) (Simmons, 2005: 345); *vampyrus* (Linnaeus, 1758) – Vietnam, Burum, Malay Peninsula, Borneo, Philippines, Sumatra, Java, and Lesser Sunda Isls, adjacent small islands including Anak Krakatau (Simmons, 2005: 346); *vetulus* Jouan, 1863 – New Caledonia (Simmons, 2005: 346); ***voeltzkowi*** Matschie, 1909; *woodfordi* Thomas, 1888 – New Georgia group, Russell and Florida Isls, Guadalcanal, Malaita (Solomon Isls) (Simmons, 2005: 346); *yapensis* K. Andersen, 1908 – Yap Isls (Simmons, 2005: 346).

COMMON NAMES:
Czech: praví kaloni, upírové. Dutch: Kalongs. English: Flying-foxes, Flying Foxes. French: Renards volants, Roussettes géantes. German: Flugfüchse.

GENERAL DISTRIBUTION:
McNab (2009: 156) indicates that *Pteropus* "is primarily an island taxon, with 55 species (of the 57 species or 96.5 %) having some or all of their distribution on islands". Furthermore, McNab (2009: 158) states that the distributional pattern of *Pteropus* on islands is extremely variable, with some species being limited to small islands (e.g. *P. voeltzkowi* on Pemba, *P. livingstonii* on Anjouan and perhaps on Mohéli in the Comoros, *P. rodricensis* on Rodrigues, and *P. niger* on Mauritius, and other (Asian) species on islands that are hundreds or even thousands of kilometers apart.

BIOGEOGRAPHY:
Kingdon (1989) suggested that *Pteropus* doesn't occur in central parts of the continent since it might depend on seawater as source of salts. This is rejected by McNab and Armstrong (2001: 710) as this would not explain why there are no representatives of this genus in the African coastal areas.

Pteropus aldabrensis True, 1893

*1893. *Pteropus aldabrensis* True, Proc. U.S. Natl. Mus., 16 (948): 533. Publication date: 14 July 1893. Type locality: Seychelles: Aldabra Island. Syntype: USNM 20984: ♂, skin and skull. Collected by: Dr. William Louis Abbott; collection date: 26 September 1892. Presented/Donated by: ?: Collector Unknown. Syntype: USNM 20985: ♂, skin and skull. Collected by: Dr. William Louis Abbott; collection date: 1892. Presented/Donated by: ?: Collector Unknown. - Comments: USNM 20984/36053 + 20985/36054: "cotypes" (syntypes); ad ♂♂, SS; coll. W.L. Abbott, 26 September 1892 and 5 October 1892: see Poole and Schantz (1942: 139), who also indicate "No type is specified in the original description, but these two specimens are mentioned by number and are therefore regarded as cotypes." Catalogued 30 June 1893: see Lyon and Osgood (1909: 256). Fisher and Ludwig (2015: 52) mention that *Proc. U.S. Natl. Mus.* **16**: 1, (published on 14 July 1893) was a "Preprint" of *Proc. U.S. Natl. Mus.* **16**: 533, which was published on 21 October 1893. (Current Combination)

1971. *Pteropus seychellensis aldabrensis:* Hill, Phil. Trans. Roy. Soc. Lond., B 260: 574. (Name Combination)

? *[Pteropus seychellensis] aldabrabensis:* Honacki, Kinman and Koeppl, Mammal species of the world: A taxonomic and geographic reference., 124. - Comments: Honacki *et al.* (1982: 124) mention "*aldabrabensis*" in the list of included taxa, and mention "*P. aldabrensis* (sic)." in the list with ISIS numbers. Bergmans (1991: 154) states it isn't clear to him why Honacki *et al.* (1982) changed the spelling. (Emendation)

TAXONOMY:
Bergmans (1991) showed that *P. aldabrensis* differs strongly from *P. seychellensis*, a view followed by Simmons (2005: 334).

O'Brien *et al.* (2009) suggested that *P. aldabrensis*, *P. rufus*, *P. niger* and *P. seychellensis* (including *comorensis*) should be considered

geographical forms of a single species *P. giganteus* (Brünnich, 1782) from the Indian subcontinent, Maldives and Andaman archipelagos.

O'Brien (2011: 261) indicates that the last complete innundation of the Alabra atoll occurred some 125,000 years ago, and that the diversification of *Pteropus* in the area is therefore of recent age.

Almeida *et al.* (2014: 83) places this in the '*vampyrus*' group.

COMMON NAMES:
Czech: kaloň aldabránský. English: Aldabra Flying Fox, Aldabra Flying-fox. French: Renard volant d'Aldabra. German: Aldabra-Flugfuchs. Spanish (Castillian): Zorro volador de Aldabra.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU D2 ver 3.1 (2001)) because it is known from only a single location (the Aldabra Atoll), and it is plausible that this restricted range species could be threatened by tropical cyclones, similar stochastic events or a rising sea level (Mickleburgh *et al.*, 2008dh; IUCN, 2009).

Critically endangered - C2a(ii): see Jones *et al.* (2009b: 506). Conenna *et al.* (2017: Suppl.) mention its status as Vulnerable (VU).

Assessment History -
2008 - VU D2 ver 3.1 (2001) (Mickleburgh *et al.*, 2008dh; IUCN, 2009). 2004 - CR C2a(i) ver 3.1 (2001) (Mickleburgh *et al.*, 2004cv; IUCN, 2004).

CITES - Appendix II.

MAJOR THREATS:
The population is probably stable with no declines reported. However, because of the restricted nature of the species range it is considered to be especially vulnerable to threats such as tropical cyclones and rises in sea level (60% of the atoll is at or below 1 m asl.) (Mickleburgh *et al.*, 1992; Hutson, 2004a; Justin Gerlach *pers. comm.,* 2008; Mickleburgh *et al.*, 2008dh; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dh) [in IUCN (2009)] report that although the species is not directly protected (Tony Hutson *pers. comm.,* 2008), the Aldabra Atoll is a highly protected UNESCO World Heritage site and a Special Reserve under the Seychelles National Parks and Nature Conservancy Act (Mickleburgh *et al.*, 1992; Hutson, 2004a: 128). There is a distinct need for additional research into the total population number of this restricted range species and to monitor any changes in abundance (Hutson, 2004a: 128).

GENERAL DISTRIBUTION:
Pteropus aldabrensis is endemic to the Aldabra Atoll (approximately 150 km^2) in the Seychelles. Bats have been recorded from all main islands and have been observed flying between islands of the atoll (Hutson, 2004a; von Brandis, 2004).

Native: Seychelles [Aldabra].

BIOGEOGRAPHY:
See O'Brien *et al.* (2009) for further details.

MOLECULAR BIOLOGY:
DNA - See O'Brien *et al.* (2009) and Almeida *et al.* (2014).
Karyotype - Unknown.
Protein / allozyme - Unknown.

ROOST:
Racey and Nicoll (1984) [in O'Brien (2011: 262)] indicate that *P. aldabrensis* roosts in coconut palms, figs and *Sideroxylon inerme*.

DIET:
Hutson (2004a: 127) mentions that fruits of the following plants are eaten: *Ficus lutea, F. rubra* (as *F. avi-avi*) and *F. reflexa, Calophyllum inophyllum, Terminalia catappa, Mystroxylon aethiopicum*, and also flowers of *Cocos nucifera* and *Agave sisalana*. Roberts and Seabrook (1989) [in Courts (1998: 188)] report that *P. seychellensis aldabrensis* licked coccoids (*Icerya seychellarum*) from the leaves of infested *Ficus* trees, probably to supplement their diets.

POPULATION:
Structure and Density - The population is reported to consist of only a few hundred animals (Cheke and Dahl, 1981; Carroll, 1985). Hutson (2004a) notes that no major colonies were located in 1968, with the largest roosting group on the small lagoon islet of Iles Michel that was probably well under 100 animals. Hutson (2004a) suggests that the total population was fewer than 250 animals in 1968, although he considered that the majority of the population may be present on the relatively little explored Middle Island (= Malabar Island) 26 km^2 in size. von Brandis (2004) reports that large groups of these bats have been recorded in Casuarina trees, with the largest group of more than 100 animals reported at the eastern end of Middle Island (=Malabar Island) in 1995. Conrad Savy (*pers. comm.,* 2008) indicates that the bats were commonly seen in good numbers during 2001 (Mickleburgh *et al.*, 2008dh; IUCN, 2009).

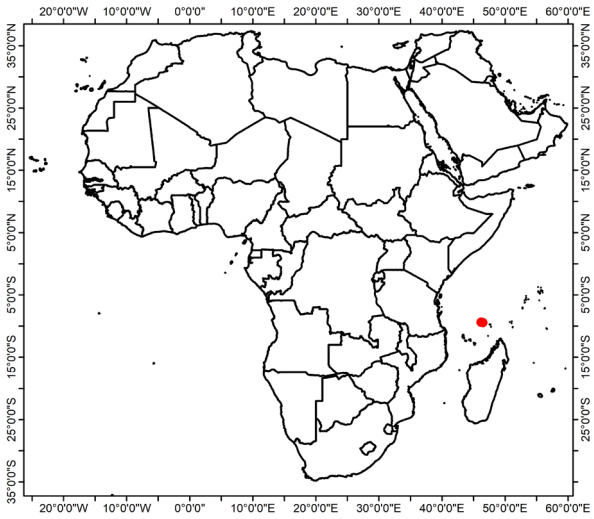


Figure 7. Distribution of Pteropus aldabrensis

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Seychelles.

Pteropus livingstonii Gray, 1866

*1866. *Pteropus livingstonii* Gray, Proc. zool. Soc. Lond., 1866, I: 66. Publication date: May 1866. Type locality: Comoros: Anjouan Island. Holotype: BMNH 1863.12.11.2: ad, skin and skull. Collected by: Dr. Livingstone. Presented/Donated by: Earl Russell. See Andersen (1912b: 250). (Current Combination)

1971. *Pteropus livingstonei:* Hayman and Hill, Mammals of Africa: Chiroptera, 10. (Lapsus)

TAXONOMY:
See Bergmans (1991), Simmons (2005: 339) and Smith and Leslie (2006: 1).

P. livingstonii together with *P. voeltzkowi* form the most distinct and ancient lineage of the western Indian Ocean *Pteropus* spp. (O'Brien *et al.*, 2009). The phylogenetic analyses performed by Chan *et al.* (2011: 7) suggest that both are sister species. This is supported by Almeida *et al.* (2014), who places this in the '*livingstoni*' group.

COMMON NAMES:
Czech: kaloň komorský. Dutch: Zwarte Komorenkalong, Schoudervlekkalong. English: Comoro Black Flying Fox, Comoro Flying Fox, Black Flying- fox, Livingstone's Flying Fox, Comores Flying Fox. French: Renard volant des Comores, Renard volant noir, la roussette de Livingstone. German: Livingstones Flugfuchs. Spanish (Castillian): Zorro Volador De Livingston.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
No fossils are known (Smith and Leslie, 2006: 2).

CONSERVATION STATUS:
Global - Listed as Endangered (EN A2c; B1ab(iii) ver 3.1 (2001)) because of a serious population decline, estimated to be more than 50% over the next ten years, inferred from ongoing habitat loss and degradation, and because its extent of occurrence is less than 5,000 km^2, all individuals are in fewer than five locations, and there is continuing decline in the extent and quality of its habitat (Mickleburgh *et al.*, 2008t; IUCN, 2009). Daniel *et al.* (2016: 742) recategorized the species to "Critically Endangered".

Assessment History -
2008 - EN A2c; B1ab(iii) ver 3.1 (2001) (Mickleburgh *et al.*, 2008t; IUCN, 2009). 2004 - CR A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2004p; IUCN, 2004). 2002 - CR A1c+2cd, B1+2c, C2a (Mickleburgh *et al.*, 2002a: 22). 1998 - EN A1c+2cd, B1+2c, C2a (Trewhella *et al.*, 1998: 32). 1996 - CR (Baillie and Groombridge, 1996). 1994 - EN (Groombridge, 1994). 1993 - EN (World Conservation Monitoring Centre, 1993). 1990 - EN (IUCN, 1990). 1988 - EN (IUCN Conservation Monitoring Centre, 1988).

CITES -
Appendix II, see Smith and Leslie (2006: 4) for discussion.

MAJOR THREATS:
The species is threatened by the continuing degradation of its forest habitat by conversion of land to agricultural use, especially the use of lowland areas for export crops (such as cloves). In degraded forest the species is outcompeted by the bat *Pteropus seychellensis* (Mickleburgh *et al.*, 2002a). Tree felling has additionally destroyed a number of roosts (Trewhella *et al.*, 2005). There is also increased disturbance because of human population growth, however, the species is not

hunted for food (Trewhella *et al.*, 2005). The small remaining population is additionally potentially threatened in its restricted range by the effects of tropical cyclones (Mickleburgh *et al.*, 2008t; IUCN, 2009). Since Anonymus (2000: 30) points out that this species generally roosts and feeds in native trees, the destruction of these forests can have a devastating effect, especially since *P. livingstonii* uses different tree species for food during different seasons.

Sagot and Chaverri (2015: 1670) mention roost loss or disturbance, and habitat degradation or loss as major threats for this species. Daniel *et al.* (2016: 743) indicate that the estimated forest loss between 2000 and 2010 was 9.3 % per annum.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008t) [in IUCN (2009)] report that a species action plan developed by the NGO Action Comoros is being implemented for this species (Sewall *et al.*, 2003). A national environmental education programme has been implemented to raise awareness of this species (Trewhella *et al.*, 2005). National legislation to protect this species is being developed (Trewhella *et al.*, 2005) and work has begun to establish a forest reserve for this bat on Moheli and on evaluating a site for a reserve on Anjouan (Trewhella *et al.*, 2005). Sewall (2004: 10) suggests that the protection of specific "bat trees" can already provide a short-term solution.

Since 1992, there is an active captive-breeding programme underway for this species initiated by the Durrell Wildlife Conservation Trust and the Bristol Zoo, where 35 animals are housed, of which 21 were born in captivity (Anonymus, 2000: 31). At the Jersey Wildlife Preservation Trust (JWPT), 6 bats (5 ♂♂ and 1 ♀) were imported from the Comores in 1992, and a second group with the same composition was imported in 1993, followed by an additional ♀ in 1995 (Carroll and Feistner, 1996: 334).

Based on a study of mitochondrial and microsatellite markers, Ibouroi *et al.* (2018a: 1425) conclude that - for conservation purposes - the *S. livingstonii* populations from Anjouan and Mohéli should be considered as two separate management units, and that the focus should be targeted on the Anjouan population.

GENERAL DISTRIBUTION:
Pteropus livingstonii is endemic to two of the four Comoro Islands: Anjouan (formerly Johanna) and Moheli (Trewhella *et al.*, 2001; Smith and Leslie, 2006: 1). On Anjouan, the species avoids lower parts of the island below 300 to 1100 m asl, and on Moheli between 150 to 700 m asl.

Native: Comoros (Cheke and Dahl, 1981; Clark *et al.*, 1997; Trewhella *et al.*, 2001; Smith and Leslie, 2006: 1; Goodman *et al.*, 2010c: 124).

GEOGRAPHIC VARIATION:
See Smith and Leslie (2006: 1).

General description of exernal morphology:
See Smith and Leslie (2006: 1).

DETAILED MORPHOLOGY:
Baculum - Unknown

For a description of the cranium, teeth, ear and tragus, and wingshape and aspect ratio see Smith and Leslie (2006: 1-2).

Dickson *et al.* (2016: 963) and Killick *et al.* (2017: 1077) studied cardiomyopathies on a group of captive bats, where dilated cardiomyopathy may be a major cause of death (Drane *et al.*, 2017: 89).

SEXUAL DIMORPHISM:
It is not clear if sexual dimorphism occurs in *P. livingstonii* due to insufficient numbers of adult females have been difficult to collect in the wild (Clark *et al.*, 1997; Trewhella *et al.*, 2005; Young *et al.*, 1993; Smith and Leslie, 2006: 2).

ECHOLOCATION:
Not known to echolocate.

MOLECULAR BIOLOGY:
DNA - See O'Brien *et al.* (2009) and Almeida *et al.* (2014).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
Ibouroi *et al.* (2018b: 2395) reported that the species' habitat is restricted to steep, high-elevation slopes of the Comoro's remaining natural forests.

HABITS:
See Smith and Leslie (2006).

Based on wing morphology, Lindhe Norberg *et al.* (2000) classified *P. livingstonii* as a soaring species.

ROOST:
See Smith and Leslie (2006). Anonymus (2000: 30) indicates that *P. livingstonii* roosts in tall trees in the rain forest, at medium altitude. These nesting trees are, in general, local species. Trewhella *et al.* (2001) indicate that day-roost sites are also shared with *P. s. comorensis*. Daniel *et al.* (2016: 747) indicate that only four tree species

were used as roost on Mohéli [M] and 12 on Anjouan [A]: *Ficus exasperata* Vahl (sandpaper tree, forest sandpaper fig, white fig, or sandpaper leaf tree) [M+A], *Gyrostipula comoriensis* J.-F. Leroy [A], *Gambeya* spp. [A], *Ficus lutea* Vahl (giant-leaved fig or Lagos rubbertree) [A], *Nuxia pseudodentata* Gilg [A], *Albizia lebbeck* (L.) Benth. (lebbeck, lebbek tree, flea tree, frywood, koko and woman's tongue tree) [M], *Ocotea comoriensis* Kosterm. [A], *Weinmannia comoriensis* Tul. [A], *Brachylaena ramiflora* (DC.) Humbert [A], *Ficus pirifolia* Lamk. [A], *Terminalia catappa* L. (country-almond, Indian-almond, Malabar-almond, sea-almond, tropical-almond or false kamani) [M], *Antidesma hildebrandtii* Pax & K. Hoffm. [A], *Albizia glaberrima* (Schumach. & Thonn.) [A], *Khaya comorensis* (Comorian mahogany) [M], *Cryptocarya* spp. [A].

Ibouroi *et al.* (2018b: Suppl.) reported the following roost trees being used on the Comoro Islands: Asteraceae: *Brachylaena ramiflora*; Combretaceae: *Terminalia catappa*; Cunoniaceae: *Weinmannia comorensis*; Gentianaceae: *Anthocleista grandiflora*; Lauraceae: *Ocotea comorensis*; Leeaceae: *Leea guineensis*; Loganiaceae: *Nuxia pseudodenta*; Meliaceae: *Khaya comorensis*; Mimosaceae: *Albizia glaberrima, Albizia lebbeck*; Moraceae : *Ficus antandronarum, Ficus lutea, Ficus pirifolia*; Myrtaceae: *Eugenia comorensis*; Sapotaceae: *Gambeya boiviniana*.

Granek (2000a: 29 - 30) determined the following roost site characteristics:
1) between 500 and 1,100 m in elevation,
2) steeply sloped land,
3) some native forest cover was present,
4) presence of water in the same valley,
5) presence of an east- or south-facing slope
6) the valley was protected by mountains on three sides, forming a 'bowl' (protecting them from the wind and the mid-day sun),
7) presence of the following tree species: *Gambeya* sp. and *Nuxia pseudodentata*.
However, Granek (2002: 95) indicates that there was no significant association between the bat roosts and characteristics 1, 2 and 3.

MIGRATION:
Intra-island movement among roosts is likely, but inter-island movement is unknown (Smith and Leslie, 2006: 3).

DIET:
See Smith and Leslie (2006: 3). Kock and Nader (1984: 30 - 31) and Sewall (2004:10) point out that this species almost completely feeds on native trees, and changes tree species according to the season. One of its favourite foods is the fruit of a giant-leaved fig tree (*Ficus lutea*) (Sewall, 2004: 9 - 10). Young *et al.* (1993) [in Carroll and Feistner (1996: 330)] indicate that *R. obliviosus* and *P. livingstonii* were captured at the same kapok and fig feeding sites on Anjouan, which would suggest that their feeding niches might overlap. However, they also indicate that there might be a vertical separation between the two species.
Nectar and fruits of the Moraceae family form an important part of the diet, while pollen is not important Cotterill (1995).

Trewhella *et al.* (2001: 141) reported the following food items (with known items in bold and suspected items in plain text): Aphloiaceae: *Aphloia theaeformis* [= *Aphloia theiformis* (Vahl) Benn.]; Asteraceae: ***Brachylaena ramiflora*** (DC.) Humbert; Clusiaceae: *Rheedia anjouanensis* H. Perrier [= *Garcinia anjouanensis* (H. Perrier) P.W. Sweeney & Z.S. Rogers; Cunoniaceae: *Weinmannia comorensis* Tul.; Gentianaceae: *Anthocleista grandiflora* L. (forest fever tree); Lauraceae: *Ocotea comorensis* ?; Malvaceae: ***Ceiba pentandra*** (L.) Gaertn. (kapok tree); Monimiaceae: ***Tambourissa comorensis*** Lorence; Moraceae: *Artocarpus altilis* (Parkinson) Fosberg (breadfruit), *Artocarpus heterophyllus* Lam. (jackfruit or jack tree), ***Ficus lutea*** Vahl (giant-leaved fig), ***Ficus pirifolia*** ?; Myrtaceae: *Eugenia jambos* L. [= *Syzygium jambos* L. (Alston)] (rose apple); Oxalidaceae: *Averrhoa bilimbi* L. (bilimbi, cucumber tree or tree sorrel); Sapotaceae: ***Gambeya*** sp.; Stilbaceae: *Nuxia pseudodentata* Gilg, 1895.

Courts (1998: 189) reports that captive animals catch and eat insects flying by.

Bell *et al.* (2019: 250) indicate that dominant male bats (in a captive colony) defend small feeding territories within the colony, and are therefore often more sedentary, which might result in these animals being heavier and running a higher risk of cardiomyopathy.

PREDATORS:
See Smith and Leslie (2006).

POPULATION:
Structure and Density - In 2002 there were estimated to be 1,200 bats in 20 roosts, many of which have been recently located as a result of the implementation of a national environmental education programme (Trewhella *et al.*, 2005). Sewall (2009: 3) indicates that the population might count 1,200 - 1,500 animals. Prior to the national environmental education programme there were estimated to be fewer than 200 bats.

During an extensive survey in 2011 - 2012, Daniel *et al.* (2016: 742) estimated the population size to be about 1,260 animals, distributed over 21 roosts on Anjouan and Mohéli.

Ibouroi *et al.* (2018b: 2408) observed 1,243 bats divided over 19 locations, with colony sizes ranging from 3 to 349 individuals (average: 65).

Also see Smith and Leslie, 2006: 1).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008t; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 15 years.

ACTIVITY AND BEHAVIOUR:
See Smith and Leslie (2006: 1).

Trewhella *et al.* (2001: 135) indicate that *P. livingstonii* is more diurnally active than the sympatric *P. seychellensis comorensis*, and is the dominant species during their encounters.

REPRODUCTION AND ONTOGENY:
See Smith and Leslie (2006: 2).

Szekely *et al.* (2015: Suppl.) mention a gestation period of 152 days. At birth, the young weights 137 g (adult weight: 696.5 g).

MATING:
See Smith and Leslie (2006).

Riccucci (2011: 141) reports on same sex sexual behaviour in captive held *P. livingstonii*.

PARASITES:
Fountain *et al.* (2019: 268) examined the captive population at the Jersey Zoo and found them to be infected by the following *Staphylococcus* species (in descending order): *S. xylosus, S. aureus, S. saprophyticus, S. nepalensis, S. simulans, S. sciuri, S. kloosii, S. simiae, S. hominis, S. epidermidis, S. succinus, S. warneri, S. lentus, S. lugdunensis, S. cohnii, S. haemolyticus, S. equorum, S. capitis*.

UTILISATION:
Is not hunted for food (Trewhella *et al.*, 2005).

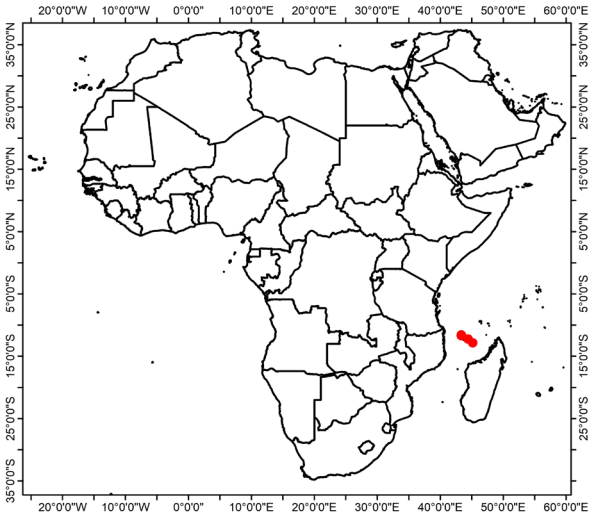


Figure 8. Distribution of *Pteropus livingstonii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Comoros, Mayotte.

Pteropus niger (Kerr, 1792)

*1792. *Vespertilio vampirus niger* Kerr, in: Linnaeus, Animal Kingdom, 1 (1): xvii, 90. Publication date: February 1792. Type locality: Réunion: "Réunion island". - Comments: Andersen (1912b: viii) mentions that the type was once in the ancient Royal Cabinet in Paris, but is probably no longer in existence.

1797. *Vespertilio caninus* Blumenbach, Handb. Naturg, 5 ed.: 73. - Comments: Pavlinov *et al.* (1995) consider *caninus* to be a synonym of *vampyrus*, but Andersen (1912b: 220) indicates this is a synonym of *niger* Kerr, 1792. The name was originally proposed as a replacement for *V. vampyrus* L., but this includes *vampyrus*, *rufus* and *niger*. Andersen also indicates that Goldfuss' plate of "*V. caninus*" Blumenbach (1809), is a copy of Schreber's plate xiv, which is *Pteropus niger*.

1803. *Pteropus fuscus* E. Geoffroy Saint-Hilaire, Catalogue des Mammifères du Muséum national d'Histoire naturelle, Paris, 46. Type locality: Réunion: Réunion and Madagascar [Goto Description]. - Comments: Andersen (1912b: 220) mentions that Geoffroy based himself on three specimens "viz., two mounted specimens (wings expanded), sent from Réunion by de la Nux (nos. 86 and 87), and a third 'envoyé de Madagascar, par le citoyen Macé, naturaliste' (no. 88)". Andersen also indicates that specimen 88 (from Madagascar) was probably obtained from a dealer. He was also unable to find any of these specimens.

1804. *V[espertilio] mauritianus* Hermann, Obs. Zool. , 19. Publication date: 31 August 1804. Type locality: Mauritius: "Mauritius" [Goto Description].

1808. *Pteropus rufus:* Tiedemann, Zool, 1808: 535. Type locality: Madagascar: "Madagascar". - Comments: Not of E. Geoffroy Saint-Hilaire, 1803, but see).
1810. *Pteropus vulgaris*E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 15: 92. Type locality: Réunion: Réunion and Madagascar: Restricted to Réunion by Andersen (1912b: 221), due to the type locality for *Pteropus fuscus* is Réunion. Holotype: MNHN A.1.C.18 - 745H - 154: ad ♂, mounted skin (skull not removed). - Comments: A redescription and renaming of *Pteropus fuscus* Geoffroy, 1803 (see Andersen, 1912b: 221).
1870. *Spectrum vulgare* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 100. Type locality: : Mauritius, Réunion, ? Madagascar [Goto Description].
1895. *Pteropus pteropus* Merriam, Science, N.S. 1 (14): 376. Publication date: 5 April 1895. Type locality: Réunion: Réunion and Madagascar. - Comments: Combination introduced into literature by Merriam on the mistaken supposition that Brisson's nomenclature was binomial (see Andersen, 1912b: 223).
? *Pteropus niger:* (Name Combination, Current Combination)

TAXONOMY:
See Bergmans (1991) and Simmons (2005: 341).

O'Brien *et al.* (2009) suggested that *P. aldabrensis*, *P. rufus*, *P. niger* and *P. seychellensis* (including *comorensis*) should be considered geographical forms of a single species *P. giganteus* (Brünnich, 1782) from the Indian subcontinent, Maldives and Andaman archipelagos.

Almeida *et al.* (2014: 85) place *P. niger* in the "*vampyrus*" group.

COMMON NAMES:
Czech: kaloň mauricijský. English: Greater Mascarene Flying Fox, Mascarene Flying-fox, Mauritian Flying Fox. French: Renard volant de l'île de Mascarene, Renard volant de Maurice, Renard volant des Mascaraignes, Roussette noire, grande Roussette des Mascareignes. German: Grosser Maskarenen-Flugfuchs. Spanish (Castillian): Zorro volador negro de Mauricio.

CONSERVATION STATUS:
Global - Listed as Endangered (EN B1ab(iii,v) ver 3.1 (2001)) because its extent of occurrence is less than 5,000 km^2 (Mauritius is 1,860 km^2), its entire range is restricted to only one island (and possibly one other island), and there is continuing decline in the extent and quality of its habitat, as well as the number of mature individuals due to hunting pressure, and culling of the species (Jenkins *et al.*, 2008k; IUCN, 2009).

Conenna *et al.* (2017: Suppl.) mention its status as Vulnerable (VU), but Anthony *et al.* (2018: 12075) indicated that the culling ot the bats in 2015-2016 resulted in upgrading the status to "Endangered" by the IUCN in 2018.

Assessment History - 2008 - EN B1ab(iii,v) ver 3.1 (2001) (Jenkins *et al.*, 2008k; IUCN, 2009). 1996 - VU A1d+2cd ver 2.3 (1994) (Baillie and Groombridge, 1996). 1994 - VU A1d+2cd ver 2.3 (1994) (Groombridge, 1994). 1993 - VU (World Conservation Monitoring Centre, 1993). 1990 - VU (IUCN, 1990). 1988 - VU. 1986 - Rare (IUCN Conservation Monitoring Centre, 1986). 1981 - VU: A1d+2cd. Extinct on Réunion Island (see Cheke and Dahl, 1981).

CITES - Appendix II

MAJOR THREATS:
Like other *Pteropus* species in the region, this species is threatened by cyclones, the removal of feeding and roosting trees, and persecution/hunting by people (Carroll and Feistner, 1996). Up until recently populations of this species were considered healthy because of the lack of any severe cyclones, and active protection (Nyhagen, 2004). In October 2006 the government endorsed a culling programme for 2,000 bats because of their perceived role in inflicting serious economic damage on lychees. This is obviously in conflict with the fact that the species is protected under the Wildlife and National Parks Act 1993. Only six bats were officially culled, despite illegal hunting parties being known to kill up to a few hundred bats in one night. The law is currently being revised and it is unknown whether further culling will be supported, although most likely it will be (Jenkins *et al.*, 2008k; IUCN, 2009).
Anthony *et al.* (2018: 12075) reported that in November-December 2015 30,938 bats were culled and in December 2016 yet another 7,380 bats. Florens and Baider (2018: 60) furthermore reported that 12,500 bats were planned to be culled in 2018.

Olival (2015: 6) reviews why culling is not an effective means to mitigate conflicts between fruit

growers and bats, nor to reduce the likelihood of zoonotic disease risk.

Florens (2015: 1325; 2016: 33) indicated that the official population estimates are between 90,000 and 1,000,000 bats. The government set a cull target of 20 %, which resulted in the death of 20,000 bats. However, as the real number of bats accounted for about 50,000 animals, this meant that about half of the population was eradicated.

CONSERVATION ACTIONS:
Jenkins *et al.* (2008k) [in IUCN (2009)] report that *P. niger* became a protected species in 1993 on Mauritius (Nyhagen *et al.*, 2005) and is reported to occur in protected areas, including the Black River Gorges National Park (Nyhagen, 2004), nature reserves and mountain reserves. There is a clear need to assess the population size, population dynamics, response to cyclones, assess relative fruit predation, roosting habitat requirements and impact of culling on this species and effectiveness of netting trees to prevent foraging. Oleksy *et al.* (2018: "5") also suggest to harvest the fruits at an earlier stage to reduce their attractiveness to bats as bats prefer to eat fruits that are to ripe to be sold. Additionally, they found that 10% of the lychee losses and up to 50% (or more) of the mango losses could be attributed to natural falling of fruit, which could also be reduced by early harvesting. Their study also indicated (p."6") that netting of trees could reduce damage caused by bats 12 to 23 fold.

GENERAL DISTRIBUTION:
Historically, *Pteropus niger* is distributed within the Mascarene Islands (Reunion Island, Mauritius Island, subfossil on Rodriquez Island). Since becoming extirpated from La Réunion in the early eighteenth century, this species has been restricted to the western Indian Ocean island of Mauritius. In 2007 a small colony of *P. niger* (up to 6 individuals) was located on La Réunion, though a few individuals have been observed on previous occasions over the past decade, most likely blown over from Mauritius by annual cyclones. Breeding within this small population on La Réunion is suspected but not confirmed.
Caceres (2010: 9) mentions that the orginal population disappeared from La Réunion between 1772 and 1801.

Native: Mauritius; Réunion.

BIOGEOGRAPHY:
See O'Brien *et al.* (2009) for further details.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
The adult's weight is on average 456.3 g (see Szekely *et al.*, 2015: Suppl.), but Oleksy *et al.* (2019: 5) reported an average weight of 617 (± 76) g for females and 630 (± 96) g for males.

MOLECULAR BIOLOGY:
DNA - See O'Brien *et al.* (2009).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITS:
P. niger is primarily nocturnal, but Nyhagen *et al.* (2005: 492) observed some specimens foraging during the day.

Using solar-powered GSM-tracking, Oleksy *et al.* (2019: 5) found that on average males traveled 9.38 km each night and females 6.06 km. The maximum distance traveled during one night was 92.92 km for a male and 79.19 km for a female. They also found that home ranges of males averaged 74,633 ha, whereas these for females only covered 31,072 ha. The core foraging areas averaged 2,222 ha for males, 1,364 ha for females.

ROOST:
On La Réunion, Caceres (2010: 14) reported that Yellow jade orchid tree (*Michelia champaca,* Chinese fan palm (*Livistona chinensis*), Longan (*Dimocarpus longan*), soft bollygum (*Litsea glutinosa*) and Wampee (*Clausena lansium*) are used as roosting trees. These roost trees can be used for several years, although during the year several roosts on different places of the island can be used.

DIET:
Nyhagen *et al.* (2005: 493) reported that on Mauritius, *P. niger* ate 22 plant species, 20 of which were visited for fruit, two for floral resources and one for leaves (of *Diospyros tessellaria* both fruits and flowers were eaten). Nyhagen (2004: 120) described the characteristics, which fruit eaten by *P. niger* posses: easily accessible (95 %), medium size (47 %), medium size seed (68 %), vivid colours (53 %), sweet smell (58 %), sweet flavour (74 %), and not juicy, i.e. low water content (58 %). Four of the plant species (*Artocarpus heterophyllus, Diospyros tessellaria, Mangifera indica* and *Mimusops petiolaris*) possess five of these seven characteristics. Nyhagen (2004: 122) also mentions that this bat is the only native vertebrate to feed on fruits of *Labourdonnaisia glauca*.

Seltzer *et al.* (2013: table S2) provide an overview of the plant species found beneath bat feeding roosts. For *P. niger* these include *Psidium guajava* L. (apple guava - Myrtaceae) and *Syzygium jambos* L. (Alston) (Malabar Plum - Myrtaceae).

Florens *et al.* (2017: 89) provided the following list of fruits eaten by *P. niger*: Aphoiaceae: *Aphloia theiformis* (Vahl) Benn.; Apocynaecae: *Tabernaemontana persicariifolia* Jacq.; Araliaceae: *Polyscias maraisiana* (Marais) Lowry & G.M. Plunkett (Ox tree); Arecaceae: *Dictyosperma album* (Bory) H. Wendl. & Drude ex-Scheff. (princess palm, hurricane palm), *Hyophorbe lagenicaulis* (L.H. Bailey) H.E. Moore (bottle palm, palmiste gargoulette), *Latania loddigesii* Martius (Latanier de l'île Ronde, Latanier de Maurice); Burseraceae: *Protium obtusifolium* (Lam.) Marchand; Calophyllaceae: *Calophyllum tacamahaca* Willd., 1811; Celastraceae: *Cassine orientalis* (Jacq.) Kuntze (bois d'olive); Chrysobalanaceae: *Grangeria borbonica* Lam., 1789; Combretaceae: *Terminalia bentzoe* (L.) L. f.; Ebenaceae: *Diospyros egrettarum* I. Richardson, *Diospyros tessellaria* Poir. (black ebony, Mauritian ebony), *Diospyros melanida* Poir.; Elaeocarpaceae: *Elaeocarpus integrifolius* Lam.; Lecythidaceae: *Foetidia mauritiana* Lam.; Loganiaceae: *Geniostoma borbonicum* (Lam.) Spreng.; Melastomataceae: *Warneckea trinervis* (DC.) Jacq.-Fél.; Moraceae: *Ficus reflexa* Thunb., *Ficus rubra* Vahl, 1805, *Ficus mauritiana* Lam.; Myrtaceae: *Eugenia alletiana* Baider & V. Florens, *Eugenia elliptica* Lam., 1789, *Eugenia pollicina* J. Guého & A.J. Scott, *Eugenia lucida* Lam., *Eugenia tinifolia* Lam., *Syzygium glomeratum* (Lam.) DC., *Syzygium populifolium* (Baker) J. Guého & A.J. Scott, 1980; Pandanaceae: *Pandanus eydouxia* Balf. f., *Pandanus utilis* Bory; Pittosporaceae: *Pittosporum senacia* Putt.; Rubiaceae: *Pyrostria borbonica* (J.F. Gmelin) Razafim. & B. Bremer; Salicaceae: *Ludia mauritiana* J.F. Gmelin, 1791; Sapindaceae: *Stadmania oppositifolia* Lam.; Sapotaceae: *Labourdonnaisia calophylloides* Bojer (Bois de natte à petites feuilles), *Labourdonnaisia glauca* Bojer (Bois de natte à grandes feuilles), *Labourdonnaisia revoluta* Bojer, *Mimusops maxima* (Poir.) R.E. Vaughan (Grand natte), *Mimusops petiolaris* Dubard, 1915 (macaque, makak, bois makak), *Sideroxylon boutonianum* A. DC, *Sideroxylon cinereum* Lam., *Sideroxylon puberulum* C. DC. (Manglier rouge), *Sideroxylon grandiflorum* A. DC. (tambalacoque, dodo tree).

POPULATION:
Structure and Density - The present population on Mauritius appears to be stable; 14 roosting sites were reported by Nyhagen (2004), but Robin, 2007) identified 57 roosts. This latter study only looked at 24 of the 57 roosts and calculated a minimum population size of 12,000 - 16,000. It can therefore be assumed that the minimum island wide population is over 25,000 (V. Tatayah *pers. comm.* [in Jenkins *et al.* (2008k) in IUCN, 2009]). Anthony *et al.* (2018: 12074) referred to a survey held in October 2016, which yielded a population estimate of about 62,000 individuals.
Trend - 2008 - Decreasing (Jenkins *et al.*, 2008k; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 19.4 years.

PARASITES:
Hirst (1923: 980) mentions that the mite *Ancystropus mulleri* Kolenati was collected from *P. vulgaris* [= *P. niger*].

VIRUSES:
Rhabdoviridae
Of the 36 bats from Mauritius tested by Mélade *et al.* (2016a: 6) against *Lagos bat lyssavirus* and *Duvenhage lyssavirus*, two and 13 respectively, displayed a sero reaction. Also one out of 21 specimens tested for *European bat lyssavirus 1* showed this reaction.

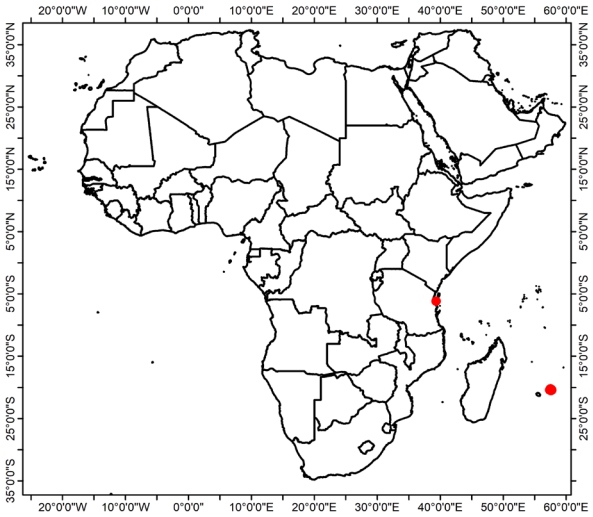


Figure 9. Distribution of *Pteropus niger*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar, Mauritius, Réunion, Tanzania.

Pteropus rodricensis Dobson, 1878

*1878. *Pteropus rodricensis* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, xxxvii, 20, 36, pl. 3, fig. 3. Publication date: June 1878. Type locality: "Africa": Mascarene Islands: Rodrigues Island [Goto Description]. Holotype: BMNH 1876.3.11.1: ad ♂, skull and alcoholic. Collected by: J. Gulliver. Presented/Donated by: The Royal

Society. See Andersen (1912b: 275). Paratype: SMF 44785: juv ♀, skull and alcoholic. Collected by: J. Gulliver. Presented/Donated by: ?: Collector Unknown. (Current Combination)

1907. *Pteropus mascarinus* Mason, Ann. Mag. nat. Hist., ser. 7, 20 (117): 221. Publication date: 1 September 1907. Type locality: Mauritius: 15 mi (=22 km) NE Mauritius: Round island (La Ronde) [Goto Description]. Holotype: BMNH 1925.8.10.1:.

TAXONOMY:
See Bergmans (1991) and Simmons (2005: 343).

Almeida *et al.* (2014: 85) place *P. rodricensis* in the "*vampyrus*" group.

COMMON NAMES:
Czech: kaloň rodrigueský, kaloň zlatý. Dutch: Rodriguez vliegende hond. English: Rodriguez Flying Fox, Rodrigues Flying Fox. French: Renard volant de Rodrigues, Renard Volant de l'île de Rodriguez. German: Rodriguez-Flughund, Rodrigues-Flugfuchs. Spanish (Castillian): Zorro volador de la isla Rodrigues.

CONSERVATION STATUS:
Global - Listed as Critically Endangered (CR B1ab(iii)c(iv) ver 3.1 (2001)) because the global population is restricted to a single location (the island of Rodrigues), and has a extent of occurrence is less than 100 km^2, and undergoes extreme fluctuations due to tropical cyclones. Cyclones have devastating long term effect on the number of bats (sometimes causing significant mortality) and remaining areas of the species vulnerable forest habitat (Mickleburgh *et al.*, 2008u; IUCN, 2009).

Assessment History -
2008 - CR B1ab(iii)c(iv) ver 3.1 (2001) (Mickleburgh *et al.*, 2008u; IUCN, 2009). 2004 - CR B1ac(iv) ver 3.1 (2001) (Mickleburgh *et al.*, 2004q; IUCN, 2004). 2002 - CR: B1+3d (Mickleburgh *et al.*, 2002a: 22), extinct on Round Island. 1996 - CR (Baillie and Groombridge, 1996). 1994 - EN (Groombridge, 1994). 1993 - EN (World Conservation Monitoring Centre, 1993). 1990 - EN (IUCN, 1990). 1988 - EN (IUCN Conservation Monitoring Centre, 1988). 1986 - EN (IUCN Conservation Monitoring Centre, 1986).

U.S. ESA - Endangered.
CITES - Appendix II.

MAJOR THREATS:
Deforestation has been a serious threat to the species, especially where mature fruit trees and important roost trees were felled. Because of the deforestation of this forest buffer, any remaining patches of forest (and their roosting bats), are now much more susceptible to tropical cyclones. These cyclones can cause significant fluctuations in bat population size and, along with shortage of food and dehydration, are now the major current threat to the species (Powell and Wehnelt, 2003). In the past the species was also hunted for food, however, this is now rare (Trewhella *et al.*, 2005; Mickleburgh *et al.*, 2008u; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008u) [in IUCN (2009)] report a successful captive breeding programme for this species was initiated by the Durrell Wildlife Conservation Trust, with breeding populations of this bat now maintained at 28 zoos around the world (Powell and Wehnelt, 2003). In 1995, the International Studbook contained 542 individuals distributed over 18 institutions (Carroll and Feistner, 1996: 334).

In-situ conservation efforts have concentrated on restoration of the natural habitat, watershed protection and awareness raising among the local people through environmental education programmes (Powell and Wehnelt, 2003; Trewhella *et al.*, 2005).

GENERAL DISTRIBUTION:
Pteropus rodricensis is confined to the western Indian Ocean island of Rodrigues (Mauritius). It was historically present on the island of Mauritius and Round Island (Mauritius), but is now extinct on these islands. It appears to range up to around 200 m asl.

Native: Mauritius [Mauritius (main island) - Regionally Extinct, Rodrigues].

DETAILED MORPHOLOGY:
Baculum - Unknown

Gardner *et al.* (2007: 196) studied the heart of several *P. rodricensis* specimens kept in captivity, and found it to have a normal cardiac silhouette, comparable to domestic small mammals.

Carter and Adams (2013: 33) postulated that tracheal and primary bronchi calcification will occur in echolocating *Artibeus jamaicensis* but not in non-echolocating *Syconycteris australis* and *Pteropus rodricensis*. The calcification would be needed to counteract the compressive forces executed by the flight muscles on the respiratory tract, as there is a sychronisation between wing-

beat and respiration, and the latter is linked with the production of echolocation calls. However, to their surprise, they found that the tracheae and primary bronchi of *P. rodricensis* were also heavily calcified.

MOLECULAR BIOLOGY:
O'Brien and Hayden (2004: 144) report that, notwithstanding the reduction of the population to less than 70 individuals in the 1970's, the species has still retained some genetic diversity.

DIET:
Courts (1998: 189) reports that captive animals catch insects flying by, and that these were readily eaten. The bats also ate mealworms (*Tenebrio molitor*) and waxmoth larvae (*Galeria mellonella*).
Blood glucose - Heard and Whittier (1997) found blood glucose concentrations within the normal mammalian range.

POPULATION:
Structure and Density - Until around 1916, the species was reported to be abundant on Rodrigues, and even in 1955 large numbers (about 500) still roosted in tamarinds (Mickleburgh *et al.*, 2002a). In 1965 there were fewer bats, but the species was still common. There was a marked decline in the 1970's, and following Cyclone Celine II in 1979, the population was reduced to around 70 bats. By 1980 the population had recovered to between 200 and 250 animals (Carroll and Mace, 1988), and at the end of February 1990, the population was estimated to be greater than 1,000 bats (Mickleburgh *et al.*, 2002a). Recently the population had recovered to around 5,076 bats (Powell and Wehnelt, 2003). However, the impact of cyclone Kalunde in March 2003 appears to have reduced the population to around 4,000 animals (Anonymus, 2006), although Caceres (2010: 19) reports that the current population is estimated at about 5,500 individuals.
Trend - 2008 - Increasing (Mickleburgh *et al.*, 2008u; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 28 years.

ACTIVITY AND BEHAVIOUR:
For a selection of sounds, check http://macaulaylibrary.org/search?taxon=Pteropus rodricensis&taxon_id=11036948&taxon_rank_id=67&tab=audio

Riccucci (2016: 94) observed several different behaviours: "play chase" by immature bats flying to one location and rapidly leaving; "play wrestle", which involves close belly contact between individuals, with restrained biting on the neck. He also noticed that pairs or groups of bats (mostly females) wrestle together in long play sessions.

REPRODUCTION AND ONTOGENY:
Kunz *et al.* (1994: 691) report on allomaternal care, or epimeletic (care-giving) behaviour, exhibited by one female toward another, before, during. and after giving birth.

Szekely *et al.* (2015: Suppl.) report a gestation period of 198 days. The young then weights 45 g (adult: 350 g).

MATING:
McCracken and Wilkinson (2000: 339) refer to Carroll and Mace (1988), who indicated that *P. rodricensis* forms harem groups consisting of one male and up to eight females.

Riccucci (2011 141) suggests that male-male mounting behaviour is a way to assert dominance.

PARASITES:
BACTERIA
Gram-positive bacterium - Heard *et al.* (1979) recorded the following gram-positive bacteria from *Pteropus rodricensis* - *Actinomycetis*, *Bacillus* spp., *Corynebacterium* spp., *Enterococcis* spp., *Lactobacillus* spp., *Staphylococcus aureus*, *Staphylococcus* spp., *Streptococcus* spp. hemolytic, *Streptococcus* sp Group D and *Streptococcus* sp.
Gram-negative bacterium - Heard *et al.* (1979) recorded *Bacteroides* spp., *Escherichia coli*, *Klebsiella oxytoca*, *Klebsiella pneumonia*, *Morganella morganii*, *Proteus mirabilis*, and *Proteus* spp. Helmick *et al.* (2004: 88) reported a *Pasteurella* from one captive bat.

Fungi
Heard *et al.* (1979) recorded an unspecified yeast.

UTILISATION:
In the past the species was also hunted for food, however, this is now rare (Trewhella *et al.*, 2005).

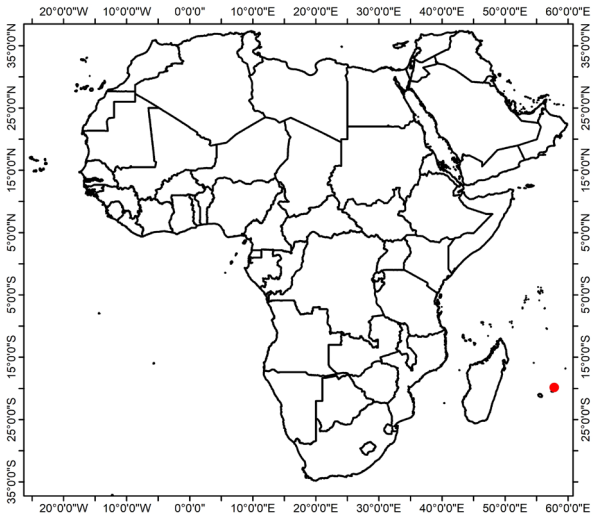


Figure 10. Distribution of *Pteropus rodricensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Mauritius.

Pteropus rufus E. Geoffroy St.-Hilaire, 1803

*1803. *Pteropus rufus* E. Geoffroy Saint-Hilaire, Catalogue des Mammifères du Muséum national d'Histoire naturelle, Paris, 47. Type locality: Madagascar: North and Central Madagascar [Goto Description]. - Comments: Type locality originally "Madagascar", restricted to North and Central Madagascar by Andersen (1908b: 367) (See Peterson *et al.*, 1995: 14). Andersen (1912b: viii) indicates that the type was once in the Paris Museum, but is probably no longer in existence. On page 206, he also mentioned that the specimen was sent by "le citoyen Macé, naturaliste" (nr 90 of Geoffroy's catalog). (Current Combination)

1810. *Pteropus Edwardsii* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 15: 92. Type locality: Madagascar: "Madagascar". - Comments: Renaming of *P. rufus* E. Geoffroy Saint-Hilaire, 1803 (see Andersen, 1906c: 206; Allen, 1939a: 60). Mentioned as *edwardii* by Smith (1833: 52) and as *edwarsi* by Koopman (1993a). Description is based on the same specimen as *Pteropus rufus* Geoffroy, 1803.

1816. *Pteropus madagascariensis* Oken, Lehrbuch Naturgeschichte, Jena, 3 (2): 936. Type locality: Madagascar: "Madagascar". - Comments: Renaming of *P. edwardsii* E. Geoffroy Saint-Hilaire, 1810 (see Andersen, 1912b: 207; Allen, 1939a: 60).

1825. *Pteropus phaiops* Temminck, Monogr. Mamm, 1: 178. Type locality: Madagascar: "Madagascar". - Comments: Syntypes: RMNH Jentink Cat. Syst., p. 146 [under *Pt. edwardsi*] c (skull not removed), d (skull removed); Cat. Ost., p. 259, c.

1838. *Pteropus phæops* Oken, Allg. Naturgesch, 7 (2): 990. Type locality: Madagascar.

1908. *Pteropus rufus princeps* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 2 (10): 367. Publication date: 1 October 1908. Type locality: Madagascar: Tuléar province: Fort Dauphin [25 02 S 47 00 E] [Goto Description]. Holotype: BMNH 1891.11.30.10: ad ♂, skull and alcoholic. Collected by: M. Cloisel. See Andersen (1912b: 14), Peterson *et al.* (1995: 14).

? *Pteropus rufus rufus:* (Name Combination)

TAXONOMY:
See Bergmans (1991) and Simmons (2005: 343 - 344). Commonly cited from "E. Geoffroy, 1803. Cat. Mamm. Mus. Nat. Hist. Nat. Paris, p. 47", but this work was never published, which would make this a *nomen nudum*. However, Opinion 2005 (Case 3022) fixed the authorship and date of this name to E. Geoffroy St.-Hilaire (1803) by (see Anonymus, 2002b: 154).

O'Brien *et al.* (2009) suggested that *P. aldabrensis*, *P. rufus*, *P. niger* and *P. seychellensis* (including *comorensis*) should be considered geographical forms of a single species *P. giganteus* (Brünnich, 1782) from the Indian subcontinent, Maldives and Andaman archipelagos.

Almeida *et al.* (2014: 85) place *P. rufus* in the "*vampyrus*" group.

COMMON NAMES:
Czech: kaloň madagaskarský, upír černolící. English: Madagascan Flying Fox, Madagascan Flying-fox, Red Flying Fox, Madagascar Fruit Bat, Madagascar Flying Fox. French: Renard volant de Madagascar, Renard volant roux, Roussette rougeâtre, Renard volant malgache. German:

Madagaskar-Flugfuchs. Malagasy: Fanihy. Spanish (Castillian): Zorro volador de Madagascar.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Gunnell *et al.* (2014: 3) refer to Goodman and Junkers (2013), who report on fossil material from the Andrahomana cave in Madagascar.

CONSERVATION STATUS:
Global - This species is listed as Vulnerable (VU A2acd ver 3.1 (2001)) based on the loss of over 30% of its population over the last 20 years. This can be attributed to the increased level of hunting particularly with the introduction of shotguns and continued loss of its preferred roosting habitats (Andriafidison *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - VU A2acd ver 3.1 (2001) (Andriafidison *et al.*, 2008a; IUCN, 2009). 2004 - VU A2b+3d ver 3.1 (2001) (Participants of CBSG CAMP Madagascar Mammal Worksh, 2004; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996). 1993 - LR/lc (World Conservation Monitoring Centre, 1993).

CITES - Appendix II.

MAJOR THREATS:
There are numerous threats to this species. It is listed as a game species under Malagasy law and can be legally hunted between the first of May and the first of September (Anonymus, 2007b: 6; Durbin, 2007; Randrianandrianina *et al.*, 2010: 412). Only the few roosts that are located in protected areas therefore receive some protection (Racey *et al.*, 2009). *Pteropus rufus* is hunted for food across Madagascar (MacKinnon *et al.*, 2003; Rakotondravony, 2006; Rakotonandrasana and Goodman, 2007; Racey *et al.*, 2009; Randrianandrianina *et al.*, 2010) where it is an important subsistence food, but also of commercial importance. Although quantitative data on the supply of *P. rufus* for food and the impact of this harvest on colonies/populations is lacking, there is some evidence that the offtake is locally unsustainable (Racey *et al.*, 2009). Hunting occurs at roost sites and where the bats forage, especially when they feed on trees in villages (Jenkins and Racey, 2008). There is evidence that *P. rufus* from Ile Sainte Marie is hunted commercially and frozen shipments are sent to the mainland port of Toamasina (Rakotonandrasana and Goodman, 2007). The conversion of the forest used by roosting bats into agriculture is another threat to *P. rufus* and results in the permanent loss of suitable trees which in many cases have been used for decades. *Pteropus rufus* feeds on a number of cultivated fruits that have a high economic value in rural Madagascar and is often subjected to persecution.

Randrianandrianina *et al.* (2010: 413) observed that a minimum of five *P. rufus* specimens were caught each night, when they were feeding on kapok (*Ceiba pentandra*) nectar in July. For one roost in Andranomena, Oleksy *et al.* (2015b: 4) reported that six hunters camped for three nights per week for approximately eight months per year and captured about 20 bats per night.

Oleksy *et al.* (2015b: 4) and Cardiff and Jenkins (2016: 97) mention that roost sites are also threatened by fire and agricultural expansion. These roost sites are particularly vulnerable as they are located in large trees located in forest fragments in savanna or scrub habitats.

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008a) [in IUCN (2009)] report that it is listed on CITES Appendix II and is a game species under Malagasy law (Durbin, 2007) but neither of these provide any practical in situ conservation measures (Racey *et al.*, 2009). There are a few roosts in protected areas, notably Parc National Kirindy-Mité, Parc National de Masoala, Parc National de Mananara-nord (MacKinnon *et al.*, 2003) and Berenty Private Reserve (Long, 2002), but many of the existing parks and reserves appear to be without roosting colonies (e.g. Goodman, 1996; 1999; Alonso *et al.*, 2002; Goodman *et al.*, 2005a; Schmid and Alonso, 2005). The ongoing process to triple the surface of protected areas in Madagascar is providing an unprecedented opportunity to include traditional roosts in the new conservation sites. There is also significant scope for local institutions to conserve roosts and this is already occurring in some parts of Madagascar where the bats use sacred forests (Jenkins *et al.*, 2007b) or where communities have created social contracts to protect the bats (Jenkins *et al.*, 2007a).

GENERAL DISTRIBUTION:
Pteropus rufus is endemic to Madagascar. It is one of the most widespread bat species on the island and appears to only be absent from the highly populated central highlands (MacKinnon *et al.*, 2003). The highest density of roost sites is in coastal regions, especially from Morombe in the south-west to Antsiranana in the north (MacKinnon *et al.*, 2003). It has also been recorded from the islands of Nosy Be, Nosy Komba, and Ile Sainte-Marie (Rakotonandrasana and Goodman, 2007: 6).

Native: Madagascar (Bollen and Van Elsacker, 2002; MacKinnon *et al.*, 2003; Simmons, 2005:

344; Rakotonandrasana and Goodman, 2007: 6; Long and Racey, 2007; Jenkins and Racey, 2008).

BIOGEOGRAPHY:
See O'Brien *et al.* (2009) for further details.

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 54) described the baculum having a distal tip forming an arch-shaped structure and a basal portion which is lobed with a distinct central prolongation; length: 3.22, 3.86 mm, width: 3.53, 4.15 mm. In subadults, the bones are notably reduced in length and width.

MOLECULAR BIOLOGY:
DNA - See O'Brien *et al.* (2009).

Karyotype - 2n = 38 and FN = 68, containing 11 pairs of metacentrics, 6 submetacentrics, 1 pair of acrocentrics; X: large submetacentric, Y: small acrocentric (see Richards *et al.*, 2016d: 187, 189).

Protein / allozyme - Unknown.

HABITAT:
MacKinnon *et al.* (2003) failed to locate any roost sites within the endemic spiny forests of south-west Madagascar. Long and Racey (2007) did not find any evidence to show that *P. rufus* uses the endemic plants of the spiny forest in the Mandrare region of Madagascar.
Jenkins *et al.* (2007b: 212) indicate that *P. rufus* is generally found in forest fragments or linear patches of vegetation along water.

HABITS:
Jenkins and Racey (2008) indicate that day roosts and night feeding areas are often spatially distinct, and are over 40 km apart.

ROOST:
P. rufus roost in foliage (Jenkins and Racey, 2008).

In their 2005 survey, Jenkins *et al.* (2007b: 213) have found six roosting sites, with colony sizes ranging from 40 to over 1,000 animals. Three of these were protected by local taboes or ancestral traditions.

Ravelomanantsoa *et al.* (2019: 110) indicate that *P. rufus* uses large trees (e.g. *Cocos nucifera* - Arecaceae) as roost.

DIET:
Bollen and Van Elsacker (2002: 37) found that *P. rufus* at Ste. Luce, ate the fruits of 40 endemic species, and that typically one seed species was found in a dropping. Oleksy and Jones (2013: 113) reported that 110 plant species were found in its diet, of which 59 (55 %) were endemic. However, Long (2002) and Long and Racey (2007) found *P. rufus* at Berenty in south-east Madagascar to have a narrow dietary breadth, consisting of only 14 plant species. The single most important food source for *Petropus rufus* in south-east Madagascar, is the pollen of *Agave sisalana* a commercial introduced species, while they also eat other locally cultivated and introduced fruits (*Mangifera indica*, *Psidium* cf. *cattleianum*, *Sclerocarya caffra*, *Cordia sinensis* and *Hylocereus* sp.) and native and endemic forest species (*Tamarindus indica* (leaves), *Celtis philippensis*, *Ficus megapoda*, *F. grevei*, *F. pachyclada* and *Grewia* sp.) (Long, 2002; Long and Racey, 2007). Jenkins *et al.* (2007b: 212) indicate that the most important food plants include *Ficus guatteriifolia*, *Syzigium* sp., *Terminalia fatrea*, *Uapaca thouarsii* and *U. littoralis*.
Raheriarisena (2005: 255) mentions that this species' diet is composed of fruits (59.0 - 65.1%), flowers (17.3 - 35.0%), and leaves (6.0 - 18.0%), but also that the percentages of these elements vary with the seasonal variations of plant phenology and the species' activity, especially its reproduction status.

Bollen *et al.* (2004a: 603) found that *P. rufus* preferred to consume multi-seeded fruits.

Bollen (2007: 140) lists the following food plants consumed by *P. rufus*: Annonaceae: *Polyalthia madagascariensis* Cavaco & Keraudren, 1957; Araliaceae: *Polyscias* sp.; Areceae: *Dypsis nodifera* Mart., 1849, *Dypsis prestoniana* Beentje, 1995; Bignoniaceae: *Ophiocolea delphinensis* H. Perrier, 1938; Canellaceae: *Cinnamosma madagascariensis* var. *namoronensis* H. Perrier, 1948; Combretaceae: *Terminalia fatraea* (Poir.) DC., 1828; Ericaceae: *Vaccinium emirnense* Hook, 1837; Euphorbiaceae: *Uapaca ferruginea* Baillon, 1858, *Uapaca littoralis* Denis, 1927, *Uapaca thouarsii* Baillon, 1858; Flacourtiaceae: *Ludia antanosarum* Capuron & Sleumer, 1972, *Scolopia orientalis* Sleumer, 1972; Grossulariaceae: *Brexia* sp.; Lauraceae: *Beilschmiedia madagascariensis* (Baillon) Kostermans, 1952, *Ocotea* sp.; Liliaceae: *Dracaena reflexa* var. *nervosa* H. Perrier, 1936; Loganiaceae: *Anthocleista longifolia* (Lam.) Boiteau, 1973, *Anthocleista madagascariensis*, Baker, 1882, *Bakerella ambongoensis* Balle, 1964, *Bakerella* sp.; Monimiaceae: *Tambourissa purpurea* (Tul.) A. DC, 1868; Moraceae: *Ficus baroni* Baker, 1883, *Ficus guatteriifolia* Baker, 1890, *Ficus pyrifolia* Burm. f., 1768; Myrtaceae: *Syzygium* sp.2; Rubiaceae: *Canthium variistipula* (Arènes ex Cavaco), *Ixora* sp., *Mapouria*

aegialodes Bremekamp, 1963, *Mapouria* sp., *Hyperacanthus mandenensis* Rakotonas. & A.P. Davis, 2004, *Tricalysia* cf. *cryptocalyx* Baker, 1882, *Vepris elliotii* (Radlk.) I. Verdoorn, 1926; Sapotaceae: *Sideroxylon beguei* var. *saboureani*, *Sarcolaena multiflora* Thouars, 1805.

Ravelomanantsoa *et al.* (2019: 110) reported that fruits of *Ziziphus jujuba* Mill.(Jujube, Red dade, chinese dade - Rhamnaceae) are consumed.

Oleksy *et al.* (2015a: 678) followed 15 radio-tracked animals (nine ♂♂ and six ♀♀ females) between July and September 2012 and found that females had larger home ranges and core foraging areas, which might be explained by the higher energy requirements of the females during the gestation period. The bats showed a strong preference for overgrown sisal (*Agave sisalana*) plantations, and also ate large quantities of figs (*Ficus grevei*).

Oleksy *et al.* (2017: 1) found seeds of *Ficus polita*, *F. grevei* and *F. lutea* in bat faeces. They found that the seeds that passed through the bat's digestive track had an increased germination success.

Based on stable isotope analyses, Reuter *et al.* (2016) found that *Pteropus rufus*, *Eidolon dupreanum* and *Rousettus madagascariensis* have broadly overlapping diets, although there are differences between *P. rufus* and *E. dupreanum*. Furthermore, they found that the diet shifted when these two species occurred sympatrically.

Raharimihaja *et al.* (2016: 9512) tested a number of methods to deter *P. rufus* from feeding on commercial fruits (*Litchi chinensis*). They found that an organic product made from dried blood and vegetable oil (Plantskydd®) with a taste and odour aimed at deterring mammal feeding, gave the best results.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Madagascar harrier-hawk (*Polyboroides radiates* (Scopoli, 1786)) as diurnal avian predator.

POPULATION:
Structure and Density - Roosts are conspicuous and noisy but the bats are often tightly clustered making abundance estimates at the larger sites difficult. MacKinnon *et al.* (2003) reported that colony size ranged from 10 to 5,000 animals with a median of 400. They found that nationally 17.5% of 154 roosts had been abandoned in the last ten years and desertion rates were much higher (70%) in the central highlands. The estimated national population size in 2000 was 300,000 (MacKinnon *et al.*, 2003). In December 2005, Rahaingodrahety *et al.* (2008) recorded colony sizes of 900 at Berenty Private Reserve, 412 at Amborabao and 54 at Sainte Luce.

Based on tooth-derived estimated of adult survival, Brook *et al.* (2019: 165) showed that even with a perfect juvenile annual survival (100 %) stable population trajectories for *P. rufus* are not possible.

Trend - 2008 -Decreasing (Andriafidison *et al.*, 2008a; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
For a selection of sounds, check http://macaulaylibrary.org/search?taxon=Pteropus rufus&taxon_id=11067862&taxon_rank_id=67&tab=audio

REPRODUCTION AND ONTOGENY:
Kaudern (1914: 11 - 12) reported that he was unable to shoot any pregnant female or females with young during his travels on Madagascar, which took place in the dry season (May to September), so he assumed they had their reproductive season in Spring or Summer [as *P. edwardsi*].
Rand (1935) [in Fox *et al.* (2009: 272)] found two large foetuses in each of the three female specimens that were available to him.

PARASITES:
BACTERIA
Gram-positive bacterium - Reviewed in McCoy (1974), who listed *Enterococcus* spp. and *Staphylococcus* spp.
Gram-negative bacterium - Mayoux *et al.* (1971: 29) and McCoy (1974) listed *Citrobacter* sp., *Enterobacter* sp., *Escherichia coli*, *Salmonella typhi*, *S. typhimurium*, *Salmonella* spp., and *Shigella flexneri*.

Gomard *et al.* (2016: 5) added *Leptospira* to this list (see also Dietrich *et al.*, 2018a: 3).

PROTOZOA
Ranaivoson *et al.* (2019: 1) were the first to report *Babesia* sp. (order Piroplasmida; family Babesiidae), an erythrocythic protozoan) from Madagascan bats (and the first Pteropodid infection). They examined 203 *P. rufus*, of which nine (all males) were positive for babesial infection, whereas none of the 203 bats carried any ectoparasites.

VIRUSES:
Coulanges *et al.* (1974) [in Fontenille *et al.* (1989: 239)] found antibodies against West-Nile virus in 11.4 % of the 94 bats from the Anjiro region they examined.

Coronaviridae - Coronaviruses
Thirteen novel strains of betacoronaviruses were identified in Madagascar in 2010 (Razanajatovo *et al.*, 2015).

Paramyxoviridae
3 out of 20 Madagascan specimens tested by Mélade *et al.* (2016b: 4) were positive for paramyxoviruses.
Henipavirus
Nipah (NiV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) found an overall contamination of 2.3%.
Hendra (HeV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) found an overall contamination of 2.3%.
Tioman (TiV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) found an overall contamination of 2.3%.

Rhabdoviridae – Rabies like viruses
Lyssavirus - Rabies related viruses
Andriamandimby *et al.* (2013: 3) reported on one *P. rufus* from Madagascar, which tested positive to antibodies for European Bat Lyssavirus type 1 (EBLV-1). Of the 11 bats tested by Mélade *et al.* (2016a: 6) for *Duvenhage lyssavirus*, five showed a positive reaction.

UTILISATION:
Pteropus rufus being the largest bat is the main source of bat bushmeat in Madagascar (Jenkins and Racey, 2008). In many regions nets are erected inside or on the periphery of roosts to intercept flying bats (Jenkins *et al.*, 2007b; Jenkins and Racey, 2008). In southern Madagascar *P. rufus* is netted when it feeds on sisal (*Agave sisalana*) plants at night and at least some of the bats are sold locally (Rahaingodrahety, 2007). Firearms (shotguns) are also used to hunt *P. rufus* in many areas (Jenkins and Racey, 2008). In eastern Madagascar individual trees with roosting bats are felled by hunters who club the fallen animals with sticks (MacKinnon *et al.*, 2003).
Pteropus rufus is hunted in the Daraina area in northeastern Madagascar (Rakotondravony, 2006) where roosts of over 1,000 individuals have been reported from littoral forest (Jenkins and Racey, 2008). Although the people living around the forests refrain from eating the bats, the colonies are reportedly subject to frequent hunting by local immigrants (Rakotondravony, 2006). In Makira, *P. rufus* is eaten widely by local communities and at $1.5 US/kg was the most expensive meat (Golden, 2005). In the Mahavavy-Kinkony area of western Madagascar, regular hunting at a *P. rufus* roost was reported by Rakotoarivelo and Randrianandrianina (2007); hunting teams of up to eight men visited the roost on a regular basis and caught up to 100 bats on each occasion. These were sold around villages and to local restaurants for $0.5 US each. On Nosy Boraha, *P. rufus* is regularly exploited from at least one roost and is served seasonally in restaurants in the main town on the island (Rakotonandrasana and Goodman, 2007). One hunter also reported that frozen shipments of *P. rufus* are sent to the mainland port of Toamasina (Rakotonandrasana and Goodman, 2007). At a small restaurant near Mahajanga in 2000, at least 30 *P. rufus* were reportedly sold daily, although it is not clear whether this figure is monthly average estimate or reflects a seasonal peak in availability (Racey *et al.*, 2009). In the sisal plantations surrounding Berenty Private Reserve, hunters can expect to catch 8 - 12 individuals per week between September and May and 25 - 30 between June and August, where they are sold discretely in villages around the reserve for $ 0.7 - 1.0 US (Rahaingodrahety, 2007) therefore a single hunter could catch between 164 and 192 bats per year.
Pteropus rufus and *Eidolon dupreanum* appear to be the only species sold in restaurants, where they are either served individually, complete with head and wings, jointed, or are diced up into small pieces and accompanied by rice (Jenkins and Racey, 2008).
Rakotondravony (2006) considered hunting of *P. rufus* a minor threat in northern Madagascar, while Golden (2005) reported large annual harvests in the Makira forest and Maroantsetra were unsustainable.
See also Goodman *et al.* (2008d).
Golden and Comaroff (2015: 5) indicate that flying foxes and other fruit bats (including *P. rufus*) are frequently the subject of food taboos, which they link to the fact that these bats are carriers of virulent zoonotic diseases.

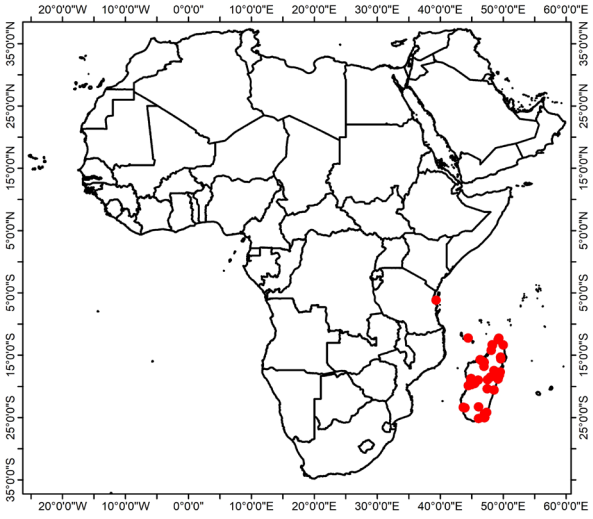


Figure 11. Distribution of *Pteropus rufus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Comoros, Madagascar, Tanzania.

Pteropus seychellensis A. Milne-Edwards, 1877

*1877. *Pteropus seychellensis* A. Milne-Edwards, Bull. Sci. Soc. Philom. Paris, sér. 7, 2: 221. Type locality: Seychelles: Mahe Island. Lectotype: MNHN ZM-MO-1878-1110 - 35A-157: ad ♂, mounted skin and skull. Collected by: M. Lantz. Paralectotype: MNHN ZM-MO-1878-1106: Collected by: M. Lantz. Rode (1941: 230): nr 157b. Paralectotype: MNHN ZM-MO-1878-1107 - 35B: ♂, mounted skin (skull not removed). Collected by: M. Lantz. Rode (1941: 230): nr 157a. Paralectotype: MNHN ZM-MO-1878-1108: Collected by: M. Lantz. Rode (1941: 230): nr 157c. Paralectotype: MNHN ZM-MO-1878-1109 - 35C: Collected by: M. Lantz. Rode (1941: 230): nr 157d. Paralectotype: MNHN ZM-MO-1878-1111: Collected by: M. Lantz. Paralectotype: MNHN ZM-MO-1878-1112: Collected by: M. Lantz. - Comments: Bergmans (1991: 151) indicated that the lectotype (MNHN CG 1878-1110), as well as most of the other specimens on which Milne-Edwards based his description, were in fact collected by Lantz on Marianne Island, and not on Mahé Island. (Current Combination)

1880. *Pteropus comorensis* Wallace, Island Life, 400. Type locality: Comoros: "Comoro Islands". - Comments: Allen (1939a: 60) and Simmons (2005) mention J.M. Nicoll, 1908 as author, since the original description by Wallace (1880) is actually a nomen nudum.

1908. *Pteropus comorensis* Nicoll, Three voyages of a naturalist being an account of many little-known islands in three oceans visited by the "Valhalla" R.Y.S. - Witherby & Co. London, 87. Type locality: Mayotte: Buzi Island [0 - 600 ft] [Goto Description]. Paratype: SMF 44784: ♂, skull and alcoholic. Collected by: Michael John Nicoll; collection date: 1906. Presented/Donated by: ?: Collector Unknown. Syntype: BMNH 1906.6.3.14: ad ♂, skin and skull. Collected by: Michael John Nicoll; collection date: 2 March 1906. Presented/Donated by: Earl of Crawford. Syntype: BMNH 1906.6.3.15: ad ♂, skin and skull. Collected by: Michael John Nicoll; collection date: 2 March 1906. Presented/Donated by: Earl of Crawford. Syntype: BMNH 1906.6.3.16: ad ♂, skin and skull. Collected by: Michael John Nicoll; collection date: 25 February 1906. Presented/Donated by: Earl of Crawford. - Comments: Nicoll (1908: 88) mentions that the bats were shot in the evening when returning to the ship, and before (p. 87) he mentioned that every evening the bats were flying from the little island (= "Buzi Island") to the main island (= Mayotte).

? *Pteropus seychellensis comorensis:* (Name Combination)

? *Pteropus seychellensis seychellensis:* (Name Combination)

TAXONOMY:
Hill (1971a: 574) included *aldabrensis*, but we follow Bergmans (1991) and Simmons (2005: 344) who considers this to be a separate species.

It seems probable that the two recognized subspecies *Pteropus seychellensis seychellensis* (from the Seychelles) and *Pteropus seychellensis comorensis* (from the Comoros Islands and Mafia Island) represent distinct taxa at the species level. In addition, the population of *Pteropus seychellensis comorensis* from Mafia island (Tanzania) might represent a species distinct from the populations of this bat recorded from the Comoros Islands (Mickleburgh *et al.*, 2008di; IUCN, 2009).

O'Brien *et al.* (2009) suggested that *P. aldabrensis*, *P. rufus*, *P. niger* and *P. seychellensis* (including *comorensis*) should be considered geographical forms of a single species *P. giganteus* (Brünnich, 1782) from the Indian subcontinent, Maldives and Andaman archipelagos. O'Brien *et al.* (2009) show that *P. s. seychellensis* is more closely related to *P. niger* from Mauritius, than to *P. s. comorensis*. Further, based on cytochrome *b* and 12S results, there appears to be no notable genetic differentiation in populations of *P. s. comorensis* from Grande Comore and Mayotte, suggesting genetic exchange.

Chan *et al.* (2011: 7) found that *P. s. comorensis* and *P. rufus* alleles differed by as few as two base-pairs. Based on this mitochondrial haplotype network, *P. s. seychellensis* was more closely related to *P. niger* and these two were more closely related to *P. rufus* than to *P. s. comorensis*.

Almeida *et al.* (2014: 85) place *P. seychellensis* in the "*vampyrus*" group.

COMMON NAMES:
Comorian: ndema, ndrema. Czech: kaloň seychelský. English: Seychelles Flying Fox, Seychelles Fruit Bat. French: Renard volant des Seychelles, Roussette des Seychelles. German: Seychellen-Flugfuchs. Spanish (Castillian): Zorro volador de las Seychelles.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008di; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008di; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cs; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996). 1993 - LR/lc (World Conservation Monitoring Centre, 1993); VU [assessed as *P. s. aldabrensis*] (World Conservation Monitoring Centre, 1993). 1990 - VU [assessed as *P. s. aldabrensis*] (IUCN, 1990). 1988 - VU [assessed as *P. s. aldabrensis*] (IUCN Conservation Monitoring Centre, 1988).

CITES - Appendix II.

MAJOR THREATS:
Overall, there currently appear to be no major threats to the species. There is some limited hunting for food on a few islands in the species range (e.g. Mahé and Praslin in the Seychelles) however, this does not appear to be significantly impacting the population at present. Additional localised threats include mortality through collision with power lines, and possible persecution as a pest of fruit crops (Mickleburgh *et al.*, 2008di; IUCN, 2009). However, Sagot and Chaverri (2015: 1670) mention the following threats: Roost loss or disturbance, habitat degradation or loss, introduced predators.

Due to the numerous amount of bats around Mutsamudu (Anjouan, Coromo islands), Middleton and Hume (2010: 132) report that this bat is not a part of the people's diet.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008di) [in IUCN (2009)] report that a large population (2,000 to 3,000 bats) of this species is present in the Morne Seychellois National Park on Mahé, Seychelles (Nicoll and Racey, 1981). There is a general need to continue monitoring activities for this species in order to detect any possible declines and to determine if there are any movements between populations. Studies are underway to better determine the taxonomic status of the population of bats from Mafia Island (*Pteropus seychellensis comorensis*) largely to understand if this population should be recognised at the species level distinct from *P. seychellensis*. The population of Mafia Island may be threatened, and an assessment of the situation on this island and of the possibilities for the species' protection there is highly desirable (Mickleburgh *et al.*, 2002a).

Based on their study of mitochondrial and microsatellite markers, Ibouroi *et al.* (2018a: 1425) conclude that the populations of *P. seychellensis* occurring on the Comoro Islands can be treated as one management unit for conservation purposes (contrary to what they found for *P. livingstonii*).

GENERAL DISTRIBUTION:
Pteropus seychellensis has been recorded from the Seychelles, the Union of the Comoro and Tanzania. In the Seychelles it is present on a number of islands including Mahé, Praslin, La Digue, and Silhouette. Gerlach (2004) mentions that it has recently been recorded roosting on several islands where its presence was previously unconfirmed. In the Comoros it is known from the islands of Anjouan, Grand Comore and Moheli. In Tanzania, it is restricted to Mafia island, possibly Zanzibar, although Simmons (2005) considers this record extremely dubious.

Ibouroi *et al.* (2018b: 2395) indicated that its distribution is negatively correlated to natural forest across the entire area on the Comoro Islands, but that its foraging areas were positively correlated with natural forests and high-elevation areas.

Cheke (2011: 59) argues this species (as *P. comorensis*) was introduced on Mafia island by Comorians, rather than having arrived on the island by itself, which he supports by indicating that the bat was not noticed (perhaps not present) until the 1930s, and that no bones were found in middens (p. 65).

Known across an elevational range on Grand Comore from sea level to 1,000 m, on Anjouan from sea level to 760 m, on Mohéli from sealevel to 500 m, and Mayotte from sea level to 250 m (Cheke and Dahl, 1981; Mickleburgh *et al.*, 1992; Trewhella *et al.*, 2001; Goodman *et al.*, 2010c: 123).

Native: Comoros (Goodman *et al.*, 2010c: 123 as *P. s. comorensis*); Mayotte; Seychelles; Tanzania.

BIOGEOGRAPHY:
See O'Brien *et al.* (2009) and Goodman *et al.* (2010c: 123) for further details.

MOLECULAR BIOLOGY:
DNA - See O'Brien *et al.* (2009).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
Goodman *et al.* (2010c: 123) indicate that *P. s. comorensis* is adapted to the anthropgenic transformation of the former natural habitats of the different islands, including the widespread plantations of fruit trees. They occur in a variety of habitats from urban settings, agricultural zones, to remnant forest patches.

HABITS:
See Cheke and Dahl (1981); Trewhella *et al.* (1995); Trewhella *et al.* (2001) and Louette (2004).

Gerlach (2003: 79) reports on *P. seychellensis* specimens flying low over the sea surface, and dipping their belly fur in the water. He postulates that this is possibly a strategy to remove parasites. The risk of falling in sea was minimised as the bats only dipped in exceptionally calm weather.

Based on wing morphology, Lindhe Norberg *et al.* (2000) classified this species (as *P. seychellensis comorensis*) as "non-soaring".

ROOST:
Racey and Nicoll (1984) [in O'Brien (2011: 262)] indicate that *P. seychellensis* roosts in tall trees (*Casuarina* or *Albizzia*).

Ibouroi *et al.* (2018b: Suppl.) reported the following roost trees being used by *P.seychellensis comorensis* on the Comoro Islands: Anacardiaceae: *Mangifera indica, Brachylaena ramiflora*; Bombacaceae: *Adansonia digitata, Ceiba pentandra*; Caesalpiniaceae: *Tamarindus indica*; Combretaceae: *Terminalia catappa*; Fabaceae: *Pterocarpus indicus*; Lauraceae: *Ocotea comorensis*; Leeaceae: *Leea guineensis*; Loganiaceae: *Nuxia pseudodenta*; Mimosaceae: *Albizia glaberrima, Albizia lebbeck*; Moraceae: *Artocarpus heterophyllus, Ficus antandronarum, Ficus lutea, Ficus pirifolia*; Myrtaceae: *Eucalyptus* sp., *Eugenia jambolana*; Sapindaceae: *Litchi chinensis*.

DIET:
Pteropus seychellensis eats 27 species of plant, including 17 fruits (Racey and Nicoll, 1984).

Trewhella *et al.* (2001: 141) reported the following food items (with known items in bold and suspected in plain text): Anacardiaceae: *Anacardium occidentale* L. (cashew), ***Mangifera indica*** L. (mango); Annonaceae: *Annona muricata* L. (soursop), *Annona reticulata* L. (custard apple), *Annona squamosa* L. (sugar apple or sweetops); Aphloiaceae: *Aphloia theaeformis* [= *Aphloia theiformis* (Vahl) Benn.]; Arecaceae: *Cocos nucifera* L. (coconut tree); Cannabaceae: *Trema orientalis* (L.) Blume (charcoal-tree, Indian charcoal-tree,pigeon wood or Oriental trema); Caricaceae: ***Carica papaya*** L. (papaya); Combretaceae: ***Terminalia catappa*** L. (Indian-almond); Fabaceae: ***Erythrina*** sp. (coral trees); Gentianaceae: *Anthocleista grandiflora* L. (forest fever tree); Lamiaceae: ***Vitex*** sp. (chaste tree); Loganiaceae: *Strychnos spinosa* Lam. (Natal orange, spiny orange or green monkey orange); Malvaceae: ***Adansonia digitata*** L. (baobab), ***Adansonia madagascariensis*** Baill. (baobab), ***Ceiba pentandra*** (L.) Gaertn. (kapok tree); Monimiaceae: *Tambourissa anjouanensis*, *Tambourissa leptophylla* (Tul.) A. DC., *Tambourissa mohelienses* Lorence, *Tambourissa paradoxa* Perkins; Moraceae: *Artocarpus altilis* (Parkinson) Fosberg (breadfruit), *Artocarpus heterophyllus* Lam. (jackfruit or jack tree), ***Ficus*** sp.; Musaceae: *Musa sapientum* L. (banana or plantane); Myrtaceae: *Eugenia jambos* L. [= *Syzygium jambos* L. (Alston)] (rose apple), *Psidium cattleyanum* Sabine (Cattley guava, strawberry guava or cherry guava), *Psidium guajava* L. (common guava), ***Syzygium cuminii*** (L.) Skeels (Java plum); Oxalidaceae: *Averrhoa bilimbi* L. (bilimbi, cucumber tree or tree sorrel); Rubiaceae: *Psychotria* aff. *aledjoensis* De Wild. [= *Psychotria mannii* Hiern, 1877]; Rutaceae: *Citrus* x *aurantifolia* (Christm.) Swingle (key lime), *Citrus* x *aurantium* L. (bitter orange, seville orange, sour orange, bigarade orange, or marmalade orange), *Citrus reticulata* Blanco, 1837 (mandarine orange), *Citrus* x *sinensis* (L.) Osbeck (orange).

POPULATION:
Structure - O'Brien *et al.* (2009), based on cytochrome *b* and 12S results, indicated that there appeared to be no notable genetic differentiation in populations of *P. s. comorensis* from Grande Comore and Mayotte, suggesting genetic exchange.

Density - This species is widespread throughout the Seychelles, with some colonies consisting of up to 300 individuals. It is very common in villages and towns (Goodman, 2007). The population was estimated to be around 10,000 individuals on the Seychelles in 1979, and was believed to be close to this level in 2004 although adequate censuses have not been completed for all islands (Gerlach, 2004).

On the Comoro Islands, Ibouroi *et al.* (2018b: 2406) observed 11,898 bats at 59 different sites,

with colony sizes varying between 11 and 742 individuals (average: 184).

Trend - 2008 - Stable (Mickleburgh *et al.*, 2008di; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Riccucci (2016: 93) reported on play behaviour on Praslin Island, which included play-fighting, tussle, and play-chasing. He indicated that this behaviour was not limited to young bats, but saw this also among adults.

Trewhella *et al.* (2001: 135) indicate that the sympatric *P. livingstonii* is more diurnally active (leaving their roosts at 11 a.m.) than *P. seychellensis comorensis* (leaving its roosts not before 3 p.m.), and is the dominant species during their encounters.

REPRODUCTION AND ONTOGENY:
See Trewhella *et al.* (1995) and Reinhardt and Jacobs (2006).

MATING:
McCracken and Wilkinson (2000: 339) indicate that Cheke and Dahl (1981) reported that *P. seychellensis* forms harem groups.

PARASITES:
BACTERIA
Dietrich *et al.* (2018a: 3) reported the presence of bacteria of the genus *Leptospira*.

VIRUSES:
Astroviridae
Hoarau *et al.* (2018: 1) tested 21 bats from the Comoros, but none of them tested positive for this group of viruses.

Rhabdoviridae
Four of 40 tested bats from Mayé showed a seroreaction against *Lagos bat lyssavirus* (LBV) (Mélade *et al.*, 2016a: 6). Six against *Duvenhage lyssavirus* (DUVV), and one out of 17 tested, against *European bat lyssavirus 1* (EBL-1). For the 19 specimens tested from Mayotte, two were positive for LBV and one for DUVV.

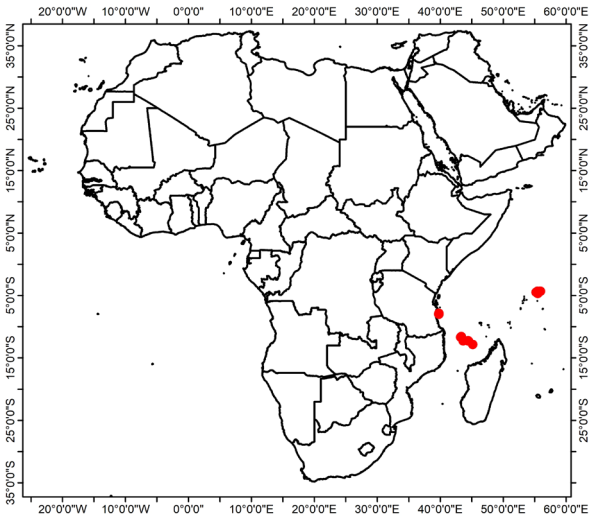


Figure 12. Distribution of *Pteropus seychellensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Comoros, Mayotte, Seychelles, Tanzania.

Pteropus subniger (Kerr, 1792)

*1792. *Vespertilio vampyrus subniger* Kerr, in: Linnaeus, Animal Kingdom, 1 (1): xvii, 91. Publication date: February 1792. Type locality: Réunion: "Réunion island". - Comments: Andersen (1912b: viii) mentions that the type was originally in the Cabinet Réaumur, but is probably no longer in existence.

1802. *Spectrum rubidum* Daudin, in: Buffon, Histoire Naturelle des Quadrupèdes, Didot ed, 14: 188. Type locality: Mauritius: Reunion. - Comments: Type locality fixed by Andersen (1912b: 169) since the name was proposed for Buffon's Rougette, which was based on a specimen sent by de la Nux from Reunion. The year of publication might not be correct (see Allen, 1939a: 61).

1803. *Pteropus fuscus:* Desmarest, Nouveau Dictionnaire d'Histoire Naturelle, 19: 544. Type locality: Réunion: "Réunion Island". - Comments: Not of E. Geoffroy Saint-Hillaire, 1803, see Allen (1939a: 61).

1803. *Pteropus ruber* E. Geoffroy Saint-Hilaire, Catalogue des Mammifères du Muséum national d'Histoire naturelle, Paris, 48. Type locality: Mauritius: Réunion [Goto Description]. - Comments: Originally "Madagascar", but corrected to Réunion by Andersen (1912b: 169). Andersen also indicates that the type specimen is not in the Paris Museum.

1810. *Pteropus rubricollis* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 15: 93. Type locality: Réunion: "Réunion Island". - Comments: One specimen sent by Mr. de la Nux: see Geoffroy Saint-Hilaire (1810a: 94). Andersen (1912b: 169) indicates that this is the

same specimen as used by Brisson (1756) for his description of "*Pteropus collo rubro*" and by Buffon (1763) for his "*Rougette*".

1814. *Pteropus torquatus* G. Fischer, Zoognosia, 3: 553. - Comments: This is a renaming and redescription of Brisson's "*Pt. collo rubro*" (see Andersen, 1912b: 169).

1815. *Pteropus collaris* Illiger, Abh. K. Preuss. Akad. Wiss. Berlin, 78, 84. Type locality: Mauritius: Réunion: Type locality originally "E. African Islands", but restricted to Réunion by Andersen (1912b: 169). - Comments: "According to Andersen (1912b: 169), it looks like the publication was part of series dated 1804-1811, but actually appeared in 1815 in the section on E. African Islands." Simmons (*pers. comm.*).

1837. *Pteropus vulgaris* Temminck, Monogr. Mamm, 2: 74, pl. 38.

? *Pteropus subniger:* (Name Combination, Current Combination)

TAXONOMY:
See Bergmans (1991) and Simmons (2005: 344).

Almeida *et al.* (2014: 83) indicate that *P. subniger* could not be tested, but tentatively placed in an "*incertae sedis*" group.

COMMON NAMES:
Czech: kaloň maskarénský, upír obecný, upír červenokrký, kaloň obojkový. English: Dark Flying Fox, Lesser Mascarene Flying Fox, Lesser Mascarene Flying-fox. French: Petit Renard volant de Mascareignes, Roussette foncée, Rougette, Petit renard volant de Mascarene, Roussette à collet rouge. German: Kleiner Maskarenen-Flugfuchs. Spanish (Castillian): Zorro volador oscuro de Mauricio.

CONSERVATION STATUS:
Global - The last authentic record of this species on Mauritius was in 1859, but it is believed to have died out between 1864 and 1873. On Réunion, no new records appeared after 1862 and it seems probable that it became extinct in the 1860s (Mickleburgh *et al.*, 2008de; IUCN, 2009).

Assessment History -
2008 - EX ver 3.1 (2001) (Mickleburgh *et al.*, 2008de; IUCN, 2009). 2004 - EX ver 3.1 (2001) (Mickleburgh *et al.*, 2004cu; IUCN, 2004). 1996 - Ex (Baillie and Groombridge, 1996). 1994 - Ex (Groombridge, 1994). 1993 - Ex (World Conservation Monitoring Centre, 1993). 1990 - Ex (IUCN. 1990). 1988 - Ex (IUCN Conservation Monitoring Centre, 1988). 1981 - probably extinct (Cheke and Dahl, 1981).

CITES - Appendix II.

MAJOR THREATS:
Both deforestation and local hunting are thought to have contributed to the extinction of this species. It was thought to have lived in hollow trees (Mickleburgh *et al.*, 2008de; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008de) [in IUCN (2009)] report that this is no longer applicable.

GENERAL DISTRIBUTION:
Pteropus subniger was previously known from the Mascarenes Islands (Mauritius and Réunion). It was restricted to elevations of between 1,200 and 1,600 m asl.

O'Brien (2011: 286) reports it from the Tanzanian island of Mafia.

Regionally extinct: Mauritius; Réunion.

POPULATION:
Structure and Density - This species is now extinct. It is believed to have become extinct on Mauritius between 1864 and 1873. It is likely to have disappeared from Réunion in the 1860s. It may have lasted a little longer but is now certain to be extinct. In the 1730s it was common enough to consider for the bat oil trade (Mickleburgh *et al.*, 2008de; IUCN, 2009).

UTILISATION:
Caceres (2010: 9) indicates that in the 1730s its population (on La Réunion) was large enough to trade its fat.

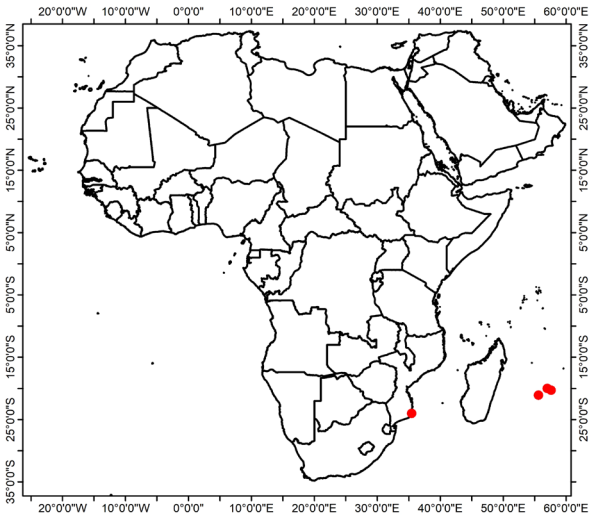


Figure 13. Distribution of *Pteropus subniger*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Mauritius, Mozambique, Réunion.

Pteropus voeltzkowi Matschie, 1909

*1909. *Pteropus (Spectrum) voeltzkowi* Matschie, Sber. Ges. naturf. Freunde Berlin, 486. Publication date: October 1909. Type locality: Tanzania: Pemba Island: Fufuni [ca. 07 31 S 38 25 E]. Holotype: ZMB 88677: ad ♂, skin and skull. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 13 March 1903. Paratype: ZMB ad ♀. See Turni and Kock (2008). Paratype: ZMB 88678: ad ♀. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 13 March 1903. See Turni and Kock (2008). Paratype: ZMB 88679: ad ♀. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 12 March 1903. See Turni and Kock (2008). Paratype: ZMB 88680: ad ♀. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 13 March 1903. See Turni and Kock (2008). Paratype: ZMB 88681: ad ♀. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 13 March 1903. See Turni and Kock (2008).
2010. *P[teropus] voletzkowi:* Goodman, Weyeneth, Ibrahim, Saïd and Ruedi, Acta Chiropt., 12 (1): 133. (Lapsus)
? *Pteropus voeltzkowi:* (Name Combination, Current Combination)

TAXONOMY:
See Bergmans (1991) and Simmons (2005: 346).

P. voeltzkowi together with *P. livingstonii* form the most distinct and ancient lineage of the western Indian Ocean *Pteropus* spp. (O'Brien *et al.*, 2009). The phylogenetic analyses performed by Chan *et al.* (2011: 7) suggest that both are sister species. This is supported by Almeida *et al.* (2014: 85), who place this species in the "*livingstonii*" group.

COMMON NAMES:
Czech: kaloň pembánský, kaloň pembský. Dutch: Pemba vliegende hond. English: Pemba Flying-fox, Pemba Flying Fox. French: Renard volant de Pemba. German: Pemba-Flugfuchs. Spanish (Castillian): Zorro volador de Voeltzkow.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU D2 ver 3.1 (2001)) because it is known from only a single location (Pemba Island), where ongoing active conservation activities have significantly reduced the plausibility of future declines of this species (Mickleburgh *et al.*, 2008df; IUCN, 2009).

Assessment History -
2008 - VU D2 ver 3.1 (2001) (Mickleburgh *et al.*, 2008df; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Mickleburgh *et al.*, 2004cw; IUCN, 2004). 2002 - CR C2a (Mickleburgh *et al.*, 2002a: 22). 1996 - CR (Baillie and Groombridge, 1996). 1994 - EN (Groombridge, 1994). 1993 - EN (World Conservation Monitoring Centre, 1993). 1990 - EN (IUCN, 1990). 1988 - VU (IUCN Conservation Monitoring Centre, 1988).

CITES - Appendix II.

MAJOR THREATS:
Much of the natural forest habitat of this bat has been cleared or severely fragmented. The species has been hunted for food with the use of shotguns replacing traditional methods, resulting in an unsustainable use (Entwistle and Corp, 1997a). As of 2005, hunting had been reduced but not stopped on Pemba (Trewhella *et al.*, 2005). An additional threat is posed by the collision of bats with overhead electric cables (Mickleburgh *et al.*, 2008df; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008df) [in IUCN (2009)] report that ongoing awareness raising on the importance and uniqueness of the endemic fruit bat, and the need for sustainable hunting, has been undertaken through environmental education programmes (Trewhella *et al.*, 2005; Juma, 2007). Income for the local community is being generated through bat related ecotourism activities (Juma, 2007). It has been reported from the recently gazetted Ngezi-Vumawimbi Nature Forest Reserve and Msitu Kuu Forest (Pakenham, 1984; Juma, 2007). Illegal logging and the invasive umbrella tree (*Maesopsis eminii*), that degrades the habitat of this bat, are being controlled within the Nature Forest Reserve (Juma, 2007).

A captive breeding program was set up in 1994, starting with 18 specimens, of which 12 were housed in the Phoenix Zoo (USA), but only 4 ♂♂ and 1 ♀ survived, and Carroll and Feistner (1996: 334) were not yet able to provide information about the program's success.

GENERAL DISTRIBUTION:
Pteropus voeltzkowi is endemic to the island of Pemba in Tanzania, where it occurs at elevations from sea level to 45 m asl.

Native: Tanzania.

MOLECULAR BIOLOGY:
DNA - See O'Brien *et al.* (2009).
Karyotype - Unknown.
Protein / allozyme - Unknown.

ROOST:
Entwistle and Corp (1997a: 137) reported roosts to be found in primary forest (n = 5), secondary forest (overgrown clove plantations) (n = 6), traditional graveyards (n = 4), mangroves (n = 1), and isolated trees (n = 3).
The tree species included: *Uapaca guineensis, Mangifera indica, Ficus natalensis, Ficus lutea, Syzygium jambolanum, Terminalia catappa, Adansonia digitata, Antiaris toxicaria, Erythrophleum suaveolens, Afzelia quanzensis, Parinari curatellifolia*, and *Blighia unijugata*.

DIET:
Seltzer *et al.* (2013: table S2) provide an overview of the plant species found beneath bat feeding roosts. For *P. voeltzkowi* this includes *Ficus sur* Forssk. (Broom cluster fig - Moraceae).

Entwistle and Corp (1997b: 357) analysed faecal pellets, ejecta and dropped fruits, as well as information obtained from villagers and students, and provided the following overview of the bat's diet: *Mangifera indica* L. (mango - Anacardiaceae [fruit]), *Artocarpus altilis* (Parkinson) Fosberg (breadfruit - Moraceae [fruit]), *Ficus* spp. (figs - Moraceae [fruit]), *Carica papaya* L. (papaya - Caricaceae [fruit]), *Ceiba pentandra* (L.) Gaertn. (kapok - Malvaceae [flowers/pollen]), *Anacardium occidentale* L. (cashew apple - Anacardiaceae [fruit]), *Musa spp.* (banana or plantain - Musaceae [fruit and flowers/pollen]), *Psidium guajava* L. (guava - Myrtaceae [fruit]), *Terminalia catappa* L. ('kungu' or Indian-almond - Combretaceae [fruit]), *Parinari curatellaefolia* Planch. ex Benth. (mupundu or mobola plum - Chrysobalanaceae), *Cocus nucifera* L. (coconut - Arecaceae [leaves]), *Eugenia aromatica* (L.) Baill. [= *Syzygium aromaticum* (L.) Merrill & Perry (clove - Myrtaceae [fruit]), *Calophyllum inophyllum* L. (Alexandrian laurel - Callophyllaceae), *Syzygium jambolanum* Lam. [= *Syzygium cumini*] (L.) Skeels. (jambolana or Java plum - Myrtaceae [flowers/pollen]). They also indicated (p. 359) that cultivated species are prominently present in the diet during the months of June and July.

POPULATION:
Structure and Density - In the early 1990s the population of this species appears to have been reduced to a few hundred animals at most (Mickleburgh *et al.*, 1992). Entwistle and Corp (1997a) reported that in 1997, 94% of the population was restricted to 10 roosts (of 41 in total) with a total estimate of 4,600 to 5,500 individuals. Entwistle (2001: 356) reported that more recent local participation in survey work had helped to give a more accurate population estimate of ca. 6,900 bats (Trewhella *et al.*, 2005). The population of bats has continued to increase and by the end of 2006 there were ca. 19,000 animals (Juma, 2007).
Trend - 2008 - Increasing (Mickleburgh *et al.*, 2008df; IUCN, 2009).

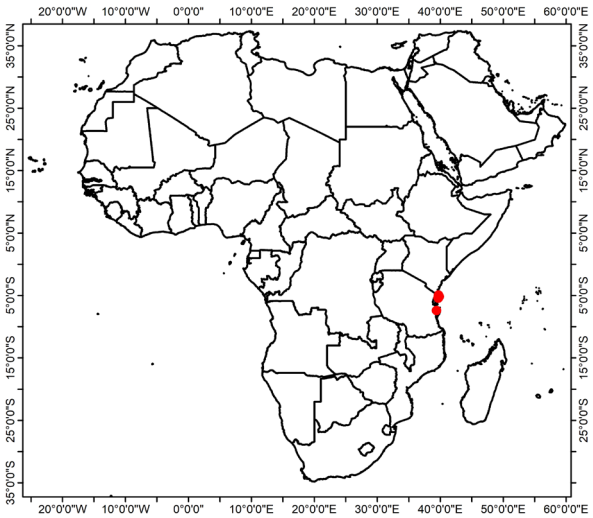


Figure 14. Distribution of *Pteropus voeltzkowi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Tanzania.

Subfamily Rousettinae Andersen, 1912

1912. *Epomophorinae* K. Andersen, Cat. Chiroptera Brit. Mus. Publication date: 23 March 1912. - Comments: Considered as a valid subfamily by Bergmans (1997: 69) who includes the tribes Epomophorini Gray, 1866 (*Epomophorus, Micropteropus, Hypsignathus, Epomops, Nanonycteris*), Myonycterini Lawrence and Novick, 1963 (*Myonycteris, Lissonycteris, Megaloglossus*), Scotonycterini Bergmans, 1997 [new tribe] (*Scotonycteris, Casinycteris*), Plerotini Bergmans, 1997 [new tribe] (*Plerotes*)? However, Almeida *et al.* (2016: 83) included the Epomophorine genera in the Rousettinae.

1912. *Rousettinae* K. Andersen, Cat. Chiroptera Brit. Mus. Publication date: 23 March 1912. - Comments: Bergmans (1997: 69) recognizes the Rousettinae as a separate subfamily in which he included the tribes Rousettini Andersen, 1912 (*Rousettus, Eonycteris, Eidolon*)

and Dobsoniini Andersen, 1912 (*Dobsonia, Aproteles*). Almeida *et al.* (2016: 83), however, provided an entirely different arrangement.

1970. *Rousettina* Koopman and J.K. Jones Jr., Classification of Bats. - Comments: Not included in Simmons (2005) since it was not proposed as family name, but as a subdivision within the Pteropodidiae (Simmons, pers. comm.).

TAXONOMY:
The subfamily was already recognized by Bergmans (1997: 69) and confirmed by the phylogenetic study by Almeida *et al.* (2016: 83), although their content differs. Bergmans (1997: 69) considered the Epomophorinae to be a valid separate subfamily, whereas Almeida *et al.* (2016: 83) included them in the Rousettinae.

Currently recognized tribes and genera of Rousettinae: Rousettini (***Rousettus*** Gray, 1821), Eonycterini (*Eonycteris* Dobson, 1873), Scotonycterini (***Casinycteris*** Thomas, 1910, ***Scotonycteris*** Matschie, 1894), Epomophorini (***Epomophorus*** Bennett, 1836, ***Epomops*** Gray, 1870, ***Hypsignathus*** H. Allen, 1861, ***Micropteropus*** Matschie, 1899, ***Nanonycteris*** Matschie, 1899), Stenonycterini (***Stenonycteris*** Gray, 1870), Myonycterini (***Lissonycteris*** K. Andersen, 1912, ***Megaloglossus*** Pagenstecher, 1885, ***Myonycteris*** Matschie, 1899), Plerotini (***Plerotes*** K. Andersen, 1910).

Genus ***Casinycteris*** Thomas, 1910

*1910. *Casinycteris* Thomas, Ann. Mag. nat. Hist., ser. 8, 6 (31): 111. Publication date: 1 July 1910 [Goto Description]. - Comments: Type species: *Casinycteris argynnis* Thomas, 1910. (Current Combination)

TAXONOMY:
Revised by Bergmans (1991).

Included in the Scotonycterini tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Casinycteris*: ***argynnis*** Thomas, 1910; ***campomaanensis*** Hassanin 2014; ***ophiodon*** (Pohle 1943).

COMMON NAMES:
Czech: krátkonebí kaloni. English: Short-palate Fruit-bats, Short-palated Fruit-bats. French: Casinyctère. German: Kurzgaumen-Flughunde.

Casinycteris argynnis Thomas, 1910

*1910. *Casinycteris argynnis* Thomas, Ann. Mag. nat. Hist., ser. 8, 6 (31): 111. Publication date: 1 July 1910. Type locality: Cameroon: Ja River: Bitye [03 13 N 12 22 E, 2 000 ft] [Goto Description]. Holotype: BMNH 1911.5.5.1: ad ♀, skin and skull. Collected by: George Latimer Bates Esq. Collection date: 19 November 1909; original number: 502. (Current Combination)

1943. *[Scotonycteris] argynnis:* Pohle, Sber. Ges. naturf. Freunde Berlin, 86 (for 1942). (Name Combination)

TAXONOMY:
See Bergmans (1991) and Simmons (2005: 315 - 316).

COMMON NAMES:
Czech: kaloň krátkonebý. English: Golden Short-palate Fruit-bat, Yellow-winged Short-palate Fruit-bat, Thomas's Short-palate Fruit-bat, Short-palated Fruit Bat, Golden Short-palated Fruit Bat. French: Casinyctère dorée, Roussette à petit palais, Chauve-souris frugivore à palais court, Casinyctère. German: Goldener Kurzgaumen-Flughund.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008c; IUCN, 2009).

Assessment History -

2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008c; IUCN, 2009). 2004 -NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004k; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
Mickleburgh *et al.* (1992) indicate that there is little information on the threats to this species, but that it may be threatened by deforestation. It is possible that this species eats cultivated fruits, and consequently might be persecuted as a crop pest (Mickleburgh *et al.*, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008c) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, and it is not known if the species is present within any protected areas. Mickleburgh *et al.* (1992) recommend that surveys are needed to assess the conservation status of this species, to determine if it is present in protected areas, and to learn more about the food plants and general natural history of this species.

GENERAL DISTRIBUTION:
This lowland species is distributed in Central Africa. It has been recorded from southern Cameroon, the Central African Republic and the Democratic Republic of the Congo.

Native: Cameroon; Central African Republic; Congo (The Democratic Republic of the) (Bergmans, 1991; Lunde *et al.*, 2001: 537; Monadjem *et al.*, 2010d: 550); Equatorial Guinea; Gabon (Drexler *et al.*, 2012a: Suppl. Table S1).
Presence uncertain: Congo.

DETAILED MORPHOLOGY:
Chawana *et al.* (2013: 160) report an average brain mass of 0.83 g (n = 2).

FUNCTIONAL MORPHOLOGY:
The eye of this bat contains about 130,000 retinal ganglion cells (Coimbra *et al.*, 2016: 191). The minimum angle of resolution was about 0.227° (ca. 8 mm at 1 m distance).

HABITAT:
This species is generally associated with lowland tropical moist forest, swamp forest, a mosaic of these two forest habitats, and a mosaic of swamp forest and secondary grassland (Bergmans, 1991).

ROOST:
It is a solitary rooster, with one specimen collected in the dense foliage of a bush Nowak (1999).

DIET:
Gembu Tungaluna (2012: 91 - 93) followed the consumption of fruits by this species year-round in the DRC and reported the following: First heavy rain season (September - November): *Uapaca guineensis* Müll.Arg., 1864 (Sugar plum, red cedar, false mahogany, rikio) (31%), *Ficus leprieuri* Miq., 1867 (19%), *Ficus wildemanniana* Warb. (14%), *Pseudospondia microcarpa* Engl. (10%), *Musanga cecropioides* R. Br. & Tedlie (African corkwood tree, umbrella tree) (8%), *Myrianthus arboreus* P. Beauvois, 1805 (giant yellow mulberry, bush pineapple, corkwood) (8%), *Spondias cytherea* Sonnerat, 1782 (Ambarella, otaheite apple, great hog plum) (2%), *Dacryoides edulis* H.J. Lam (safou, African pear, bush pear, Nsafu, bush butter tree, butterfruit) (2%), *Carica papaya* L. (papaya) (2%).
First mild rain season (December - February): *Ficus leprieuri* (42%), *Musanga cecropioides* (27%), *Myrianthus arboreus* (11%), *Spondias cytherea* (5%), *Uapaca guineensis* (5%), *Ficus vallis-choudae* Delile (5%), *Ficus wildemanniana* (5%).
Second heavy rain season (March - May): *Ficus wildemanniana* (62%), *Ficus leprieuri* (25%), *Pseudospondias microcarpa* (A. Rich.) Engl. (13%).
"Dry" season (June - August): *Ficus leprieuri* (100%).

PREDATORS:
Blanding's Tree Snake (*Toxicodryas blandingii*) was found in a mist net eating a traped *C. argynnis* in the Democratic Republic of the Congo (Nagy *et al.*, 2011).

POPULATION:
Structure and Density - It is locally not uncommon, with many specimens (~20) caught in mist nets from a locality in the eastern Democratic Republic of the Congo (Mickleburgh *et al.*, 2008c; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008c; IUCN, 2009). 2004 - Unknown (Mickleburgh *et al.*, 2004k; IUCN, 2004).

REPRODUCTION AND ONTOGENY:
The female gives birth to a single young (Hayssen *et al.*, 1993).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, three individuals for antibody to SARS-CoV in sera from Bandundu Province, DRC, none were found to be positive (0/3).

Filoviridae - Filo viruses

Marburgvirus - Towner *et al.* (2007) tested 2 individuals from Gabon using real-time RT-PCR and conventional and nested RT-PCR; neither were found to be positive for Marburg virus specific RNA.

Drexler *et al.* (2012a: Suppl. Table S1) indicated that none of the 21 specimens they examined from Gabon tested positive for *Respirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Cameroon, Central African Republic, Congo (Democratic Republic of the).

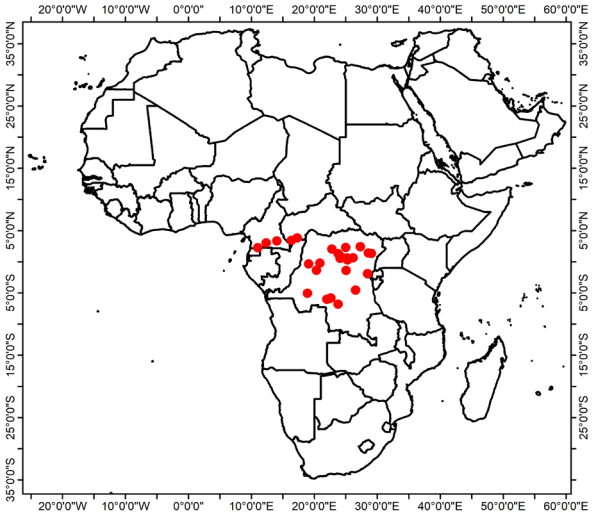


Figure 15. Distribution of *Casinycteris argynnis*

Casinycteris campomaanensis Hassanin, 2014

*2014. *Casinycteris campomaanensis* Hassanin, C. R. Biologies, 337 (2): 134, 137, figs 1B, 3, 4. Publication date: 5 February 2014. Type locality: Cameroon: South Region: Campo-Ma'an area: Nkoélon-Mvini [02 23.831 N 10 02.691 E, 117 m] [Goto Description]. Holotype: MNHN ZM-2011-637: ad ♀, skull and alcoholic. Collected by: Alexandre Hassanin; collection date: 21 November 2007; original number: C07-41. Presented/Donated by: ?: Collector Unknown. - Etymology: The specific epithet refers to the Campo-Ma'an area, where the holotype was collected (see Hassanin, 2014: 137). (Current Combination)

COMMON NAMES:
English: Campo-Ma'an fruit bat. French: Casinyctère de Campo-Ma'an. German: Campomaan-Flughund.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon.

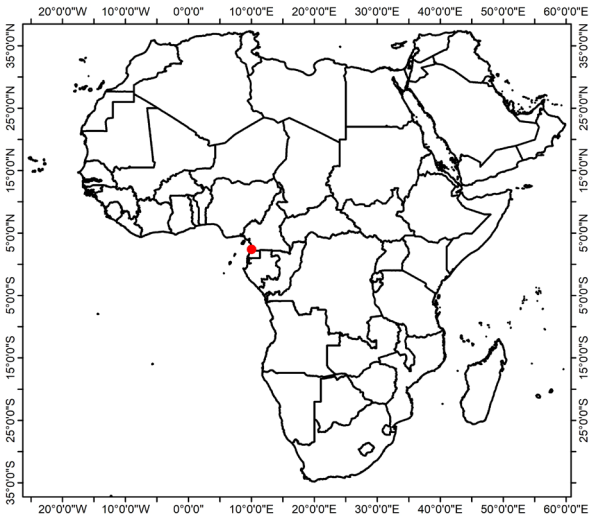


Figure 16. Distribution of *Casinycteris campomaanensis*

Casinycteris ophiodon (Pohle, 1943)

*1943. *Scotonycteris ophiodon* Pohle, Sber. Ges. naturf. Freunde Berlin, 78, figs 1 -2 (for 1942). Type locality: Cameroon: Kribi, Bez: Bipindi [03 06 N 10 30 E] [Goto Description]. Holotype: ZMB 50001: sad ♀, skull only. Collected by: Georg August Zenker; collection date: May 1899. See Turni and Kock (2008: 21). Pohle (1943: 78) mentioned that the skull was removed from the alcoholic specimen. - Etymology: From "*ophiodon*" meaning snake-toothed.

1946. *Scotonycteris ophiodon cansdalei* Hayman, Ann. Mag. nat. Hist., ser. 11, 12 (95): 766 (for 1945). Publication date: 19 September 1946. Type locality: Ghana: Central province: Oda district: Oda [05 55 N 00 56 W] [Goto Description]. Holotype: BMNH 1946.229: ad ♀, skin and skull. Collected by: George Soper Cansdale; collection date: 24 December 1945;

original number: 420. - Etymology: In honour of Mr. George Soper Cansdale, the collector of the type specimen (see Hayman, 1946: 770).

2014. *Casinycteris ophiodon:* Hassanin, C. R. Biologies, 337 (2): 141. Publication date: 5 February 2014. (Current Combination)

TAXONOMY:
See Simmons (2005: 349).

COMMON NAMES:
Czech: kaloň hadozubý. English: Snake-toothed Harlequin Fruit-bat, Pohle's Harlequin Fruit-bat, Snake-toothed Tear-drop Fruit-bat, Pohle's Tear-drop Fruit-bat, Pohle's Fruit Bat. French: Scotonyctère à dents de serpent, Roussette de Pohle. German: Schlangenzähniger Harlekin-Flughund, Pohles Harlekin-Flughund, Poehle's Traenenflughund.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU A2c ver 3.1 (2001)) because it is suspected that a population decline, estimated to be more than 30% would be met over the next 10 years or three generations, inferred from the susceptibility of the specialist species to habitat degradation (Mickleburgh *et al.*, 2008db; IUCN, 2009).

Assessment History -
2008 - VU A2c ver 3.1 (2001) (Mickleburgh *et al.*, 2008db; IUCN, 2009). 2004 - EN A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2004co; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is highly impacted by deforestation, and through forest fragmentation and degradation. Threats presumably include logging and mining activities, and the conversion of land to agricultural use (Mickleburgh *et al.*, 2008db; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008db) [in IUCN (2009)] report that this species has been recorded from the Mount Nimba World Heritage Site (Guinea, Liberia and Côte d'Ivoire) and from Tai National Park (Côte d'Ivoire). There is a need to maintain areas of suitable primary forest throughout much of West Africa, especially in areas where this seemingly rare bat has been recorded. Further field surveys are needed to locate any additional populations of this species.

GENERAL DISTRIBUTION:
Scotonycteris ophiodon is known only from a relatively few scattered records in West Africa and Central Africa. It has been recorded from Liberia, Côte d'Ivoire, Ghana, Cameroon and Congo. It seems to be known from 16 localities only, and has not been recorded from a number of areas where intensive netting has taken place. The species has been recorded at elevations from 120 m (Oda, Ghana) to 1,200 m asl (Mount Nimba).

Native: Cameroon; Congo; Côte d'Ivoire (Henry *et al.*, 2004: 24); Ghana; Liberia.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Haiduk *et al.*, 1980; 1981: 226) reported $2n$ = 34, FN = 62, BA = 32, a subtelocentric X chromosome and an acrocentric Y chromosome for specimens from Cameroon.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - This appears to be a naturally rare species (Mickleburgh *et al.*, 2008db; IUCN, 2009).
Trend - Decreasing (Mickleburgh *et al.*, 2008db; IUCN, 2009).

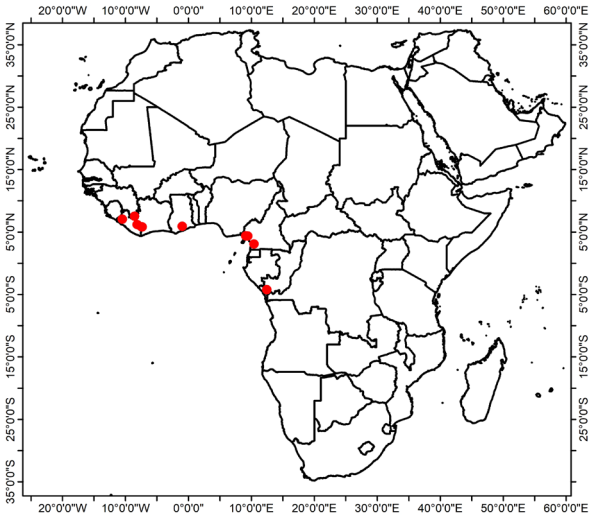


Figure 17. Distribution of *Casinycteris ophiodon*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo, Côte d'Ivoire, Ghana, Liberia.

Genus ***Epomophorus*** Bennett, 1836

1835. *Pteropus:* Ogilby, Proc. zool. Soc. Lond., 1835, III (xxxi): 100. Publication date: 9 October 1835. - Comments: Preoccupied by *Pteropus* Brisson, 1762.

*1836. *Epomophorus* Bennett, Proc. zool. Soc. Lond., 1835, III (xxxiv): 149. Publication date: 12 February 1836. - Comments: Type species: *Pteropus whitei* var. *epomophorus* Bennett, 1836 (= *Pteropus gambianus* Ogilby, 1835). - Etymology: From the Greek "*ἐπί*", meaning upon, "*ωμος*", meaning shoulder, and "*φόρος*", meaning bearing, refering to the conspicuous tufts of hair on the shoulders of the males (see Palmer, 1904: 268; Boulay and Robbins, 1989: 4). (Current Combination)

1853. *Pachysoma* Temminck, Esq. zool. Côte de Guiné, 64. - Comments: Preoccupied by *Pachysoma* MacLeay, 1821, a genus of Coleoptera: see Boulay and Robbins (1989: 1). Not *Pachysoma* I. Geoffroy Saint-Hilaire, 1828. Andersen (1912b: 514) indicates that *Pachysoma* Temminck includes both *Epomophorus* and *Cynopterus*.

1975. *Epomorphus:* Höhne, Loose and Seeliger, Ann. Microbiol. (Inst. Pasteur), 126 A: 503. (Lapsus)

1978. *Epomophevus:* Arata and Johnson, in: Pattijn, Ebola Virus Haemorrhagic Fever, 135. (Lapsus)

2014. *Epimorphosis:* Walldorf and Mehlhorn, Parasitology Research Monographs, 5 - Springer Verlag - Berlin Heidelberg: 13.. (Lapsus)

2016. *Epomorphorus:* Pancer, Gut and Litwinska, Post. Mikrobiol., 55 (2): 208. (Lapsus)

2017. *Epomophorous:* Waruhiu, Ommeh, Obanda, Agwanda, Gakuya, Ge, Yang, Wu, Zohaib, Hu and Shi, Virol. Sin., 32 (2): 5. Publication date: 6 April 2017. (Lapsus)

? *Epomophorus sp.:*

Taxonomy:

Revised by Bergmans (1988), who transferred *Micropteropus grandis* to this genus. A key to this genus is presented in Boulay and Robbins (1989) and Claessen and De Vree (1991). See Simmons (2005: 322).

Almeida *et al.* (2016: 83) found *Epomophorus* to be paraphyletic not only because they transferred *dobsonii* from the genus *Epomops*, but also because *Micropteropus pusillus* seems highly related. However, they suggest further investigation of rapidly evolving nuclear loci and additional species of both genera to decide whether *Micropteropus* and *Epomophorus* are synonyms.

Included in the Epomophorinii tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Epomophorus*: ***angolensis*** Gray, 1870; ***anselli*** Bergmans and Van Strien, 2004; ***crypturus*** Peters, 1852; ***dobsonii*** Bocage, 1889; ***gambianus*** (Ogilby, 1835); ***grandis*** (Sanborn, 1950); ***labiatus*** (Temminck, 1837); ***minimus*** Claessen and De Vree, 1991; ***minor*** Dobson, 1880; ***wahlbergi*** (Sundevall, 1846).

Common Names:

Czech: výložkoví kaloni. English: Epauletted Fruit-bats. French: Epomophores, Chauves-souris à épaulettes. German: Epaulettenflughund, Epaulettenflughunde. Italian: Epomòfori. Kiluba (DRC): Mulima.

General description of external morphology:

Fenton (1992: 49) suggests that the white ear spots present disruptive patterns, which contribute to the cryptic appearance of these bats when resting in foliage.

Detailed morphology:

The region of the shoulder pouches was morphologically, anatomically and histologically investigated by Püscher (1972), who found special muscles to move the dermal pouch, but no special cutaneous glands.

Predators:

Steyn (1964: 257) reported an Epauletted Fruit Bat of 6 inches being eaten by a small Python of 2 feet 7 inches.

Mikula *et al.* (2016: Supplemental data) mention *Epomophorus* sp. to be preyed upon by African goshawk (*Accipiter tachiro* (Daudin, 1800)) [possibly either *E. crypturus* or *E. wahlbergi*], Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850).

Parasites:

BACTERIA

Bartonellae

Kamani *et al.* (2014: 628) tested 30 Nigerian *Epomophorus* sp., and found at least 16 of them testing positive for *Bartonella* DNA.

HAEMOSPORIDA

Perkins and Schaer (2016: Suppl.) mention the presence of *Hepatocystis epomophori* Rodhain, 1926 in *Epomophorus* sp. bats. Of the 138 South Sudanese *Epomophorus* sp. bats examined by Schaer *et al.* (2017: 2), 130 (94 %) were infected by *Hepatocystis*.

HEMIPTERA
Cimicidae: Haeselbarth *et al.* (1966: 8) recorded *Afrocimex constrictus* Ferris & Usinger 1957 associated with *Epomorphorus* sp. from Kiambu, near Nairobi, Kenya.

DIPTERA
Nycteribiidae: *Cyclopodia greeffi* Karsch 1884 found in a belt across central Africa, between lat. 10° south and north, while in West Africa it occurs further north up to lat. 20° (Haeselbarth *et al.*, 1966: 117).

VIRUSES:
Flaviviridae

Andral *et al.* (1968: 855) reported on the isolation of yellow fever virus in Ethiopia from either *Epomophorus anurus*, "*Epomophorus monstruosus*" or "*Epomophorus limbatus*".

Paramyxoviridae
Rubulavirus
Krüger *et al.* (2018: 318) state that broad geographic distribution of the genus *Epomophorus* in Sub-Saharan Africa makes it conceivable that Bat Mumpsvirus (batMuV) is widely dispersed in the region. This virus is closely related to the human Mumpsvirus of which in 2016 100,576 cases were reported in Africa, and which is serologically not distinguishable from the human virus.

Epomophorus angolensis Gray, 1870

*1870. *[Epomophorus macrocephalus] var. angolensis* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 125. Type locality: Angola: Benguela [12 34 S 13 24 E, 160 m] [Goto Description]. Holotype: BMNH 1864.1.9.4: juv ♂. Presented/Donated by: Mr. J.J. Monteiro Esq. - Etymology: Named from a specimen taken at Benguela, Angola (see Smithers, 1983: 56; Taylor, 2005).
? *Epomophorus angolensis:* (Name Combination, Current Combination)

TAXONOMY:
Member of the *gambianus* species group Simmons (2005: 322). See also Bergmans (1988).

COMMON NAMES:
Afrikaans: Angola-witkolvrugtevlermuis. Czech: kaloň angolský. English: Angolan Epauletted Fruit-bat, Angolan Epauletted Fruit Bat. French: Epomophore d'Angola, Roussette à épaulettes d'Angola. German: Angola-Epaulettenflughund.

CONSERVATION STATUS:
Global - Listed as Near Threatened because this species may be in significant decline (but presumably at a rate of less than 30% over ten years) because of the loss of riverine roosting and fruit trees (almost qualifies as threatened under criterion A2c) (Mickleburgh *et al.*, 2008d; IUCN, 2009). This is a precautionary listing, as it is possible that the species has a less restricted habitat, and as such should be listed as Least Concern (Mickleburgh *et al.*, 2008d; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2008d; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004b; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996). 1994 - Rare (Groombridge, 1994).

MAJOR THREATS:
This species is threatened by the removal of roost trees, often for use as fuel. Griffin (1998) indicates that the removal of riverine trees is a particular threat to species of *Epomophorus* in Namibia, with relatively little suitable habitat remaining; presumably this is similar problem in Angola. It may have been threatened by the availability of firearms during the long civil war in Angola, although this requires confirmation.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008d) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species (it has been recorded from Mupa National Park and Bikuar National Park in Angola). There is a need to conserve remaining areas of suitable roosting and feeding sites for this species, and for new field surveys to better determine the current conservation status of the species (Mickleburgh *et al.*, 2008d; IUCN, 2009).

GENERAL DISTRIBUTION:
Epomophorus angolensis is present in Angola and adjacent parts of northern Namibia. It is largely a lowland species, but may range into more montane areas. In Angola it is present west and south of the Mosaic of Guineo-Congolian lowland rain forest and secondary grassland (Bergmans, 1988). In eastern Angola the range seems to be halted by the extensive mosaic region of

Brachystegia bakerana thicket and edaphic grassland (Bergmans, 1988).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 339,737 km^2.

Native: Angola (Bergmans, 1988; Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 551; Taylor *et al.*, 2018b: 60); Namibia (Monadjem *et al.*, 2010d: 551).

HABITAT:
Bergmans (1988; 1999) reports that the species is present in wetter Zambezian miombo woodland, north Zambezian woodland; *Colophospermum mopane* woodland and scrub woodland. Skinner and Chimimba (2005) suggest that the species may be largely confined to riverine forest and other evergreen forest with fruit-bearing trees.

HABITS:
Shortridge (1934) reported on animals hanging singly from bare branches of large Acacia trees near the Cunene River, however, loose colonies of up to 200 have also been found.

POPULATION:
Structure and Density - The abundance of this species is poorly known, with very little recent information (Mickleburgh *et al.*, 2008d; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008d; IUCN, 2009).

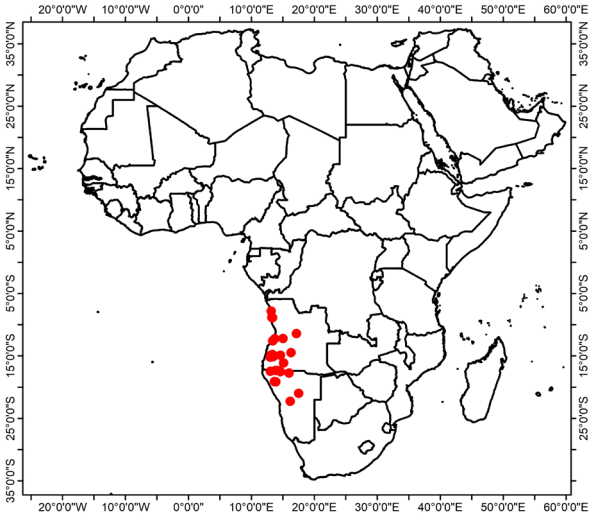


Figure 18. Distribution of *Epomophorus angolensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Namibia.

Epomophorus anselli Bergmans and Van Strien, 2004

*2004. *Epomophorus anselli* Bergmans and Van Strien, Acta Chiropt., 6 (2): 258. Type locality: Malawi: Kasungu National Park: Lisanthu [13 00 S 33 10 E, 1 000 m]. Holotype: ZMA MAM.21693b: ad ♂, skull and alcoholic. Collected by: Hugo Jachmann; collection date: 19 March 1982; original number: #25. See Bergmans and Van Strien (2004: 258 - 259). Paratype: ZMA MAM.26105: sad ♀, skin and skull. Collected by: Nico[laas] Jan Van Strien; collection date: 19 May 1988; original number: #162. Locality: Lifupa Camp - 13.05 S 3005E, 1050 m; see Bergmans and Van Strien (2004: 258 - 259). - Comments: Publication date: The volume is for "September 2004", but the paper has been accepted on 16 October 2004. - Etymology: In honour of Mr. William Frank Harding Ansell for his important contributions to the mammalogy of Malawi and other African countries (see Bergmans and Van Strien, 2004: 262). (Current Combination)

TAXONOMY:
See Bergmans and Van Strien (2004).

COMMON NAMES:
Czech: kaloň Ansellův. French: Epomophore d'Ansell. German: Ansells Epaulettenflughund.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since it has only recently been described, and there is still very little information on its extent of occurrence, status, threats and ecological requirements (Bergmans and van Strien, 2008; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Bergmans and van Strien, 2008; IUCN, 2009).

MAJOR THREATS:
Bergmans and Van Strien (2004) note that they "have no reason to believe that the species is in any danger but at the same time the available data are few and between 43 and 16 years old".

CONSERVATION ACTIONS:
Bergmans and van Strien (2008) [in IUCN (2009)] reported that this species has been recorded from the Kasungu National Park in Malawi, and further field surveys are needed to better understand the

distribution range, threats and conservation status of this species .

GENERAL DISTRIBUTION:
Epomophorus anselli is currently only known from Malawi, where it has been collected in the Kasungu National Park (collected in 1982 and 1988) and (most probably) the Karonga area (collected in 1961) (Bergmans and Van Strien, 2004).

Native: Malawi (Bergmans and Van Strien, 2004; Monadjem *et al.*, 2010d: 551).

HABITAT:
Bergmans and Van Strien (2004) record that 'the type specimen was mist netted in Miombo woodland at an elevation of 1,000 m, over a stream between two water berry trees, *Syzygium cordatum* Hochst., in fruit (Bergmans and Jachmann, 1983).' Furthermore, they state that 'the vegetation of Lifupa Camp, the locality where the female paratype was collected (exact elevation unknown, but between 1,000 and 1,100 m) is Miombo woodland with *Brachystegia* and *Julbernardia* (Bergmans and Jachmann, 1983)'.

POPULATION:
Structure and Density - It is only known from a few specimens (Bergmans and van Strien, 2008; IUCN, 2009).
Trend- 2008- Unknown (Bergmans and van Strien, 2008; IUCN, 2009).

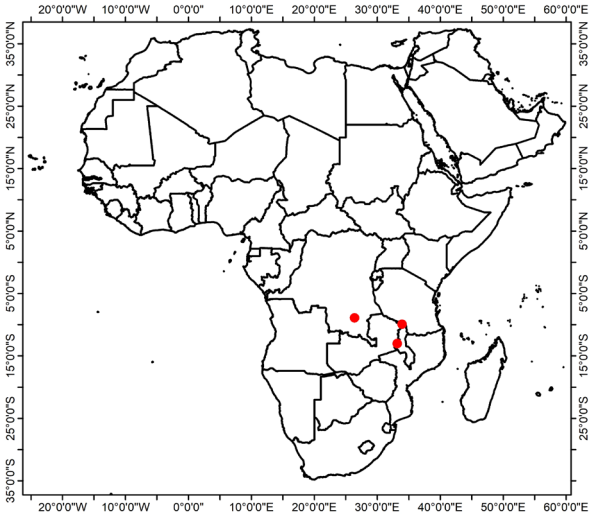


Figure 19. Distribution of *Epomophorus anselli*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Malawi.

Epomophorus crypturus Peters, 1852

*1852. *Epomophorus crypturus* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 26, pl. 5, pl. 13, fig. 1 - 6. Type locality: Mozambique: Lower Zambezi River: Tete [16 10 S 33 35 E, 230 m] [Goto Description]. Lectotype: ZMB 10080: ad ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. Lectotype designated by Andersen (1912b: 537); formerly ZMB 553; see Turni and Kock (2008). Paralectotype: ZMB 10018: ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Andersen (1912b) and Turni and Kock (2008: 8). Paralectotype: ZMB 10019: ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Andersen (1912b) and Turni and Kock (2008: 8). Paralectotype: ZMB 10020: ♂, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Andersen (1912b) and Turni and Kock (2008: 8). Paralectotype: ZMB 10078: skull only. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Andersen (1912b) and Turni and Kock (2008: 8). Paralectotype: ZMB 10081: skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. Formerly ZMB 355. See Andersen (1912b) and Turni and Kock (2008: 8). Andersen (1912b: 537) also mentions that most of the paratypes are immature specimens, and that Peters' adult male is in fact an immature.
1855. *Pt[eropus] crypturus:* Giebel, Die Säugethiere., 1002. (Name Combination)
1960. *Epomophorus gambianus parvus* Ansell, Rev. Zool. Bot. afr., 61: 160. Type locality: Zambia: Zambezi district: Chingi [13 01 S 22 44 E]. Holotype: BMNH 1959.610: ad ♂. - Comments: Type locality originally Balovale [=Zambezi] district, restricted to Chingi by Ansell (1978: 17).
1986. *Epomophorus crypturus parvus:* Meester, Rautenbach, Dippenaar and Baker, Transv. Mus. Monogr., 5: 27. (Name Combination)
1988. *Epomophorus gambianus crypturus:* Bergmans, Beaufortia, 38 (5): ???. (Name Combination)
? *Epomophorus angolensis:* - Comments: Not of Gray, 1870.

? *Epomophorus crypturus crypturus:* (Name Combination)
? *Epomophorus gambianus:* - Comments: Not of Ogilby, 1835.

TAXONOMY:
Bronner *et al.* (2003) state that *Epomophorous crypturus* was previously afforded full species status (Corbet and Hill, 1980; Swanepoel *et al.*, 1980; Koopman, 1982; Meester *et al.*, 1986; Claessen and De Vree, 1990, 1991; 2005).

Meester *et al.* (1986) states that Koopman (1966) considers the possibility that the extralimital *E. anurus* Heuglin, 1864, may be conspecific with *crypturus*. This would extend the range of *crypturus* to Uganda, Rwanda, southern Sudan, Ethiopia, Eritrea and westwards to Nigeria. However, Kock (1969a) and Koopman (1975) regard *anurus* instead as a synonym of the extralimital *E. labiatus* (Temminck, 1837), while Hayman and Hill (1971) retain it as a separate species, so that a close relationship with *crypturus* does not seem to be indicated. Further uncertainty surrounds the status of *E. gambianus parvus*. Ansell (1978), while treating *parvus* as a subspecies of *gambianus*, expresses doubt whether *parvus* can be distinguished at species level from *crypturus*, and suggests that *crypturus* and *gambianus* are conspecific, with *parvus* as an intermediate subspecies or a stage in a cline running between them. Koopman (1982) retains *gambianus* as a separate species, but includes *parvus* in *crypturus*, without specifying whether or not he regards it as subspecifically distinct. While acknowledging that this problem remains to be solved we shall provisionally treat *parvus* as a taxon of *crypturus*.

COMMON NAMES:
Afrikaans: Peters se witkolvrugtevlermuis, Peters-witkolvrugtevlermuis, Klein Vrugtevlermuis. Czech: kaloň mosambický. English: Peters's Epauletted Fruit Bat, Smaller Epauletted fruit bat. French: Epomophore de Peters, Roussette à épaulettes de Peters. German: Peters' Epaulettenflughund. Nyanja (Malawi): Mleme. Portuguese: Morcego frugivoro de Peters.

ETYMOLOGY OF COMMON NAME:
In honour of Wilhelm Carl Hartwig Peters who, in 1852, published a monumental work on zoological material collected mainly in the Tete District of Mozambique (Smithers, 1983: 58).

SIMILAR SPECIES:
Taylor and Monadjem (2008: 24) provided data which enabled them to separate *E. crypturus* from *E. wahlbergi*. In the first species, the maxillary width is always smaller than in the latter (♂♂: < 14 mm; ♀♀: < 13 mm).

CONSERVATION STATUS:
Global assessment- Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, has a tolerance of a degree of habitat modification, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) assessed as *E. crypturus* (Mickleburgh *et al.*, 2008e; IUCN, 2009). 2004 - LC ver 3.1 (2001) assessed as *E. crypturus* (Mickleburgh *et al.*, 2004c; IUCN, 2004).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016x). 2004 - DD ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species as a whole. Some populations may be impacted by general persecution as crop pests (Mickleburgh *et al.*, 2008e; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008e) [in IUCN (2009)] state that this species has been recorded from many protected areas, and no direct conservation measures are needed for this widespread and adaptable species as a whole.

GENERAL DISTRIBUTION:
E. crypturus is a widespread southern African species distributed from southern parts of the Democratic Republic of the Congo and southern Tanzania, to the eastern coastline of South Africa. It ranges from eastern Angola and northern Botswana to the southeastern African coastline. It has been recorded at elevations of up to 2,185 m asl, although it has mostly been collected between 500 and 1,500 m asl (Mickleburgh *et al.*, 2008e; IUCN, 2009). For South Africa, Babiker Salata (2012: 49) found that its distribution is stongly associated with the mean temperature of the coldest quarter.

Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,213,597 km^2.

Native: Angola (Bergmans, 1988; Monadjem *et al.*, 2010d: 551); Botswana (Bergmans, 1988;

Monadjem *et al.*, 2010d: 551); Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 551); Malawi (Happold *et al.*, 1988; Bergmans, 1988; Happold and Happold, 1997b: 813; Monadjem *et al.*, 2010d: 551); Mozambique (Smithers and Lobão Tello, 1976; Bergmans, 1988; Monadjem *et al.*, 2010d: 551; 2010c: 376); Namibia (Monadjem *et al.*, 2010d: 552); South Africa (Monadjem *et al.*, 2010d: 552); Swaziland (Monadjem *et al.*, 2010d: 552); Tanzania; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 552); Zimbabwe (Monadjem *et al.*, 2010d).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - In Zimbabwe, Peterson and Nagorsen (1975: 4) recorded the following: 2*n* = 35 for a male, and 2*n* = 36 for a female (XO/XX; see also Nesi *et al.*, 2011: 552).

HABITAT:
This species is generally associated with dry savanna and riverine forest with fruit bearing trees (Mickleburgh *et al.*, 2008e).

ROOST:
Colonies often roost under the canopy of trees, in thick foliage (Mickleburgh *et al.*, 2008e).

MIGRATION:
Populations exhibit considerable movements in search of food, and may come into towns and feed on crops and fruit trees (Mickleburgh *et al.*, 2008e).

DIET:
Bonaccorso *et al.* (2014: 41) studied the foraging movements of *E. crypturus* in the Kruger National Park (RSA) in relation to the distribution of sycamore figs *Ficus sycomorus*. They also performed germination trials on 20 intact seeds that had passed through the gastro-entero tract of the bats and found 100 % germination. They also found (p. 48) that during a very dry period, the bats flew between 4 and 14 km from their roosting site to fruiting *F. sycomorus*. In normal circumstances, they only flew 400 - 2,000 m. The bats visited up to four fig trees per night.

POPULATION:
Structure and Density - It is a quite common species, sometimes forming loose colonies of hundreds of bats (Mickleburgh *et al.*, 2008e; IUCN, 2009).

Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008e; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
In the Kruger Park, Pienaar (1964: 8) reported single young attached to their mothers in December and January.

MATING:
McCracken and Wilkinson (2000: 349) suggest that *E. crypturus* uses nocturnal display sites where females visit males for mating. Males call from roosts in trees that are spaced about 50 m apart along rivers.

At Shingwedzi (Kruger National Park), Adams and Snode (2015: 4) found the following values for the male mating calls: mean fundamental frequency: 15.71 ± 0.07 kHz (first harmonic), only in one case followed by multiple harmonics at 16, 48, 64, 96, and 112 kHz.

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV: Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in four individuals from Limpopo Province, none tested positive (0/4) and six individuals from Mpumalanga Province, South Africa, none tested positive (0/6).

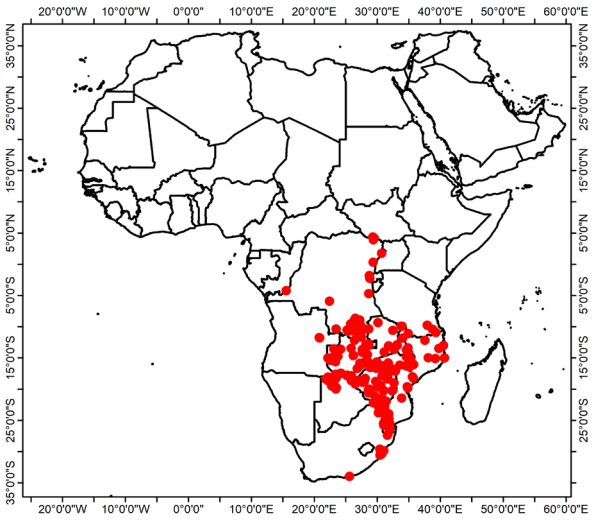


Figure 20. Distribution of *Epomophorus crypturus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Botswana, Central African Republic, Congo (Democratic Republic of the), Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe.

Epomophorus dobsonii Bocage, 1889

*1889. *Epomophorus Dobsonii* Bocage, J. Sci. mat. phys. nat., ser. 2, 1 (1): 1, Fig 1. Publication date: March 1889. Type locality: Angola: Benguela district: Quindumbo [Goto

Description]. Neotype: AMNH 88068: ♂, skin and skull. Collected by: the Phipps-Bradley Expedition; collection date: 27 February 1933; original number: 902. At Chitau, 4930 ft. Designated by Bergmans (1989) (see AMNH website). - Comments: Andersen (1912b: 501) mentions that the original type was an adult male in the Lisbon museum. Frequently mentioned as *dobsoni*. - Etymology: Named after George Edward Dobson who, among his many other papers on bats, published a Catalogue of the Chiroptera in the collection of the British Museum in 1878 (see Taylor, 2005).

1899. *Epomophorus (Epomops) dobsoni:* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 57. (Name Combination)

1912. *Epomops dobsoni:* K. Andersen, Catalogue of the Chiroptera in the British Museum. Second Edition. Volume I: Megachiroptera: viii, lvi, 500. (Name Combination, Lapsus)

1939. *Epomops dobsonii:* G.M. Allen, Bull. Mus. comp. Zool., 83: 57. Publication date: February 1939. (Name Combination)

2016. *E. dobosonii:* Calderon, Guzman, Salazar-Bravo, Figueiredo, Mattar and Arrieta, Manter, Suppl. 6: 7. Publication date: 30 September 2016. (Lapsus)

? *Epomophorus dobsoni:* (Alternate Spelling)

TAXONOMY:
See Bergmans (1979b; 1989) and Simmons (2005: 323).

The phylogenetic analyses by Almeida *et al.* (2016: 83) suggest that *dobsonii* is closely related to *Epomophorus wahlbergi* and they transfered the species to the latter genus.

COMMON NAMES:
Afrikaans: Dobson se vrugtevlermuis, Dobson-vrugtevlermuis. Czech: kaloň Dobsonův. English: Dobson's Fruit Bat, Dobson's Epauletted Fruit Bat, Dobson's Epauletted Bat, Singing Fruit Bat. French: Epomophore de Dobson, Roussette de Dobson. German: Dobsons Epaulettenflughund.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bx; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bx; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cj; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species (Mickleburgh *et al.*, 2008bx; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bx) [in IUCN (2009)] report that it has been recorded from Kasungu National Park in Malawi and from Parc National de l'Upemba in the Democratic Republic of the Congo. There is a need for additional studies into the natural history of this species and into any possible future threats to the species (Mickleburgh *et al.*, 1992).

GENERAL DISTRIBUTION:
Epomophorus dobsonii is distributed in East Africa, Central Africa and southern Africa. It has been recorded from Angola, Namibia, Zambia, southern Democratic Republic of the Congo, Malawi and Mozambique, being found as far north as Tanzania and possibly Rwanda. It has been recorded at elevations of up to 1,500 m asl (in Malawi) and at 1,890 m asl at Kibwele, Tanzania.

For southern Africa (south of 8° S), Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 503,585 km^2.

Native: Angola (Crawford-Cabral, 1989; Bergmans, 1989; Monadjem *et al.*, 2010d: 553; Taylor *et al.*, 2018b: 60); Botswana (Monadjem *et al.*, 2010d: 554); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 554); Malawi (Bergmans, 1989; Monadjem *et al.*, 2010d: 554); Mozambique; Namibia; Tanzania; Zambia (Ansell, 1973; Bergmans, 1989; Monadjem *et al.*, 2010d: 554); Zimbabwe.
Presence uncertain: Namibia (see Cotterill, 2004a: 260); Rwanda.

POPULATION:
Structure and Density - It does not appear to be an especially rare species in Malawi. There is little information on the abundance of the species over the rest of its range, but it is presumed to be reasonably common (Mickleburgh *et al.*, 2008bx; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008bx; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Hill (1941) [in Fox *et al.* (2009: 272) reported that "*E. dobsoni*" gave birth to two young, but Fox *et al.* (2009: 272) indicate that this statement was based on translated field notes, and it is not clear whether they refer to twins or to two birthing seasons each year.

VIRUSES:
Rhabdoviridae
Lyssavirus - Rabies related viruses
de Jong *et al.* (2011: 9) and Willoughby *et al.* (2017: Suppl.) report Lagos Bat Virus from *E. dobsonii*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Botswana, Congo (Democratic Republic of the), Malawi, Rwanda, Tanzania, Zambia, Zimbabwe.

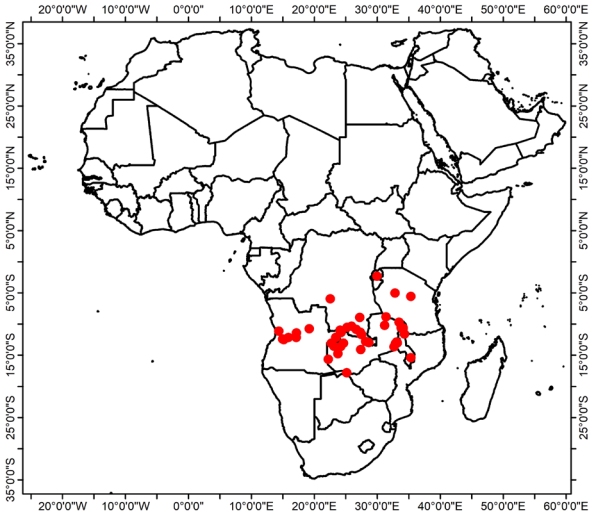


Figure 21. Distribution of *Epomophorus dobsonii*

Epomophorus gambianus (Ogilby, 1835)

*1835. *Pteropus Gambianus* Ogilby, Proc. zool. Soc. Lond., 1835, III (xxxi): 100. Publication date: 9 October 1835. Type locality: The Gambia: Banjul [Goto Description]. Holotype: BMNH 1907.1.1.233: ad ♀, skin and skull. Collected by: Dr. Percy Rendall. Formerly in Tomes collection. Paratype: BMNH 1874.a-c: 2 sad FF, 1 imm F, skin and skull. Collected by Liet. Rendall. Paratype: BMNH 1874.a = 124b: imm ♀. Presented/Donated by: ?: Collector Unknown. Paratype: BMNH 1874.b = 124c: ad ♀. Collected by: Dr. Percy Rendall. Presented/Donated by: ?: Collector Unknown. Paratype: BMNH 1874.c = 124d: imm ♀. Presented/Donated by: ?: Collector Unknown. Paratype: BMNH 1907.1.1.231: sad ♀, skin and skull. Collected by: Dr. Percy Rendall. Formerly in Tomes collection. - Comments: Type locality restricted by Kock *et al.* (2002: 80). - Etymology: Named as the species was described from a specimen from Gambia in West Africa (see Taylor, 2005).

1898. *Epomophorus guineensis* Bocage, J. Sci. mat. phys. nat., ser. 2, 5 (19): 136, fig. 3. Publication date: June 1898. Type locality: Guinea-Bissau: Bolama [11 35 N 15 30 W] [Goto Description]. - Comments: Andersen (1912b: 541) mentions the type specimen as being a mounted ad ?, skull extracted, coll. Sr. Damasceno da Costa, and in the Lisbon Museum.

2017. *Epomorphus giambianus:* Banyard and Fooks, Microbiol. Aust., 38 (1): 18. Publication date: March 2017. (Lapsus)

2019. *E[pomophorus] gambiansus:* Mbu'u, Mbacham, Gontao, Kamdem, Nlôga, Groschup, Wade, Fischer and Balkema-Buschmann, Vector-Borne Zoon. Dis., xxx: "6". Publication date: 13 April 2019. (Lapsus)

? *Epomophorus gambianus:* (Name Combination, Current Combination)

TAXONOMY:
See Boulay and Robbins (1989), Claessen and De Vree (1990) and Simmons (2005: 322).

Two subspecies are currently recognized: *E. g. gambianus* (Ogilby, 1835) and *E. g. pousarguesi* Trouessart, 1904.

COMMON NAMES:
Afrikaans: Gambiaanse witkolvrugtevlermuis. Czech: kaloň výložkový, kaloň větší. English: Gambian Epauletted Fruit bat, Gambian Epauleted Bat. French: Epomophore de Gambie, Chauve-souris à épaulettes de Gambie. German: Gambia Epaulettenflughund. Tanoboase (Ghana): sreso ampane [="original or normal bat'], ampane kronfo ["thief or criminal bat"] (see Ohemeng *et al.*, 2017: 184).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001) assessed as full species in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008f; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008f; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004l; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There are no major threats to this species as a whole. In parts of its range it is locally threatened by overhunting for food and habitat loss through logging and conversion of land to agricultural use (Mickleburgh *et al.*, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008f) [in IUCN (2009)] state that the species has a wide range, and is presumably present in many protected areas.

GENERAL DISTRIBUTION:
Senegal, Gambia over Guinea (Fahr and Ebigbo, 2003: 128), Mali (Meinig, 2000: 104), Benin (Capo-Chichi *et al.*, 2004: 161), Cameroon (Bakwo Fils *et al.*, 2014: 3), Central African Republic (Morvan *et al.*, 1999: 1195) to W Ethiopia, south to South Sudan.

Simmons (2005: 322) includes Malawi and Botswana, these records may be associated with *crypturus* and need to be verified.

E. g. gambianus - west Africa.
E. g. pousarguesi - east Africa.

Native: Benin (Capo-Chichi *et al.*, 2004: 161), Burkina Faso (Kangoyé *et al.*, 2015a: 605), Cameroon (Bakwo Fils *et al.*, 2014: 3), Central African Republic (Morvan *et al.*, 1999: 1195), Chad, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Gabon, Ghana, Guinea (Fahr and Ebigbo, 2003: 128; Decher *et al.*, 2016: 261), Guinea-Bissau (Bocage, 1889a:2; Seabra, 1898b; Monard, 1939; Veiga-Ferreira, 1948; Bergmans, 1988; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 22), Liberia, Mali (Meinig, 2000: 104), Niger, Nigeria, Senegal, Sierra Leone, South Sudan, Sudan, The Gambia, Togo.

SEXUAL DIMORPHISM:
Dobson (1873: 247) quotes Tomes' description of the male as: "The conspicuous shoulder-tufts of *E. macrocephalus* are here very fully developed. They consist of a very slight warty excrescence clothed with fur, which differs from that which surrounds it only in being of a dirty white colour."

MOLECULAR BIOLOGY:
Riesle-Sbarbaro *et al.* (2016: 447) reported on the complete mitochondrial genome of this species, which consists of 16,702 bases.

Riesle-Sbarbaro *et al.* (2018: "13") examined mitochondrial and nuclear DNA and found that connectivity and free mixing occurred between the colonies sampled over most of its distribution area. Their data lso indicated that male dispersal occurs more often and/or over longer distances than females. The Ethiopian colonies seem to form an exception as the genetic differences indicate that they apparently diverged about 1.6 Mya from the bats from the more western part of the distribution area. Also the populations from southern Ghana (Accra and Ve-Golokwati) show some genetic differentiation. Riesle-Sbarbaro *et al.* (2018: "14") suggest that the geographical barriers (e.g. mountains and water bodies such as rivers and lakes) and other environmental developments (e.g., urbanization of megacities) are the likely drivers for the regional divergences.

HABITAT:
This species is present in a variety of tropical moist and dry forest, savanna, bushland and mosaic habitats, and has additionally been reported from mangroves and swamp forests (Mickleburgh *et al.*, 2008f). It is able to persist in areas of partially degraded forest.

HABITS:
Anonymus (2002a: 103) mentions that in some areas of Benin, *E. gambianus* might be causing large trees to die, as they swarm in large numbers on a restricted surface.

ROOST:
Roosting usually takes place as individuals or small groups in dense vegetation (Happold, 1987). *E. gambianus* forms roosting colonies in crowns of trees, containing a few to 50 - 100 individuals (Kunz, 1996: 44). Ayensu (1974: 716) indicates that in Ghana, *Azadirachta indica* or the Neem tree is a favorite roosting haven. Lawson *et al.* (2018: 110) found them also roosting in mango (*Mangifera* sp.) and fig (*Ficus* sp.) trees around schools, churches, market places and people's homes.

MIGRATION:
Isotopic data collected by Omatsu *et al.* (2008: 21 - 22) suggest that *E. gambianus* has an East-West migratory behaviour inside its distribution range, which is even more pronounced than the migration displayed by *Eidolon helvum*. Six specimens that were captured in February in Mali were most probably originating from some 3,000 km to the east.

DIET:
Ayensu (1974) reports that in West Africa, *E. gambianus* visits *Parkia clappertoniana*

(Dawadawa), *Ceiba pentandra* (Silk-Cotton tree or Kapop tree), *Mangifera indica* (Mango tree), *Anacardium occidentale* (Cashew tree), *Psidium guajava* (Guava tree), *Carica papaya* (Papaya or pawpaw), and *Azadirachta indica* (Neem tree) when foraging. Bachirou *et al.* (2011: 2) indicate that *E. gambianus* is the most important seed disperser for the Neem tree in Cameroon.

Kangoyé *et al.* (2010: 291) show a picture of *E. gambianus* pollinating *Ceiba pentandra* flowers, and also indicate that this species was found transporting Shea fruits (*Vitellaria paradoxa*) or figs (*Ficus* sp.), whereas others were found in cashew fields (*Anacardium occidentale*).

Seltzer *et al.* (2013: table S2) provide an overview of the plant species found beneath bat feeding roosts. For *E. gambianus* these include *Rauvolfia caffra* Sond. (Quinine Tree - Apocynaceae) and *Psidium guajava* L. (Apple guava - Myrtaceae).

Based on faecal pellets and ejecta, Amponsah-Mensah *et al.* (2019: 5687) found the following fruits (FR) and flowers (FL) in the diet of bats from Ghana: Anacardiaceae: *Anacardium occidentale* L. (Cashew) FR), *Mangifera indica* L. (Mango - FR), *Spondias mombin* L. (Yellow mombin - FR); Annonaceae: *Annona muricata* L. (Soursop - FR), *Polyalthia longifolia* Sonn. (Indian mast tree, false ashoka - FR); Bignoniaceae: *Spathodea campanulata* P. Beauv. (African tulip tree - FL); Bombacaceae: *Bombax buonopozense* P. Beauv. (Gold Coast bombax, Red-flowered silk-cotton - FL), *Ceiba pentandra* (L.) Gaertn. (Kapok, Silk Cotton - FL); Caricaceae: *Carica papaya* L. (Papaya, Pawpaw - FR); Combretaceae: *Terminalia catappa* L. (Indian almond - FR); Cucurbitaceae: *Melothria* sp. (Mouse melon - FR); Fabaceae: *Daniellia oliveri* (Rolfe) Hutch. & Dalziel (African copaiba balsam - FL), *Parkia biglobosa* (Jacq.) R.Br. ex G.Don (African locust bean - FL); Gentianaceae: *Anthocleista vogelii* Planch. (Cabbage tree - FR, FL); Malvaceae: *Adansonia digitata* L. (Baobab - FL), *Sterculia rhinopetala* K. Schum. (Brown sterculia, Red sterculia - FR); Meliaceae: *Azadirachta indica* A.Juss (Neem - FR, FL); Moraceae: *Antiaris toxicaria* Lesch. (False iroko, Antiaris - FR), *Ficus* spp. (five species Figs - FR), *Milicia excelsa* (Welw.) C.C. Berg (Iroko, Odum - FR); Musaceae: *Musa* sp. (Banana - FR, FL); Myrtaceae: *Psidium guajava* L. (Guava - FR), *Syzygium* sp. (woodland waterberry - FR); Solanaceae: *Solanum* sp. (Potato tree - FR); Verbenaceae: *Vitex doniana* Sweet (Black plum - FR). *Ficus* sp. was present in over a third of all the samples and were eaten in all months. Other fruits that played a vital role, and were prefered over other available fruits, include *Vitex doniana* and *Anthocleista vogelii*. The main reason was probably the higher protein content of these fruits. They were also highly available in the period of late pregnancy (March and September) and parturition (April/May and October/November) (p. 5689). Amponsah-Mensah *et al.* (2019: 5690) could not confirm whether *E. gambianus* were actively eating pollen, nectar, or both, even when they observed bats visiting flowering trees and being covered in pollen.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator, as well as the Pied crow (*Corvus albus* Statius Muller, 1776). Ayivor *et al.* (2017: 6) indicate that the latter targets young, just weaned *E. gambianus*.

POPULATION:
Structure and Density - Animals are often found in loose colonies of up to 100 bats (Mickleburgh *et al.*, 2008f).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008f; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 7.8 years.

REPRODUCTION AND ONTOGENY:
Szekely *et al.* (2015: Suppl.) report that the gestation period lasts for 150 days, and that the young's weight at birth is 10 g (the adult weights 80 g).

MATING:
Nesi *et al.* (2011: 552) indicate that the male's courting call has a frequency of 1,750 Hz.

PARASITES:
BACTERIA
Höhne *et al.* (1975: 505) found *Listeria monocytogenes* bacteria in one out of two *E. gambianus* specimens from Lomé, Togo.

HAEMOSPORIDA
Schaer *et al.* (2013a: 17416) report the presence of hemosporidian parasites of the genus *Hepatocystis* in one investigated bat. Miltgen *et al.* (1977: 595) pointed out that the first reports of gametocytes from this parasite were made by the Léger(s) from Niger in 1914.

VIRUSES:
Willoughby *et al.* (2017: Suppl.) report the following viruses: Lagos bat lyssavirus, Nipah henipavirus, Reston ebolavirus, Zaire ebolavirus.

Filoviridae - Filoviruses
Ebolavirus

Hayman *et al.* (2012d: 1208) examined 37 bats from the Greater Accra region, Ghana, and found 14 to be positive for EBOV antibodies.

Paramyxoviridae
Paramyxoviruses
Hayman *et al.* (2008a: 926; 2008b: 2) detected antibodies to Nipah virus in one bat collected in Ghana in 2007.
Drexler *et al.* (2012a: Suppl. Table S1) found three bats out of 54 (5.4 %) testing positive for *Henipavirus* in the Democratic Republic of the Congo and Ghana.

Rhabdoviridae
Lyssavirus - Rabies related viruses
2006 in Nigeria, Dzikwi *et al.* (2010: 269) tested 12 brains by direct fluorescent antibody (DFA) and mouse inoculation test (MIT) which tested negative for lyssavirus antigens.
Lagos bat virus (LBV): Hayman *et al.* (2008a) detected antibodies in Ghana. In 2006, 12 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), where 3 tested positive (25%) for neutralizing anitibodies (Dzikwi *et al.*, 2010: 269).
Mokola virus (MOKV): In 2006, 12 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), none tested positive for neutralizing anitibodies (Dzikwi *et al.*, 2010: 269).

In their overview table, Maganga *et al.* (2014a: 8) reported that the following viruses were already found in *E. gambianus*: Lagos bat virus (LBV), Nipah virus (NPHV), Zaire Ebola virus (ZEBOV), Reston Ebola virus.

UTILISATION:
In some localities in Benin, specimens of this species are eated, but always in small numbers (Anonymus, 2002a: 102). Dougnon *et al.* (2012: 85) reported that the carcasses have an average weight of 40.52 ± 5.08 g (about 43 % of the body mass). They also evaluated the quality of the meat (for 100 g): total mineral matter: 14.1 g, lipids: 13.36 g, protein: 58.4 g, Calcium: 44 mg, Sodium: 48 mg, Phosphore: 80 mg and Potassium: 88 mg.

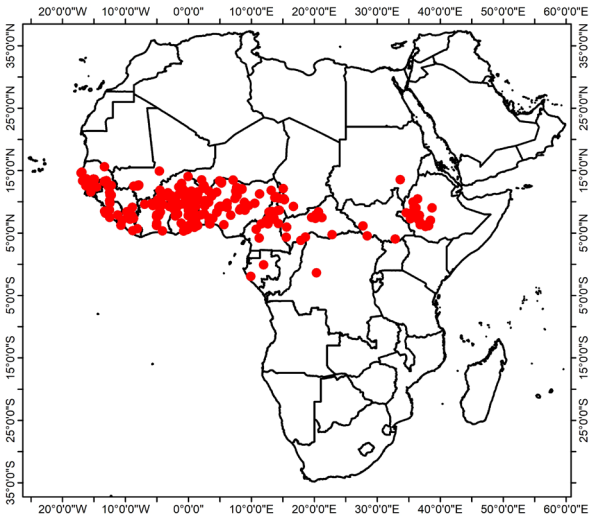


Figure 22. Distribution of *Epomophorus gambianus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, South Sudan, Sudan, Tanzania, The Gambia, Togo, Zambia, Zimbabwe.

Epomophorus gambianus gambianus (Ogilby, 1835)

*1835. *Pteropus Gambianus* Ogilby, Proc. zool. Soc. Lond., 1835, III (xxxi): 100. Publication date: 9 October 1835. Type locality: The Gambia: Banjul [Goto Description]. Holotype: BMNH 1907.1.1.233: ad ♀, skin and skull. Collected by: Dr. Percy Rendall. Formerly in Tomes collection. Paratype: BMNH 1874.a-c: 2 sad FF, 1 imm F, skin and skull. Collected by Liet. Rendall. Paratype: BMNH 1874.a = 124b: imm ♀. Presented/Donated by: ?: Collector Unknown. Paratype: BMNH 1874.b = 124c: ad ♀. Collected by: Dr. Percy Rendall. Presented/Donated by: ?: Collector Unknown. Paratype: BMNH 1874.c = 124d: imm ♀. Presented/Donated by: ?: Collector Unknown. Paratype: BMNH 1907.1.1.231: sad ♀, skin and skull. Collected by: Dr. Percy Rendall. Formerly in Tomes collection. - Comments: Type locality restricted by Kock *et al.* (2002: 80). - Etymology: Named as the species was described from a specimen from Gambia in West Africa (see Taylor, 2005).
1835. *Pteropus macrocephalus* Ogilby, Proc. zool. Soc. Lond., 1835, III (xxxi): 101. Publication date: 9 October 1835. Type locality: The Gambia: "Gambia" [Goto Description]. - Comments: collected by Rendall.
1835. *Pteropus megacephalus* Swainson, Natural History and Classification of Quadrupeds, 91, 92, 356, figs 31, 154. Type locality: The Gambia. - Comments: Type locality originally as West Africa, but Andersen (1912b: 539) mentions "Gambia" as type locality.
1836. *Pteropus epomophorus* Bennett, Proc. zool. Soc. Lond., 1835, III (xxxiv): 149. Publication date: 12 February 1836. Type locality: The Gambia: "Gambia". Holotype: BMNH

1907.1.1.232: ad ♂, skin only. Collected by: Dr. Percy Rendall. (Type for both *epomophorus* and *whitei*). Ex Tomes collection: see Andersen (1912b: 542). Holotype: NRM [unknown]: ad ♀, alcoholic (skull not removed). Collected by: Bror Yngve Sjöstedt; collection date: 4 May 1905. Kilimandjaro-Meru Expedition. See Lönnberg (1908b: 7) and Andersen (1912b: 810).

1836. *Pteropus Whitei* Bennett, Trans. Linn. Soc. Lond., 2 (1): 37, pl. 6, pl. 7. Publication date: 2 October 1836. Type locality: The Gambia: "Gambia" [Goto Description]. Holotype: BMNH 1907.1.1.232: ad ♂, skin only. Collected by: Dr. Percy Rendall. (Type for both *epomophorus* and *whitei*). Ex Tomes collection: see Andersen (1912b: 542).

1838. *Epomophorus whitii:* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 504. Publication date: 1 February 1838. - Comments: Also incorrect subsequent spelling, see Boulay and Robbins (1989: 1). (Name Combination)

1898. *Epomophorus guineensis* Bocage, J. Sci. mat. phys. nat., ser. 2, 5 (19): 136, fig. 3. Publication date: June 1898. Type locality: Guinea-Bissau: Bolama [11 35 N 15 30 W] [Goto Description]. - Comments: Andersen (1912b: 541) mentions the type specimen as being a mounted ad ?, skull extracted, coll. Sr. Damasceno da Costa, and in the Lisbon Museum.

1899. *Ep[omophorus (Epomophorus)] zechi* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 46, pl 10, fig. 3 a-c. Type locality: Benin: Togoland: Kunjuruma [Goto Description]. Lectotype: ZMB 10170/17171: ad ♂, skin and skull. Collected by: Baumann; collection date: 1894. Lectotype designated by Andersen (1912b: 541); see Turni and Kock (2008) [skin: ZMB 10170 - skull: ZMB 17171]. Paralectotype: ZMB 10009: ad ♂, skin and skull. Collected by: Baumann; collection date: 1894. Kunjuruma. Paralectotype: ZMB 10011: juv ♂, skull only. Collected by: Bloess. Gross-Popo. Paralectotype: ZMB 10065: ad ♀, skull and alcoholic. Collected by: Anton Reichenow. Accra, Ghana. Paralectotype: ZMB 3413: ad ♂, skull and alcoholic. Lagos, Nigeria, acquired from Salmin. Paralectotype: ZMB 356: ad ♂, skin and skull. Collection date: 1855. West Africa acquired from Salmin. Paralectotype: ZMB 3654: ad ♂, skull and alcoholic. Collected by: Unger. Accra, Ghana. Paralectotype: ZMB 4784: ad ♂, skull and alcoholic. Collected by: Anton Reichenow. Accra, Ghana. - Comments: Kunjuruma is the location from lectotype: see Allen (1939a: 56). Boulay and Robbins (1989: 1) mention "Accra, Goldkuste [=Ghana], Gross-Popo, Misahoho in Togoland, Lagos [Nigeria], restricted to Kunjuruma, Togoland [=Benin] by Andersen (1912b)". Turni and Kock (2008: 10) mention "Matschie (1899b: 46) gave the locality of the specimens collected by Baumann as 'Misahöhe, Togoland' (= Missahoe, Togo); however, according to the entry book the locality is Kunjuruma." Preface by Matschie is dated 14 May 1899.

1950. *Epomophorus reii* Aellen, Rev. suisse Zool., 57 (3): 559. Type locality: Cameroon: Rei Bouba [ca. 08 37 N 14 09 E] [Goto Description]. Holotype: MHNC 32-8-970: ad ♀. Collected by: MSS Cameroun; collection date: 13 September 1947. Presented/Donated by: ?: Collector Unknown. Paratype: MHNC 32-8-969: imm ♀. Collected by: MSS Cameroun; collection date: 13 September 1947. Presented/Donated by: ?: Collector Unknown. - Comments: in part?.

? *Epomophorus anurus:* - Comments: Not of Heuglin, 1864.

? *Epomophorus gambianus gambianus:* (Name Combination, Current Combination)

? *Epomophorus sp.:*

TAXONOMY:
Simmons (2005:322) does not include *crypturus*.

GENERAL DISTRIBUTION:
This subspecies ranges from Senegal in the west, through much of West Africa and parts of Central Africa. It is typically a lowland species occurring below 500 m asl.

Native: Benin; Burkina Faso; Cameroon; Central African Republic; Chad; Congo (The Democratic Republic of the); Côte d'Ivoire; Gambia; Ghana; Guinea; Guinea-Bissau (Bocage, 1889a:2; Seabra, 1898b; Monard, 1939; Veiga-Ferreira, 1948; Bergmans, 1988; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 22); Liberia; Mali; Nigeria; Senegal; Sierra Leone; Togo.

Epomophorus gambianus pousarguesi Trouessart, 1904

*1904. *Epomophorus pousarguesi* Trouessart, Catalogus Mammalium tam viventium quam fossilium, supplement, 55. Type locality: Central African Republic: Grande Brousse between Yabanda and Mpoko. Holotype: MNHN ZM-MO-1892-1020: Collected by: Jean Dybowski; collection date: 1-11 December 1891. Bergmans (1978a: 682, 683) mentions two different numbers for this specimen. In the table on pag 682, he mentions 1899-1020 and on page 683 he mentions 1892-1020. - Comments: Boulay and Robbins (1989: 1) mention "Africa Occ.-Centrali, a fl. Chari (Inter Yabanda et Mpoko), reg. Lac. Chad. Central African Republic as type locality; restricted to 'along the track between Mpoko (near Makorou) and Yabanda' by Bergmans (1978b)". The type locality is sometimes given as "Eastern Congo, Shari region". Description based on *E. macrocephalus* Pousargues (not Ogilby) see Allen (1939a: 56).
? *Epomophorus gambianus pousarguesi:* (Name Combination, Current Combination)
? *Epomophorus gambianus:* - Comments: Not of Ogilby, 1835.

TAXONOMY:
Recognized as a subspecies (Simmons, 2005: 322).

GENERAL DISTRIBUTION:
In Ethiopia populations may be found up to 2,000 m asl.

Native: Ethiopia, South Sudan, Sudan.

Epomophorus grandis (Sanborn, 1950)

*1950. *Micropteropus grandis* Sanborn, Publ. Cult. Comp. Diamantes Angola, Lisboa, 10: 55, figs 2 - 3. Publication date: 29 November 1950. Type locality: Angola: Lunda: Dundo [07 22 S 20 50 E]. Holotype: FMNH 66433: ad ♀, skull and alcoholic. Collected by: A. de Barros Machados; collection date: September 1948; original number: 2015.
1988. *Epomophorus grandis:* Bergmans, Beaufortia, 38 (5): ???. (Name Combination, Current Combination)

TAXONOMY:
Transferred from *Micropteropus* to *Epomophorus* by Bergmans (1988). See Simmons (2005: 322).

COMMON NAMES:
Czech: kaloň Sanbornův. English: Sanborn's Epauletted Fruit-bat, Lesser Angolan Epauletted Fruit Bat. French: Epomophore de Sanborn, Petit Epomophore frugivore d'Angola. German: Sanborns Epaulettenflughund.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Mickleburgh *et al.*, 2008h; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008h; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004e; IUCN, 2004). 2000 - DD (Hilton-Taylor, 2000). 1996 - EN (Baillie and Groombridge, 1996). 1994 - Rare (Groombridge, 1994).

MAJOR THREATS:
The threats to this species are not known. There is deforestation taking place in parts of the species range. However, it is not known how adaptable this species is to habitat modification (Mickleburgh *et al.*, 2008h; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008h) [in IUCN (2009)] report that it is not known if the species is present in any protected areas, and the area where it occurs has been inaccessible for many years, further studies are needed into the distribution, natural history and possible threats to this species.

GENERAL DISTRIBUTION:
Epomophorus grandis is a poorly known as it has only been recorded at the type locality of Dundo in northeast Angola (Sanborn, 1950), and from Pointe Noire on the coast of Congo (Bergmans, 1988).

Native: Angola (Bergmans, 1988; Sanborn, 1950; Monadjem *et al.*, 2010d: 552); Congo (Bergmans, 1988; Monadjem *et al.*, 2010d: 552; Bates *et al.*, 2013: 333).

HABITAT:
Although the natural history of this species is poorly known, it seems to be primarily a savanna species that may range into tropical moist forest (Mickleburgh *et al.*, 2008h; IUCN, 2009).

POPULATION:
Structure and Density - It is only known from a few specimens (Mickleburgh *et al.*, 2008h; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008h; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Congo.

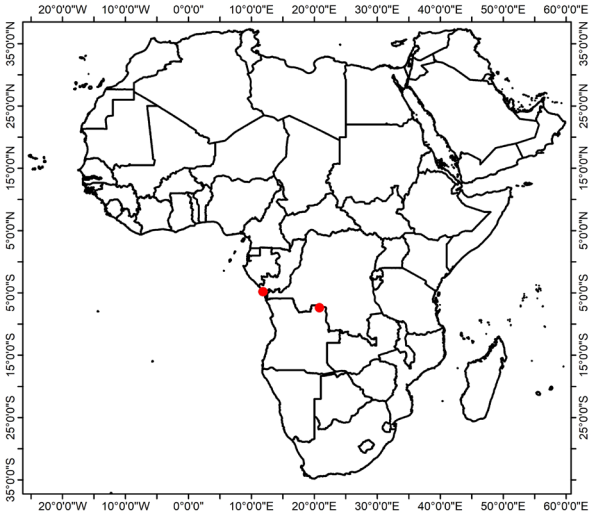


Figure 23. Distribution of *Epomophorus grandis*

Epomophorus labiatus (Temminck, 1837)

*1837. *Pteropus labiatus* Temminck, Monogr. Mamm, 2: 83, pl. 39, figs 1 - 3. Type locality: Sudan: Blue Nile province: Sennaar [15 35 N 33 38 E, 425 m] [Goto Description]. Lectotype: RMNH MAM.27342: juv ♀. Collected by: Dr. Paolo Emilio Botta. See Kock (1969a: 18). - Comments: Type locality originally given as "Abyssinia"; see Horácek *et al.* (2000: 96). Andersen (1912b: 530) mentions that Temminck (1835) had two specimens, one obtained in London without any indication about the country of origin, and a second from Paris, originating from the collections of M. Botta, the latter is the only one presently in the RMNH. - Etymology: From the Latin "*labiatus*" for lipped.

1842. *Pteropus Schoënsis* Rüppell, Mus. Senckenberg., 3 (2): 131. Type locality: Ethiopia: Shoa province: Shoa province [ca. 09 00 N 39 00 E] [Goto Description]. Holotype: SMF 4370: juv ♂, skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1841. Old catalog II.A.13a; see Kock (1969a: 18); Mertens (1925: 20) mentions it as a juv ♀. - Comments: Andersen (1912b: 531) already mentioned that the mounted specimen is of doubtfull sex.

1860. *Epomophorus labiatus:* Tomes, Proc. zool. Soc. Lond., 28: 55 - 56. (Name Combination, Current Combination)

1864. *Epomophorus anurus* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 31 (7): 12. Type locality: Sudan: Bahr-el-Ghazal province: Bongo [07 15 N 28 42 E]. Syntype: SMNS 1090: imm ♂, mounted skin and skull. Collected by: Martin Theodor von Heuglin; collection date: 1855. Dieterlen *et al.* (2013: 293) indicate that this specimen was collected in “Bellegas-Tal” [= Belegaz/Belghe], Abyssinia. Syntype: SMNS 1091: ad ♀, mounted skin and skull. Collected by: Martin Theodor von Heuglin; collection date: 1863/1864. Dieterlen *et al.* (2013: 293) indicate that this animal was collected in Bongo [= country of Bongo, southern part of the province of Bahr-el-Ghazal in the south of Sudan]. Syntype: SMNS 609/661: ad ♂, mounted skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 293) mention the skull bears number 609, and that the mounted specimen has 661 as additional number. - Comments: Thorn *et al.* (2009: 20) mention 06 40 N 29 40 E. Type locality originally given as "Gebied zw. Wau am Djur River und dem Getti River im Westen", see Kock (1969a: 18). Two syntypes: SMNS 1090 (♂, imm) and SMNS 1091 (♀, ad).

1877. *Pteropus (Epomophorus) anurus:* Heuglin, Reise in Nordost Afrika, 2: 16 - 17. (Name Combination)

1877. *Pteropus (Epomophorus) labiatus:* Heuglin, Reise in Nordost Afrika, 2: 15 - 16. (Name Combination)

1877. *Pteropus (Epomophorus) schovanus:* Heuglin, Reise in Nordost Afrika, 2: 18. - Comments: Emendation of *schoënsis* (see Andersen, 1912b: 530; Allen, 1939a: 56; Kock, 1969a: 18). (Emendation)

1899. *Ep[omophorus (Epomophorus)] doriae* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde,

54. Type locality: Eritrea: Bogos country [=Keren region] [ca. 15 45 N 38 20 E] [Goto Description]. Holotype: ZMB 10079: Collected by: Gerrard. Presented/Donated by: ?: Collector Unknown. Holotype: ZMB 5384/10079: ad ♀, skin and skull. Vendor Gerrard; see Kock (1969a: 18), and Turni and Kock (2008: 8) [skin: ZMB 5384 + skull: ZMB 10079].

1936. *Epomophorus labiatus minor:* G.M. Allen and Lawrence, Bull. Mus. comp. Zool., 79 (3): 45. - Comments: (Locality suggestive of *labiatus* rather than *Epomophorus minor* Dobson, 1880). (Name Combination)

1950. *Epomophorus reii* Aellen, Rev. suisse Zool., 57 (3): 559. Type locality: Cameroon: Rei Bouba [ca. 08 37 N 14 09 E] [Goto Description]. Holotype: MHNC 32-8-970: ad ♀. Collected by: MSS Cameroun; collection date: 13 September 1947. Presented/Donated by: ?: Collector Unknown. Paratype: MHNC 32-8-969: imm ♀. Collected by: MSS Cameroun; collection date: 13 September 1947. Presented/Donated by: ?: Collector Unknown. - Comments: in part?.

1960. *Epomophorus labiatus anurus:* Harrison, J. East Afr. Nat. Hist. Soc., 23 (7) (104): 287. Publication date: December 1960. (Name Combination)

1966. *Epomophorus crypturus:* Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: 23. - Comments: (in part: specimen IRSN 10677 from "Kilwezi"- label reads Kilubwezi). Not of Peters, 1852.

1971. *Epomophorus sp.* Hill and Morris, 29.

1974. *Epomophorus labiatus labiatus:* Largen, Kock and Yalden, Mon. Zool. ital., (N.S.) 16 (Suppl. 5): 221, 226. (Name Combination)

1978. *Epomophevus anupus:* Arata and Johnson, in: Pattijn, Ebola Virus Haemorrhagic Fever, 135. (Lapsus)

1988. *Epomophorus gambianus gambianus:* Bergmans, Beaufortia, 38 (5): 84.

1996. *Epomophorus anarus:* Kityo and Kerbis, J. East Afr. Nat. Hist., 85: 58. (Lapsus)

2019. *Epomophorus labiatuc:* Banerjee, Kulcsar, Misra, Frieman and Mossman, Viruses, 11 (1) 41: 6. Publication date: 9 January 2019. (Lapsus)

? *Epomophorus cf. labiatus:*

TAXONOMY:
Includes *anurus* and *minor*; see Claessen and De Vree (1991), but see also Bergmans (1988) and Simmons (2005: 322 - 323). Middle Eastern forms reviewed by Horácek *et al.* (2000).

COMMON NAMES:
Azande (DRC): Ndima. Chinese: 小颈囊果蝠. Czech: kaloň sudánský. English: Little Epauletted Fruit-bat, Ethiopian Epauletted Fruit-bat, Ethiopian Epauletted Fruit Bat. French: Petit épomophore, Epomophore d'Ethiopie, Roussette labiée, Roussette labiaire. German: Temmincks Epaulettenflughund. Italian: Epomòforo labiàto. Kinande (DRC): Apopo.

CONSERVATION STATUS:
Global - Listed as Least Concern in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [includes *E. minor* (Mickleburgh *et al.*, 2008l; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004d; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole. Some populations may be threatened by overharvesting for subsistence food (Mickleburgh *et al.*, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008l) [in IUCN (2009)] report that this species has been recorded from many protected areas. No direct conservation measures are currently needed for the species as a whole. Additional research is needed into the impact of possible overharvesting of animals on some populations.

GENERAL DISTRIBUTION:
Epomophorus labiatus is largely distributed in Central Africa and East Africa. It appears to range from northern Nigeria and Cameroon, into Chad, southern and central Sudan, Ethiopia and Eritrea, and from here south into eastern Democratic Republic of the Congo, Uganda, Rwanda and Burundi, Kenya and Tanzania (including the islands of Unguja [=Zanzibar] and Mafia [see O'Brien, 2011: 285]), being recorded as far south as Malawi, northern Mozambique and northern Zambia. There is one isolated record from coastal Congo, although the presence of the species in this country, and also in Chad and Nigeria, needs to be confirmed. It has been recorded from

lowland sites up to elevations of over 2,000 m asl (2,200 asl at Gondar, Ethiopia) (Mickleburgh *et al.*, 2008l; IUCN, 2009).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 436,697 km^2.

Senegal records are probably erroneous (see Bergmans, 1988), although Capo-Chichi *et al.* (2004: 161) do refer to these records.

Native: Burundi; Cameroon; Congo (Bates *et al.*, 2013: 333); Congo (The Democratic Republic of the) (Bergmans, 1988; Monadjem *et al.*, 2010d: 552); Djibouti (Pearch *et al.*, 2001: 392); Eritrea (Yalden *et al.*, 1996); Ethiopia (Yalden *et al.*, 1996); Kenya (Aggundey and Schlitter, 1984; Malawi (Ansell, 1986; Bergmans, 1988; Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 552); Mozambique (Monadjem *et al.*, 2010d: 552; Monadjem *et al.*, 2010c: 376); Rwanda (Baeten *et al.*, 1984); Saudi Arabia (Gaucher, 1992); Sudan (Koopman, 1975; Tanzania; Uganda (Kityo and Kerbis, 1996: 59); Yemen (Benda *et al.*, 2011b: 28); Zambia (Ansell, 1973; Bergmans, 1988; Monadjem *et al.*, 2010d: 552).
Presence uncertain: Chad; Congo; Nigeria.

SEXUAL DIMORPHISM:
Dobson (1873: 247) already indicated that Temminck noticed the absence of shoulder-tufts in the female.

MOLECULAR BIOLOGY:
Karyotype - Đulic and Mutere (1973b) recorded the diploid number as 2*n* = 36.

HABITAT:
This species is regularly recorded from woodland (including miombo woodland), savanna, bushland, arid or semi-desert grassland habitats and mosaics of these general habitat types. In East African coastal areas it has been recorded from mangroves (Mickleburgh *et al.*, 2008l).

HABITS:
It has been found resting together in small groups of about a dozen animals (Mickleburgh *et al.*, 2008l).

DIET:
Seltzer *et al.* (2013: table S2) provide an overview of the plant species found beneath bat feeding roosts. For *E. labiatus* this included *Ficus natalensis* Hochst (Natal Fig - Moraceae).

POPULATION:
Structure and Density - This is a common species (Mickleburgh *et al.*, 2008l; IUCN, 2009).

Trend - 2008 - Stable (Mickleburgh *et al.*, 2008l; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Bergmans (1979a), Kingdon (1974), and Kulzer (1958) [in Krutzsch (2000: 110)] indicate that the male reproductive cycle of *E. labiatus* [as *E. anurus*] is apparently in synchrony with the one from the females as there occurs a biseasonal testicular hypertrophy in West Africa.

PARASITES:
Nycteribiidae: *Tripselia blainvillii* (Leach 1817) single record (Haeselbarth *et al.*, 1966: 113, host referred to as *E. anurus*).

Teinocoptidae: *Teinocoptes epomophori* Rodhain, 1923 was reported by Fain (1967: 367) from an *E. anurus* from Astrida (=Butare), Rwanda and from an *E. labiatus minor* from Bukavu, DRC.

VIRUSES:
Willoughby *et al.* (2017: Suppl.) report the following viruses: Entebbe bat virus and Shamonda orthobunyavirus. In Uganda, Kading *et al.* (2018: 3) found neutralizing antibodies against West Nile virus (WNV), Dengue 2 virus (DENV-2), non-specific Flaviviruses, Babanki virus (BBKV), and Rift Valley fever virus (RVFV).

Coronaviridae
28.6 % (10 out of 35) of the Kenyan *E. labiatus* tested positive for CoV in the study by Tao *et al.* (2017).

Flaviviridae
Pegivirus (BPgv) - 1 out of 3 bats from Kenya examined by Quan *et al.* (2013: Table S5) were infected by clade k type *Pegivirus*.

Drexler *et al.* (2012a: Suppl. Table S1) indicated that the single specimen they examined from the Democratic Republic of the Congo did not test positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

UTILISATION:
Bobo and Ntumwel (2010: 232) report that, in the Korup area of Cameroon, "*E. anurus*" is being sold as a medicine on markets, since consuming it would render women fertile.

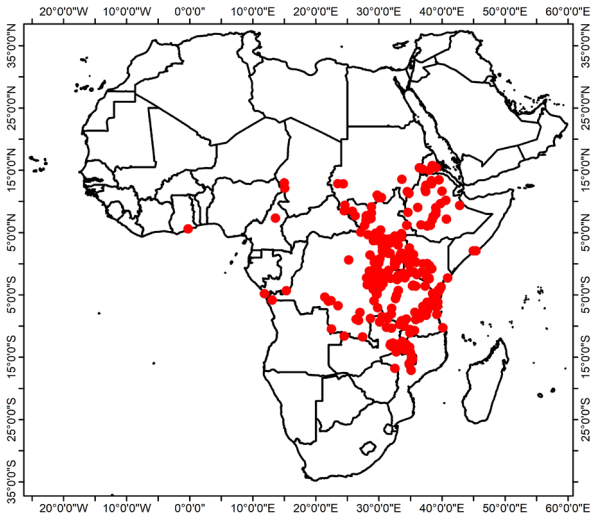


Figure 24. Distribution of *Epomophorus labiatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: "Africa", Burundi, Cameroon, Chad, Congo, Congo (Democratic Republic of the), Djibouti, Eritrea, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Rwanda, Somalia, South Africa, South Sudan, Sudan, Tanzania, Uganda, Zambia, Zimbabwe.

Epomophorus minimus Claessen & De Vree, 1991

1837. *Pteropus labiatus:* Temminck, Mon. Mammal., 2: 83 - 84. - Comments: Partim. One of the type specimens, an adult ♂, which later disappeared (Claessen and De Vree, 1991: 216). - Etymology: From the scientific Latin male adjective *labiàtus* meaning "lipped", referring to the expansible lower lip (see Lanza *et al.*, 2015: 36).
1861. *Epomophorus labiatus:* Tomes, Proc. zool. Soc. Lond., 29: 11. - Comments: Partim.
1899. *Ep[omophorus (Epomophorus)] schoensis:* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 44, 53. - Comments: Partim. Not of Rüppell, 1842.
1930. *Epomophorus minor:* Zammarano, Le colonie Italiane, 146. - Comments: Not of Dobson, 1880.
1939. *Epomophorus labiatus minor:* G.M. Allen, Bull. Mus. comp. Zool., 83: 56. - Comments: Partim. Not of Dobson, 1880.
1971. *Epomophorus labiatus labiatus:* Hayman and Hill, Mammals of Africa: Chiroptera, 6 - 7. - Comments: Partim.
1984. *Epomophorus labiatus anurus:* Aggundey and Schlitter, Ann. Carnegie Mus., 53 (5): 124. - Comments: Animals from Katilo. Not of Heuglin, 1864.
*1991. *Epomophorus minimus* Claessen and De Vree, Senckenb. biol., 71: 216. Type locality: Ethiopia: Harar province: Shewa: Bahadu [10 05 N 40 37 E, 600 m]. Holotype: SMF 44238: ad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971; original number: 16194. Full grown female with well developed nipples (see Claessen and De Vree (1991: 216). Paratype: SMF 44232: ad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44233: sad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44234: juv ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44235: juv ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44236: ad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44237: ad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44239: ad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44240: ad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44242: sad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 2015. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44243: juv ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 5 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44245: ad ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF

44246: sad ♂, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44247: ad ♂, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44248: sad ♂, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44250: juv ♂, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44252: ad ♂, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 - 7 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44253: juv ♂, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44325: juv ♀, skull and alcoholic. Collected by: M.J. Largen; collection date: 3 May 1971. Presented/Donated by: ?: Collector Unknown. - Etymology: From the Latin superlative masculine adjective *mìnimus* meaning "least, smallest" referring to the relatively small size of the species (see Lanza *et al.*, 2015: 41). (Current Combination)

TAXONOMY:
Included in *E. minor* by Bergmans (1988). Recognized as a full species by Claessen and De Vree (1991); Simmons (2005: 323).

Based on multivariate analyses, Claessen and De Vree (1991) concluded that the type specimen of *Epomophorus minor* fitted within the variation displayed by *E. labiatus* and that this name should be considered a synonym of *E. labiatus*. Consequently, no valid name was available for the smallest form included in the genus *Epomophorus* at that time. For these specimens, they proposed the new name Epomophorus minimus. However, Brosset and Caubère (1960) provided a further analysis of the problem and rejected this view, and reinstated the name *minor*. The situation is currently still not completely resolved with both names being used by various authors. The systematics of the small-sized *Epomophorus* forms, therefore, still remains unclear and needs further investigation.

Member of the *gambianus* species group.

COMMON NAMES:
Chinese: 侏颈囊果蝠. Czech: kaloň habešský. English: Least Epauletted Fruit-bat, East African Epauletted Fruit-bat, East African Epauletted Fruit Bat. French: Petit Epomophore, Epomophore nain. German: Winziger Epaulettenflughund. Italian: Epomòforo mìnimo.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008j; IUCN, 2009).

Assessment History - 2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008j; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004j; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species. It is locally threatened in parts of its range by deforestation of its habitat for timber and firewood (Mickleburgh *et al.*, 2008j; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008j) [in IUCN (2009)] report that *E. minimus* it is not known if the species is present in any protected areas and further studies are needed into the distribution, natural history and possible threats to this species.

GENERAL DISTRIBUTION:
Epomophorus minimus is an East African species which is present in Uganda, northern Tanzania, Kenya, Ethiopia and Somalia.

Native: Ethiopia (Yalden *et al.*, 1996); Kenya (Aggundey and Schlitter, 1984; Somalia (Funaioli and Simonetta, 1966); Tanzania; Uganda (Kityo and Kerbis, 1996: 58).

HABITAT:
Recorded from dry and arid savanna habitats.

DIET:
It is possible that this species has a specialised diet to persist in its arid habitat (Mickleburgh *et al.*, 2008j).

POPULATION:
Structure and Density - It can be a common species (Mickleburgh *et al.*, 2008j; IUCN, 2009). Trend - 2008 - Stable (Mickleburgh *et al.*, 2008j; IUCN, 2009)

VIRUSES:
Drexler *et al.* (2012a: Suppl. Table S1) indicated that three out of six specimens they tested from the Democratic Republic of the Congo were positive for *Rubulavirus*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Ethiopia, Kenya, Somalia, Tanzania, Uganda.

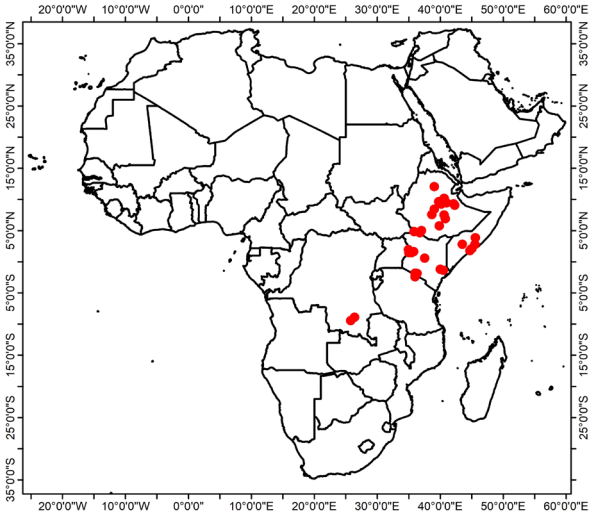


Figure 25. Distribution of *Epomophorus minimus*

Epomophorus minor Dobson, 1880

*1880. *Epomophorus minor* Dobson, Proc. zool. Soc. Lond., 1879, IV: 715. Publication date: April 1880. Type locality: Tanzania: Zanzibar [ca. 06 10 S 39 12 E]. Holotype: BMNH 1879.9.12.4: juv ♂, skull and alcoholic. Exchanged from Surgon-General G.E. Dobson see Turni and Kock (2008). Paratype: ZMB 5550: ad ♀, skull and alcoholic. Presented/Donated by: George Edward Dobson. See Turni and Kock (2008: 8). - Comments: Andersen (1912b: 532) furthermore mentions that paratypes were distributed by Dobson to various museums. Considered a valid species by Kock (1969a: 18 - 24), Koopman (1975: 363) and Ansell and Dowsett (1988: 27), but see Claessen and De Vree (1991). - Etymology: From the Latin "*minor*" (= smaller). (Current Combination)
1896. *Epomophorus pusillus:* Pousargues, Ann. Sci. Nat., (8) 3: 255.
? *Epomophorus anurus:* - Comments: Not of Heuglin, 1864.
? *Epomophorus labiatus anurus* - Comments: Not of Heuglin, 1864.
? *Epomophorus labiatus minor:* (Name Combination)
? *Epomophorus labiatus:* (Name Combination)
? *Epomophorus minor minor:* (Name Combination)

TAXONOMY:
Recognized as a full species by Simmons (2005: 323).

COMMON NAMES:
Czech: kaloň zanzibarský, kaloň menší. English: Minor Epauletted Fruit Bat. German: Zwerg-Epaulettenflughund. Yao: Lichinji (applied to all large bats).

CONSERVATION STATUS:
Global - Unknown.

GENERAL DISTRIBUTION:
Ethiopia, Somalia, Sudan, Kenya, Rwanda, SE Dem. Rep. Congo, Zambia, Tanzania, Zanzibar, Uganda, Malawi (Simmons, 2005: 323).

PARASITES:
Hirst (1923: 980) described a new mite species (*Ancystropus æthiopicus*) from an *E. minor* specimen from Zanzibar.

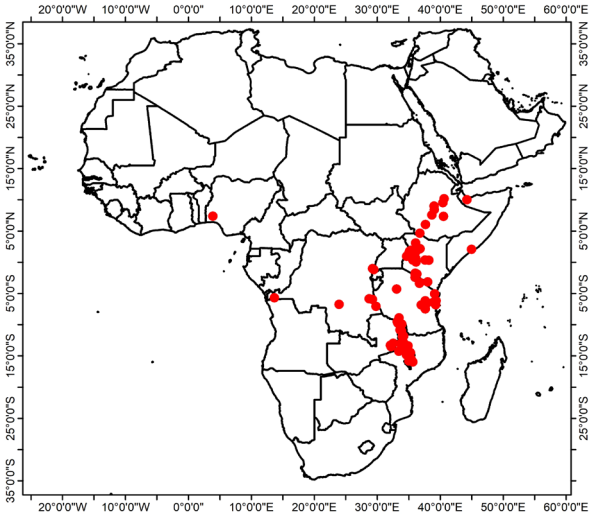


Figure 26. Distribution of *Epomophorus minor*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Ethiopia, Kenya, Malawi, Mozambique, Nigeria, Somalia, Sudan, Tanzania, Zambia.

Epomophorus wahlbergi (Sundevall, 1846)

1846. *Pteropus Haldemani* Hallowell, Proc. Acad. nat. Sci. Philad., 3 (3): 52. Publication date: prior to July 1846. Type locality: Liberia [Goto Description]. - Comments: Holotype; ad ♀, SA, in the collection of the Academy of Natural Sciences of Philadelphia, see Andersen (1912b: 524), who further mentions "'W. Africa,' obtained from 'Dr. Goheen, Physician to the American Colonization Society' (from this it might be supposed that the specimen came from Liberia; there can be little doubt, however, that it was obtained elsewhere in W. Africa; no form of *Epomophorus* with the palate-ridges of the *walhbergi* type is known to inhabit the Guinea coast west of the Cameroons)." Allen (1939a: 56) suggests that the specimen might possible have come from Liberia. Considered a valid species by Schutt and Simmons (1998: 27).

*1846. *Pteropus Wahlbergi* Sundevall, Öfvers. kongl. Sv. Vet.-Akad. Förhandl., 3 (4): 118. Type locality: South Africa: KwaZulu-Natal: Port Natal [=Durban], near [29 52 S 31 00 E] [Goto Description]. - Comments: Type locality originally: "Prope Port-Natal et in Caffraria interiore occisus" see Acharya (1992: 1). As to the publication date, Andersen (1912b: 526, footnote) mentions "Sundevall's paper was read before the Stockholm Academy on May 13th, 1846, and presumably published in the latter half of May or in June (the 'Öfversigt' appears to have been issued regularly for every month in which the Academy held a meeting). Hallowell's description of *Pt. haldemani* was passed by the Publication Committee on May 26th, 1846, and printed in the May-June issue of the Proceedings of the Philadelphia Academy, which cannot have come out before, in the earliest, in July, since it contains a report of a meeting held on June 30th. The balance of evidence would seem, therefore, to be in favour of the date priority of *Pt. wahlbergi*". Andersen (1912b: 527) also mentions "Type (by selection) in the Riksmuseum, Stockholm, a well-preserved mounted adult male, skull separate (nearly perfect), Tugela River, Natal, 27 Nov. 1843, J. Wahlberg coll., Reg. No. 1040.". - Etymology: Named after Johan August Wahlberg (1810 - 1856), explorer, hunter and outstanding collector of zoological material in Southern Africa. He was killed in 1856 by a wounded elephant near Savuti in northern Botswana (see Gyldenstolpe, 1933; Taylor, 2005, Lanza *et al.*, 2015: 48).

1870. *[Epomophorus macrocephalus] var. unicolor* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 125 [Goto Description].

1870. *Epomophorus macrocephalus var. unicolor* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 125. Type locality: Mozambique: Zambesi River: Shupanga [=Chupanga] [18 02 S 35 37 E]. Holotype: BMNH 1864.8.16.1: sad ♀, skin and skull. Collected by: Dr. Sir John Kirk; collection date: June.

1899. *Ep[omophorus (Epomophorus)] neumanni* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 43, 50. Type locality: Kenya: Mombassa [04 03 S 39 40 E] [Goto Description]. Lectotype: ZMB 9967: ad ♂, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt; collection date: about 1880. Lectotype designated by Andersen (1912b: 525); see Turni and Kock (2008). Paralectotype: ZMB 53873: ♀, skull and alcoholic. Collected by: Michael Rodgers Oldfield Thomas; collection date: 1898. Takaungu, Kenya. Paralectotype: ZMB 53897: ♀, skull and alcoholic. Collected by: Michael Rodgers Oldfield Thomas; collection date: 1898. Takaungu, Kenya. Paralectotype: ZMB 5428: ♀, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt; collection date: ca. 1876. Mombassa. Paralectotype: ZMB 54367: ♂, skull and alcoholic. Collected by: Michael Rodgers Oldfield Thomas; collection date: 1898. Takaungu, Kenya. See Turni and Kock (2008: 9). Paralectotype: ZMB 5597: juv ♂, skull and alcoholic. Collected by: Fischer. Malini, Kenya. Paralectotype: ZMB 9968: juv ♀, skull and alcoholic. Collected by: Prof. Oscar Rudolph Neumann; collection date: January 1898. - Comments: Mombasa is the locality of the lectotype: see Allen (1939a: 57). Acharya (1992: 1) mentions "No type originally designated. Type locality restricted to "Mombassa, British East Africa (=Kenya) by Andersen (1912b: 524)". Matschie mentioned 14 May 1899 in his introduction.

1899. *Ep[omophorus (Epomophorus)] stuhlmanni* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 50. Type locality: Tanzania: Usaramo: Vikindo [06 59 S 39 17 E, 120 m]

[Goto Description]. Lectotype: ZMB 9982/9983: ad ♂, skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann; collection date: 11 January 1894. Lectotype designated by Andersen (1912b: 527); skull damaged [skin: ZMB 9983 + skull: ZMB 9982]. Paralectotype: ZMB 10000: ♀, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Zanzibar. Paralectotype: ZMB 10001: ♀, skull and alcoholic. Collected by: Neumann. Zanzibar. Paralectotype: ZMB 10002: ♂, skull and alcoholic. Collected by: Neumann. Zanzibar. Paralectotype: ZMB 2957: ♂, skull and alcoholic. Collected by: Wessel. Zanzibar. Paralectotype: ZMB 67054: ♀, skull only. Collected by: Dr. Franz Ludwig Stuhlmann; collection date: 1894. Dar es Salaam. Paralectotype: ZMB 67055: ♀, skull only. Collected by: Dr. Franz Ludwig Stuhlmann; collection date: 1894. Dar es Salaam. Paralectotype: ZMB 67056: skull only. Collected by: Dr. Franz Ludwig Stuhlmann; collection date: 1894. "Ushindo" [= ?], Tanzania. Paralectotype: ZMB 9252: ♀, skin and skull. Collected by: Fülleborn. Lindi, Tanzania. See Turni and Kock (2008: 9). Paralectotype: ZMB 9978: ♀, skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9979: ♀, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9980: ♂, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9981: ♂, skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9984: skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9986: skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9988: skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9989: ♂, skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann. Vikindo. Paralectotype: ZMB 9990: ♀, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Dar es Salaam. Paralectotype: ZMB 9991: ♀, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Dar es Salaam. Paralectotype: ZMB 9992: ♀, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Dar es Salaam. Paralectotype: ZMB 9993: ♀, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Dar es Salaam. Paralectotype: ZMB 9996: ♀, skull and alcoholic. Collected by: Dr. Franz Ludwig Stuhlmann. Zanzibar. Paralectotype: ZMB 9998: ♂, skin and skull. Collected by: Dr. Franz Ludwig Stuhlmann. Dar es Salaam. - Comments: The "type locality" is the locality of the lectotype: see Allen (1939a: 56). Acharya (1992: 1) mentions "No type originally designated. Type locality restricted to Vikindo, Usaramo, German East Africa [=Tanzania] by Andersen (1912b: 527)." In part (see Allen, 1939a: 56). Matschie mentioned 14 May 1899 in his introduction.

1899. *Ep[omophorus (Epomophorus)] zenkeri* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 44, 46. Type locality: Angola: Cabinda: Tschintschoscho [= Chinchoxo] Station [05 05 S 12 02 E] [Goto Description]. Lectotype: ZMB 9974/9975: ad ♀, skin only. Collected by: Falkenstein; collection date: 1874. Lectotype designated by Andersen (1912b: 524): 8 paralectotypes designated; see Turni and Kock (2008) [skin: ZMB 9974 + skull: ZMB 9975]. Paralectotype: ZMB 3632: ♀, skull and alcoholic. Angola. Ex Mus Lisbon. Paralectotype: ZMB 4801: ♂, skull and alcoholic. Collected by: Falkenstein. Chinchoxo [=Loango Coast]. Paralectotype: ZMB 6129: ♂, skull and alcoholic. Collected by: Büttner. Gabon. Paralectotype: ZMB 9969: ♀, skull and alcoholic. Collected by: von Melchow. Malandje [=Malange], Angola. Paralectotype: ZMB 9970: ♂, skull and alcoholic. Collected by: von Melchow. Malandje [=Malange], Angola. Paralectotype: ZMB 9971: ♀, skull and alcoholic. Collected by: von Melchow. Malandje [=Malange], Angola. Paralectotype: ZMB 9976: ♂, skull and alcoholic. Collected by: Falkenstein. Chinchoxo. Paralectotype: ZMB 9977: ♂, skull and alcoholic. Collected by: Falkenstein. Chinchoxo. See Turni and Kock (2008: 10). - Comments: Allen (1939a: 56) mentioned the lectotype from Chinchoxo, Cabinda, Angola. Acharya (1992: 1) mentions "No type originally designated. Type locality restricted to Chinchoxo, Cabinda, Angola by Andersen (1912b: 524)." Matschie mentioned 14 May 1899 in his introduction.

1990. *Epomophorus walbergi:* King, Davies and Lawrie, Vet. Microbiol., 23 (1-4): 168. Publication date: June 1990. (Lapsus)

2012. *Epomophorus walhbergi:* Monadjem and Reside, Afr. Zool., 47 (2) 321. (Lapsus)

2013. *Epomophorus angolensis:* Van Cakenberghe and Seamark, African Chiroptera Report, 760. - Comments: Not of Gray, 1870 (in part). The specimens not from Angola or Namibia.

2016. *Epomophorus wahlbergyi:* Bahlman, Price-Waldman, Lippe, Breuer and Swartz, J. Anat., 229 (1): 116. Publication date: 1 March 2016. (Lapsus)

2017. *Epomorphorus wahlbergi:* Banyard and Fooks, Microbiol. Aust., 38 (1): 18. Publication date: March 2017. (Lapsus)
? *Epomophorus crypturus:* - Comments: Not of Peters, 1852.
? *Epomophorus gambianus:* - Comments: Not of Ogilby, 1836.
? *Epomophorus wahlbergi haldemani:* (Name Combination)
? *Epomophorus wahlbergi wahlbergi:* (Name Combination)
? *Epomophorus wahlbergi:* (Name Combination, Current Combination)

TAXONOMY:



Figure 27. *Epomophorus wahlbergi* from Durban, KwaZulu Natal, South Africa.

Reviewed by Acharya (1992). See Simmons (2005: 323).

COMMON NAMES:
Afrikaans: Wahlberg se vrugtevlermuis, Wahlberg-witkolvrugtevlermuis. Chinese: 韦氏颈囊果蝠. Czech: kaloň Wahlbergův. English: Wahlberg's Epauletted Fruit-bat, Wahlberg's Epauletted Fruit-bat. French: Epomophore frugivore de Wahlberg, Roussette à épaulettes de Wahlberg. German: Wahlbergs Epaulettenflughund. Italian: Epomòforo di Wàhlberg. Portuguese: Morcego frugivoro de Wahlberg. Spanish (Castillian): Zorra Voladora

SIMILAR SPECIES:
Taylor and Monadjem (2008: 24) provided data which enabled them to separate *E. wahlbergi* from *E. crypturus*. In the first species, the maxillary width is always larger than in the latter (♂♂: > 14 mm; ♀♀: > 13 mm).

Adams and Snode (2015) analysed the male mating calls of two groups of epauletted bats (*E. wahlbergi* and *E. crypturus*) in the Kruger National Park, and found differences in mean fundamental frequency, mean high frequency, mean low frequency, mean bandwidth, and mean call slope. They hypothesize that these differences may be used to avoid cross-mating between species.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008k; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008k; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004f; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Schoeman *et al.*, 2016d). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Mickleburgh *et al.*, 2008k; IUCN, 2009). However, MacEwan (2016: 3) reports on *E. walhbergi* fatalities as a result of encounters with wind turbine blades.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008k) [in IUCN (2009)] report that it is present in many protected areas and no direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Epomophorus wahlbergi is found in Central Africa, East Africa and southern Africa (it is broadly distributed across southern Africa). It has been recorded from Cameroon (Aellen, 1952), Equatorial Guinea (Rio Muni), Gabon, Congo and Angola in the west, through southern Democratic Republic of the Congo and Rwanda, being distributed in East Africa from Uganda, Kenya and southern Somalia in the north, through Tanzania (including the islands of Unguja [=Zanzibar], Pemba, and Mafia [see O'Brien, 2011: 285]), Zambia, Malawi and Mozambique into Zimbabwe, eastern and southern South Africa and Swaziland. There is a need to confirm the presence of this species in Cameroon and Equatorial Guinea. It ranges from sea level to around 2,000 m asl (Mickleburgh *et al.*, 2008k; IUCN, 2009).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,327,859 km^2.

In South Africa, its distribution is strongly associated with annual precipitation (Babiker Salata, 2012: 49).

Liberian records are probably erroneous.

Native: Angola (Bergmans, 1988; Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 552); Botswana; Burundi; Congo (Bates *et al.*, 2013: 333); Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 552); Gabon; Kenya; Malawi (Happold *et al.*, 1988; Bergmans, 1988; Happold and Happold, 1997b: 815; Monadjem *et al.*, 2010d: 554); Mozambique (Smithers and Lobão Tello, 1976; Bergmans, 1988; Monadjem *et al.*, 2010d: 554; Monadjem *et al.*, 2010c: 376); Rwanda; Somalia; South Africa (Monadjem *et al.*, 2010d: 553); Swaziland (Monadjem *et al.*, 2010d: 553); Tanzania (Stanley and Goodman, 2011: 37); Uganda; Zambia (Ansell, 1978; Bergmans, 1988; Cotterill, 2002b: 6; Monadjem *et al.*, 2010d); Zimbabwe (Monadjem *et al.*, 2010d: 553).
Presence uncertain: Cameroon; Equatorial Guinea, Namibia (Cotterill, 2004a: 260).

DENTAL FORMULA:
At birth, the following dentition is present:

i $^{2}/_{2}$ c ^{1} / $_{1}$ p $^{1}/_{1}$ = 16

The adult dental formula is:

I $^{2}/_{2}$ C $^{1}/_{1}$ P $^{2}/_{3}$ M $^{1}/_{2}$ = 28 (Sowler, 1980: 113).

Sowler (1980: 113) also reports that the second deciduous premolars appear between the second and third week, making a total of 20 teeth. All of the permanent teeth are present between week 12 and 14.

DETAILED MORPHOLOGY:
Tongue - Mqokeli and Downs (2012b examined eight *E. wahlbergi* from Pietermaritzburg, South Africa where all studied had an elongated, muscular tongue of 4.4 ± 0.33 cm (mean ± SD) long and 1.1 ± 0.4 cm (mean ± SD) wide. The anterior tip of the tongue of each was narrower compared with the broader posterior part of the tongue. The anterior tip of the tongues was 0.2 ± 0.05 cm thick with a width of 0.7 ± 0.10 cm (mean ± SD). The mid-region of the tongues had a thickness of 0.6 ± 0.05 cm and a width of 1 ± 0.20 cm (mean ± SD). The posterior regions of the tongues were 0.7 ± 0.00 cm thick and 1.5 ± 0.10 cm wide. The dorsal surface of the tongues possessed two types of mechanical papillae, filiform and conical papillae, and two types of gustatory papillae, fungiform and circumvallate papillae, which varied in distribution. Filiform papillae were highly abundant and occurred on the entire surface of the tongue. These papillae were posteriorly directed, with the small filiform papillae situated at the anterior tip of the tongue. Larger filiform papillae were present as a band posterior to these in the anterior to mid-regions of the tongue. Small filiform papillae with fungiform papillae occurred on either side of the giant filiform papillae band. The posterior part of the *E. wahlbergi* tongue (behind the giant filiform papillae) had elongated basket-like filiform papillae. These had large projections and occupied most of the posterior region of the tongue. Fungiform papillae occurred among these filifor papillae. The elongated basket-like filiform papillae were symmetrically arranged with respect to the axis of the tongue. The filiform papillae transformed into conical papillae on the left and right side of the posterior base of the tongue and pointed inwards. Short conical papillae occurred on the midportion of the posterior region of the tongue. Fungiform papillae were scattered among the filiform papillae, except in areas of giant filiform and conical papillae. At the posterior end of the tongue occurred a triangular arrangement of three circumvallate papillae directed toward the pharynx surrounded by a deep groove.

Brain - Chawana *et al.* (2013: 160) indicate the average brain mass for 2 specimens was reported as 1.81 g.

Physiology - Minnaar *et al.* (2014b: 475) studied the evaporative water loss and indicate that they can not substantiate previous findings of 5 to 10 % of the gas exchanges being done over the wing membrane.

FUNCTIONAL MORPHOLOGY:
Makanya and Mortola (2007: 687) and Kovalyova (2014: 326) indicate that the body skin epidermis for this species thick (61 ± 3 µm, SEM), the stratum corneum alone taking a third of it (21 ± 3 µm). The wing membrane was 27.8 ± 3.1 µm thick, of which the epidermis took 9.8 ± 0.7 (9.1 - 10.5) µm, with a stratum corneum (horny layer) of 4.1 ± 0.3 (3.7 - 4.4) µm. Makanya and Mortola (2007: 687) conclude that the wing web has structural modifications that permit a substantial contribution to the total gas exchange.

Coimbra *et al.* (2016: 191) mention that the eye in this species contains about 200,000 retinal ganglion cells. The minimum angle of resolution was approximately 0.167° (ca. 5-6 mm at 1 m distance).

SEXUAL DIMORPHISM:
Adams and Snode (2013: 54) indicate that males are larger than females and have bulldog-like facial pouches that inflate during mate-calling.

MOLECULAR BIOLOGY:
DNA - Unknown
Karyotype - 2*n* = 36, FN = 68 (Đulic and Mutere, 1973b; Peterson and Nagorsen, 1975; Đulic and Mutere, 1977). Đulic and Mutere (1973b; 1977) reported BA = 34, whereas Peterson and Nagorsen (1975) reported BA = 36 as they included the X (no male studied).
Protein / allozyme - Unknown.

HABITAT:
Although *E. wahlbergi* was found in bushed *Acacia* steppe, Lönnberg (1912: 27) doesn't regard this species as a steppe mammal, since a forest of tall Acacias and other trees was nearby.

HABITS:
Wickler and Seibt (1976) suggest that male *E. wahlbergi*'s call out to space out other males, but also to attract females. Funakoshi *et al.* (1995: 504) indicate that their communication calls consist of several harmonics covering the 2 - 8 kHz range, with a duration of 200 - 300 msecs, which also contain a slight click at the beginning.

In a study at the University of KwaZulu-Natal, Downs *et al.* (2015: 7) found that in winter bats generally slept for longer periods of time, and more often than in summer, and that no bats were sleeping when the ambient temperature was above 35°C. During the winter season, the percentage of sleeping bats increased between 9 and 12 o'clock as T_a increased. In both seasons, more bats were sleeping with both eyes closed than with only one open. During the first hours after their nightly activity, sleep with both eyes closed was more often observed, but this diminished later on during the day, with one eye open sleep reaching its peak around 10h00.

ROOST:
Day roosts are often located in the dense foliage of riverine or gallery forests, but sometimes caves are used too. Three to six individuals roost in small groups, and roosts are switched every five or six days, sometimes only for a few metres (Kunz, 1996: 44).

Wickler and Seibt (1976) [in McCracken and Wilkinson (2000:350)] found that *E. wahlbergi* roosts in palm leaves or thatch roofs in mixed sex colonies, containing from three to over 100 animals, where the individuals are spaced at least 2.5 cm apart (except for female-young pairs).

In the Durban area, Taylor *et al.* (1999: 66) reported *E. wahlbergi* to roost along the undersurface midribs of royal palm (*Roystonia elata* (Kunth) O.F. Cook) leaves, and sometimes under eaves of double-storey houses or in recesses under a concrete road bridge.

The bats also regularly change their day roost (see Rollinson *et al.*, 2014: 173), e.g. to reduce the distance from the roost site to their feeding sites. During the winter they changed their roosting sites more often than during the summer (p. 179). These authors also reported that the roost temperatures are generally higher than the ambient temperature, and that roosts in man-made structures had usually a higher temperature than those in natural vegetation (e.g. in *Bougainvillea, Borassus, Trema orientalis*).

DIET:
Voigt *et al.* (2011: 355) found *E. wahlbergi* to be the second most important seed disperser for syringa fruits (*Melia azedarach*), which is an alian invasive tree species in KwaZulu Natal. Jordaan *et al.* (2011: 961) fed captive specimens with fruits of *Psidium guajava* L. (Myrtaceae) and *Melia azedarach* L. (Meliaceae) during the month of May, and with those of *Eriobotrya japonica* (Thunb.) Lindl. (Rosaceae) and *Morus alba* L. (Moraceae) during September. *Solanum mauritianum* Scopoli (Solanaceae) and *Cinnamomum camphora* (L.) J. Presl. (Lauraceae) fruits were also made available to the bats, but were not eaten by any of the individuals.

In Congo, Kipalu (2009: 16) reported *E. wahlbergi* visiting/consuming fruits of the Borassus palm (*Borassus aethiopum*), African peach (*Nauclea diderichii*), and Mango (*Mangifera indica*).

Seltzer *et al.* (2013: table S2) provided an overview of the plant species found beneath bat feeding roosts. For *E. wahlbergi* these include *Rauvolfia caffra* Sond. (Quinine Tree - Apocynaceae), *Ficus natalensis* Hochst (Natal Fig - Moraceae) and *Syzygium cordatum* Hochst. (water-berry tree - Myrtaceae).

Govender *et al.* (2016: 315) found that *E. wahlbergi* prefered ripe figs over green ones.

Wickler and Seibt (1976) [in Bonaccorso *et al.* (2014: 50)] reported *E. wahlbergi* feeding on leaves of *Balanites wilsonianea* (Balanitaceae) in East Africa. Bonaccorso *et al.* (2014: 50) indicated this might also be the case in the Kruger National Park. Based on data from captive feeding experiments Bonaccorso *et al.* (2014: 50) extrapolated that the Skukuza bat colony (133

animals in 2007) would have dispersed 3.2 million fig seeds per night.

Downs *et al.* (2011b: 148) indicate that *E. wahlbergi*'s body mass was significantly higher in winter than in summer, which is possibly not attributable to an increase in body fat, but rather to excessive eating as result in increased metabolic costs.

Rollinson *et al.* (2013: 340) found that in the urban environment of Pietermaritzburg, South Africa, the bats had a greater home range in winter than in spring, which was linked with the reduction of fruiting plant species. They also found (p. 343) that male home ranges were smaller than those of females (0.46 km^2 versus 0.78 km^2). Their mean foraging distance was 1.45 ± 0.2 km in winter and 0.88 ± 0.08 km in spring.

Namah *et al.* (2019: 2) expected *E. wahlbergi* to be the pollinator of sausage trees (*Kigelia africana* (Lam.) Benth.) in the Kruger Park (RSA), but could not find any proof of this. Nor could they confirm pollination by any other species of bat.

Coleman and Downs (2012: 431) investigated the effect of sugar type and concentration on *E. wahlbergi* and suggest that these bats do not appear to have a selective pressure on the sugar composition of the fruit they eat. Mqokeli and Downs (2014: 161) performed some tests with equicaloric solutions (15 % glucose or 15 % sucrose with 0, 2.58, 5.68, 7.23 g soy protein/kg H_2O). Volumetric intake of the respective glucose and sucrose solutions varied among individual bats, with total volumetric intake being highest for solutions with no protein. The authors concluded that this suggests *E. wahlbergi* has low protein dietary requirements, which may be a response to the low-protein fruit available in the wild. They do point out that the bats may supplement their diet by actively preying on insects, but this needs to be investigated.

Blood plasma glucose concentrations – *Epomophorus wahlbergi*'s blood plasma glucose concentration was lower (5.24 ± 0.38 mmol/l) at 18:00 before feeding and increased during/after feeding (8.19 ± 1.24 mmol/l) but bats appeared to regulate it within limits (Mqokeli and Downs, 2012a: 348). Glucose intake of *E. wahlbergi* is generally high irrespective of sugar concentration (Coleman and Downs, 2012; Downs *et al.*, 2011a). Mqokeli and Downs (2012a: 349) found that blood plasma glucose concentration differed significantly with time. The greatest individual variation in blood plasma glucose concentrations were recorded at 24:00 possibly because of varying feeding and digestion rates (Mqokeli and Downs, 2012a: 350). Mqokeli and Downs (2012a: 349) found that blood plasma glucose concentrations were generally higher than the upper limit of the normal mammalian blood plasma glucose range. Mqokeli and Downs (2012a) showed diet variations in blood plasma glucose concentrations with an increase in concentrations during or directly after feeding. Mqokeli and Downs (2012a: 349) found that the body masses differed significantly at the respective blood sampling times. The lowest mean body mass (± S.E) was at 18:00 (99.69 ± 5.55 g) while the highest mean body mass was at 24:00 (105.05 ± 5.75 g). There was a significant difference in body mass between the 12:00 and 18:00 sampling times, and between the 24:00 and 18:00 sampling times. At 24:00 all bats had fed on the fruit provided and at 06:00 little fruit remained. The increase in body mass at 24:00 was about 6 %.

Germination experiments performed with four *E. wahlbergi* specimens captured on Mount Kilimanjaro (Tanzania), and fed with fig fruit parts of *Ficus sur* trees resulted in an overal germination percentage of 49.3 % after 13 days (Helbig-Bonitz *et al.* (2013: 123).

PREDATORS:
Broadley (in Schätti, 1984: 340) reports that these bats were eaten by Gaboon vipers (*Bitis gabonica*) kept in captivity.
Mikula *et al.* (2016: Supplemental data) mention the following diurnal avian predators: Dickinson's kestrel (*Falco dickinsoni* Sclater, 1864), Wahlberg's eagle (*Hieraaetus wahlbergi* (Sundevall, 1851)), Crowned eagle (*Stephanoaetus coronatus* (Linnaeus, 1766)); Trumpeter hornbill (*Bycanistes bucinator* (Temminck, 1824)).

POPULATION:
Structure and Density - Common (Mickleburgh *et al.*, 2008k; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008k; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 10.1 years.

REPRODUCTION AND ONTOGENY:
Close to the equator, this species has two birth periods in February-March and in October-December (Bergmans, 1979a; O'Shea and Vaughan, 1980), or an extended period from October to January (Wickler and Seibt, 1976; Bernard and Cumming, 1997). Further south in Malawi and Zambia this species has been described as 'aseasonally polyoestrus' with births from September to March (Happold and Happold,

1990b). In southern Africa, this species has been described as 'seasonally polyoestrus' (Taylor, 2005). Although Taylor (1998) reported that in the KwaZulu-Natal province of South Africa 'breeding occurs throughout the year with peaks in July and in the summer'. However, this statement was based on an unpublished dataset by C. Sapsford, and further details were not presented (Taylor, 2005) in [Skinner and Chimimba, 2005]). In Zimbabwe, gravid females have been recorded in June and December (Smithers and Wilson, 1979), suggesting an extended breeding season. By contrast, in Kruger National Park, South Africa, parturition has been recorded in November-December (Pienaar *et al.*, 1980). In Swaziland, subadults were present throughout the year with two peaks (January-May and August-October), while lactating females were only present between December and May (Monadjem and Reside, 2012: 322).
Lönnberg (1912: 47) mentioned that two of the three females captured on 20 March 1911 at the upper Luazomela River, Kenya were carrying young of approximately 6 cm. Stanley and Goodman (2011: 37) reported a pregnant female collected in the South Pare Mountains, Tanzania, on 20 July 1993.
One female, taken by Bergmans (1979a: 174) in Congo on 21-22 November was lactating, while three others, taken between 28 November and 13 December, were pregnant.

Szekely *et al.* (2015: Suppl.) report a gestation period of 165 days, and two litters per year.

MATING:
Wickler and Seibt (1976) [in Krutzsch (2000: 111)] indicate that male mating patterns also include courtship vocalizations (calling territories). Males also establish nocturnal display sites where females visit the males for mating (see McCracken and Wilkinson, 2000: 349). At Skukuza (Kruger National Park), Adams and Snode (2015: 4) found the following values for the male mating calls: mean fundamental frequency: 7.88 ± 0.11 kHz (first harmonic) followed by a second harmonic: 15.71 ± 0.23 kHz.

Adams and Snode (2013: 54) investigated the male-male competition for females during the mating season and found (p. 58) that the most dominant individuals were calling nearest to a ripe fig tree, and therefore more likely to be noticed by a foraging female. None of the males they observed were calling from nonfruiting sycamore fig trees.

Chaverri *et al.* (2018: 1942) point out the role of the retractile white shoulder tufts, which are erected during courtship by wing-flapping males. They also suggest that these movements may help spread pheromones.

PARASITES:
BACTERIA
One out of five bats tested by Dietrich *et al.* (2016b: 3) in Pafuri (RSA) tested positive for *Bartonella* bacteria, and one out of two bats from Rocktail Bay (RSA) tested positive for *Rickettsia*, as did one out of 80 tested from Umbilo (RSA).

gram-negative
Helmick *et al.* (2004: 88) reported a novel *Pasteurella*-like organism found in lung tissue of two captive Wahlberg's epauleted fruit bats, which were recently shipped, and died soon after release from a 30-day quarantine period.

HAEMOSPORIDA
Garnham (1948, 1950) [in Miltgen *et al.* (1977: 595)] described some liver schizonts and gametocytes, which he assigned to the genus *Hepatocystis*.

ACARI
Teinocoptidae: Fain (1967: 367) reported *Teinocoptes epomophori* Rodhain, 1923 from an *E. wahlbergi haldemani* specimen from Boma, DRC, and *Teinocoptes auricularis* from an *E. wahlbergi* from Zanzibar.
Trombiculidae: *Schoutedenichia (Schoutedenichia) cordiformis* Vercammen-Grandjean, 1958 was reported by Stekolnikov (2018a: 101), who also reported (p. 153) *Microtrombicula homopholis* (Lawrence, 1949).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV: Müller *et al.* (2007b) tested between 1986 to 1999, two individuals from Mpumalanga Province, South Africa for antibody to SARS-CoV in sera, none were found to be positive.
Four out of 63 (6.3 %) Kenyan bats tested by Tao *et al.* (2017: Suppl.) were positive for CoV.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Lagos bat virus (LBV): Isolated from South Africa (Crick *et al.*, 1982: 211; King *et al.*, 1990: 169; Meredith and Standing, 1981; Swanepoel, 2004; Markotter *et al.*, 2006b; Hayman *et al.*, 2011a: 88; Nadin-Davis *et al.*, 2011: 238; Coertse *et al.*, 2011: 251; Willoughby *et al.*, 2017: Suppl.).
Mokola virus (MOKV): King *et al.* (1990: 168) found monoclonal antibodies for MOKV in bats from South Africa. They also reported antibodies for Duvenhage and Denmark bat virus.

Paramyxoviridae

Drexler *et al.* (2012a: Suppl. Table S1) indicated that none of the 4 specimens they examined from the Democratic Republic of the Congo tested positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Burundi, Cameroon, Congo, Congo (Democratic Republic of the), Equatorial Guinea, Ethiopia, Gabon, Ghana, Kenya, Malawi, Mozambique, Namibia, Rwanda, Somalia, South Africa, South Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

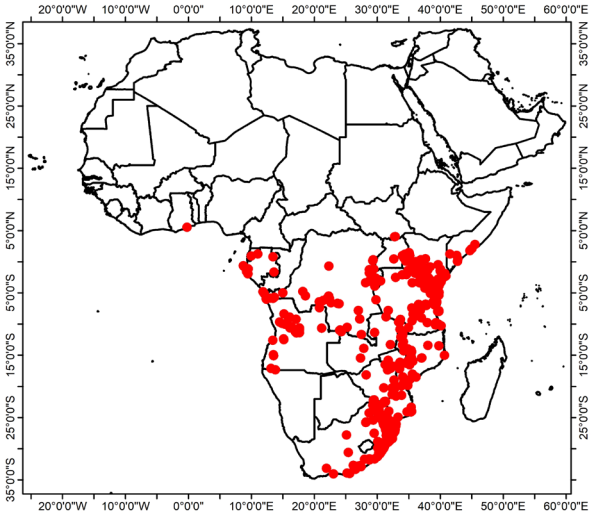


Figure 28. Distribution of *Epomophorus wahlbergi*

Genus ***Epomops*** Gray, 1866

*1870. *Epomops* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 126 [Goto Description]. - Comments: Type species: *Epomophorus franqueti* Tomes, 1860. - Etymology: Probably an abbreviation of *Epomophorus* and the Greek "*οψ*", meaning aspect, referring to its resemblance to that genus (see Palmer, 1904: 268). (Current Combination)
2007. *Epomop:* Lameed, Biodiversity, 8 (4): 8. (Lapsus)
2014. *Hepomops:* Nina, Acta Med. Port., 27 (5): 627. Publication date: Sep-Oct 2014.
2016. *Epomos:* Pancer, Gut and Litwinska, Post. Mikrobiol., 55 (2): 207.

TAXONOMY:
Reviewed by Bergmans (1989). See Simmons (2005: 323).

Andersen (1912b: 487), Grubb *et al.* (1998: 69) mention "Gray, 1866, Proc. Zool. Soc., Lond.: 65" as first publication in which the name *Epomops* was used.

The results of the phylogenetic analyses by Almeida *et al.* (2016: 82) showed that the genus *Epomops* is not monophyletic as a DNA fragment of *E. dobsonii* shows a close relationship with *Epomophorus wahlbergi*, which seems to support the similarities or transitional traits of *dobsonii* with *Epomophorus* reported by Bergmans (1989: 118).

Included in the Epomophorinii tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Based on the analyses of mitochondrial and nuclear data, Hassanin *et al.* (2016: 525) suggest that the genus *Epomops* contains only one species, which can be divided into two subspecies: *E. franqueti franqueti* in Central Africa and *E. f. buettikoferi* in West Africa.

Known species of *Epomops*: ***buettikoferi*** (Matschie, 1899); ***franqueti*** (Tomes, 1860).

COMMON NAMES:
Czech: Grayovi kaloni. English: Clamorous Fruit-bats, Noisy Fruit-bats, Singing Fruit-bats, Epauletted bats, Epaulet bats, African Epauletted bats. French: Epomophores de l'ouest. German: Epaulettenflughunde.

MOLECULAR BIOLOGY:
The *Cytb* analyses performed by Hassanin *et al.* (2016: 525) revealed that bats from West Africa, identified as either *E. franqueti* or *E. buettikoferi*, share very similar or identical haplotypes, which are divergent from those sequenced for all individuals of *E. franqueti* collected in Central Africa.

PARASITES:
HAEMOSPORIDA
Perkins and Schaer (2016: Suppl.) mention the presence of *Hepatocystis epomophori* Rodhain, 1926 in *Epomops* sp. bats. Nine out of 10 (90 %) South Sudanese bats examined by Schaer *et al.* (2017: 2) were infected by *Hepatosystis* sp.

Epomops buettikoferi (Matschie, 1899)

*1899. *Ep[omophorus (Epomophorus)] büttikoferi* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 43, 45. Type locality: Liberia: Junk river: Schieffelinsville [06 11 N 10 30 W] [Goto Description]. Holotype: RMNH ad ♂, mounted skin (skull missing). Collected by: F.X. Stampfli. - Comments: Matschie dated his introduction to 14 May 1899. - Etymology: In honour of J. Büttikofer, who collected animals in Liberia.
1972. *Epomophorus (Epomops) franqueti buettikoferi:* Püscher, Z. Säugetierk., 37 (3): 155. (Name Combination)
1996. *Epomophorus buettiforteri:* Kuhl, Obligate and opportunistic interactions, 52. (Lapsus)
2000. *Epomops buetticoferi:* Konstantinov, Pema, Labzin and Farafonova, Plecotus et al., 3: 145. (Lapsus)
2013. *Epomops buettifoferi:* Seltzer, Ndangalasi and Cordeiro, Biotropica, 45 (4): table S2. Publication date: 22 February 2013. (Lapsus)
2016. *E[pomops] f[ranqueti] buettikoferi:* Hassanin, Nesi, Marin, Kadjo, Pourrut, Leroy, Gembu, Musaba Akawa, Ngoagouni, Nakouné, Ruedi, Tshikung, Pongembo Shongo and Bonillo, C. R. Biologies, 339 (11-12): 525. Publication date: 14 October 2016. (Name Combination)
? *Epomops buettikoferi:* (Name Combination, Current Combination)

TAXONOMY:
See Bergmans (1989) and Simmons (2005: 323).

COMMON NAMES:
Czech: kaloň Büttikoferův. English: Buettikofer's Clamorous Fruit-bat, Buettikofer's Epauletted Bat, Buettikofer's Epauletted Fruit Bat, Büttikofer's Fruit Bat. French: Epomophore de Büttikofer, Epomophore de Buettikofer, Roussette de Büttikofer, Roussette de Buettikofer. German: Büttikofers Epaulettenflughund.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, has a tolerance of a degree of habitat modification, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008as; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008as; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004bg; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996). 1994 - VU (Groombridge, 1994).

MAJOR THREATS:
It is possible that there are no major threats to this species. Populations might be threatened by deforestation in parts of the species range, however, the extent to which it depends on forest cover is unclear (Mickleburgh *et al.*, 2008as; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008as) [in IUCN (2009)] suggest that further studies are needed into the dependence of this species on forested areas.

This species has been recorded from a number of protected areas in West Africa (Mickleburgh *et al.*, 1992).

GENERAL DISTRIBUTION:
Epomops buettikoferi is a lowland West African species which ranges from Senegal and Guinea-Bissau in the west, to central Nigeria in the east. Bergmans (1975: 147) indicates it is restricted to the West African "moist forest" block.

Native: Cameroon (Bakwo, 2009: 12); Côte d'Ivoire (Henry *et al.*, 2004: 24); Ghana (Decher and Fahr, 2007: 10 - 11); Guinea (Denys *et al.*, 2013: 281; Decher *et al.*, 2016: 259); Guinea-Bissau (Rainho and Ranco, 2001: 26); Liberia (Monadjem and Fahr, 2007: 50); Nigeria; Senegal; Sierra Leone.

MOLECULAR BIOLOGY:
Denys *et al.* (2013: 281) determined the karyotype of four specimens from the Guinean Mount Nimba area and found 2*n* = 36 in females (34 autosomes and two X gonosomes), and 2n = 35 in males (X0 gonosomes); NFa = 68. X = submetacentric or medium-sized.

ROOST:
E. buettikoferi roosts alone or in small groups, near its feeding area (Kunz, 1996: 52).

DIET:
Seltzer *et al.* (2013: table S2) provide an overview of the plant species found beneath bat feeding roosts. For *E. buettikoferi* this included *Milicia excelsa* (Welw.) C. C. Berg (African Teak - Moraceae).

POPULATION:
Structure and Density - It appears to remain common in many areas, with the exception of Nigeria, but populations may be declining in areas of ongoing deforestation (Mickleburgh *et al.*, 2008as; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008as; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 93) mentions that males attain puberty at the age of eleven months.

Weber *et al.* (2019: 19) reported one pregnant female on 30 March and six lactating (24, 30, 31 March, 1, 7 April) in Sierre Leone.

MATING:
The male mating pattern in *E. buettikoferi* includes courtship vocalizations (calling territories) (see Krutzsch (2000: 111).

PARASITES:
HAEMOSPORIDA
Schaer *et al.* (2013a: 17416) report the presence of hemosporidian parasites of the genus *Hepatocystis* in seven out of 25 investigated bats.

VIRUSES:
Rhabdoviridae
Lyssavirus - Rabies related viruses
Lagos bat virus - Hayman *et al.* (2008a) detected antibodies in Ghana.

Drexler *et al.* (2012a: Suppl. Table S1) indicated that the single specimen they examined from Ghana did not test positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

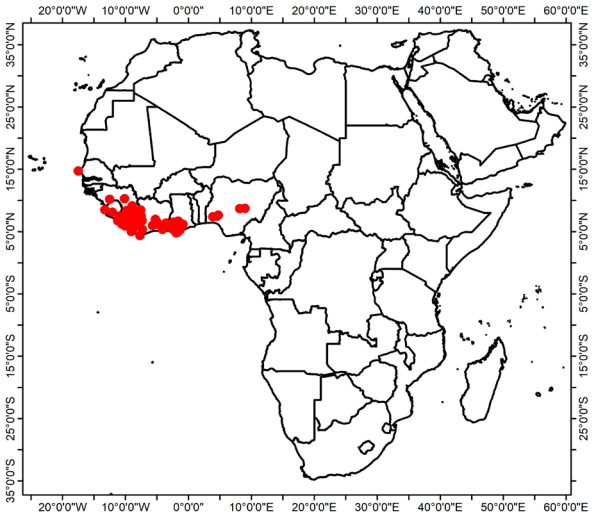


Figure 29. Distribution of *Epomops buettikoferi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Côte d'Ivoire, Ghana, Guinea, Liberia, Nigeria, Senegal, Sierra Leone.

Epomops franqueti (Tomes, 1860)

*1860. *Epomophorus franqueti* Tomes, Proc. zool. Soc. Lond., 1860, I: 54, pl. 75. Publication date: February - May 1860. Type locality: Gabon: "Gabon" [Goto Description]. Holotype: MNHN A.107-776-C.52-1852-257: ad ♂, mounted skin and skull. Collected by: Franquet. Skull has number A6767; see Rode (1941: 233), who uses number 164.

1862. *Epomophorus comptus* H. Allen, Proc. Acad. nat. Sci. Philad., 13 (11): 158 (for 1861). Type locality: "Africa": West Africa [Goto Description]. - Comments: Andersen (1912b: 497) and Allen (1939a: 57) mentioned "=Gaboon" as type locality. Publication date: Volume 13 issue 11 covers the meetings of June-July 1861, but was probably only printed in 1862. Andersen (1912b: 498) mentions "as having been collected by Du Chaillu the specimen is no doubt from Gaboon." Type in Phildalphia Museum, unmounted skin, skull extracted, ♀.

1910. *Epomops franqueti strepitans* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 5 (25): 106. Publication date: 1 January 1910. Type locality: Nigeria: 150 mi up the Niger: Asaba [06 11 N 06 43 E]. Holotype: BMNH 1895.5.3.7: ad ♂, skin and skull. Presented/Donated by: Dr. W.H. Cross. See Andersen (1912b: 497).

2017. *Epomops frangueti:* Dammann, Semin. Cell Dev. Biol., 70: 160. Publication date: 8 July 2017. (Lapsus)

2019. *Epomops frangeti:* Kaswera Kyamakya, Nebesse Mololo and Gambalemoke Mbalitini, IJEAB, 4 (2): 330.. Publication date: March-April 2019. (Lapsus)

? *Epomophorus (Epomops) franqueti:* (Name Combination)

? *Epomops franqueti franqueti / strepitans:* (Name Combination)

? *Epomops franqueti franqueti:* (Name Combination)

? *Epomops franqueti:* (Name Combination, Current Combination)

TAXONOMY:
See Bergmans (1989) and Simmons (2005: 324).

COMMON NAMES:
Czech: kaloň Franquetův, kaloň plavý. English: Franquet's Clamorous Fruit-bat, Franquet's Fruit Bat, Franquet's Epauletted Fruit Bat, Singing Fruit Bat. French: Epomophore de Franquet, Chien volant à épaulettes du Congo, Roussette de Franquet. German: Franquets Epaulettenflughund, Franquet's Epaulettenflugfuchs.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008by; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008by; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004ci; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Mickleburgh *et al.*, 2008by; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008by) [in IUCN (2009)] report that *E. franqueti* is present in many protected areas. No direct conservation measures are currently needed for this adaptable species as a whole.

GENERAL DISTRIBUTION:
Epomops franqueti is a widespread species, which is present in much of West Africa and Central Africa, with some records from East Africa. It ranges from Côte d'Ivoire and Ghana in the west, to Cameroon, and then through Central Africa to southern Sudan, Rwanda and Uganda in the east. It has been recorded as far south as northern Angola, southern Democratic Republic of the Congo and northeastern Zambia.

The record (MNHN ZM-MO-1984-1165) from Madagascar is a possible misidentification/or incorrect locality information and needs verification.

Native: Angola (Bergmans, 1989; Monadjem *et al.*, 2010d: 554); Benin (Capo-Chichi *et al.*, 2004: 161); Cameroon; Central African Republic (Morvan *et al.*, 1999: 1195); Congo (King and Dallimer, 2010: 65; Bates *et al.*, 2013: 333); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 554); Côte d'Ivoire; Equatorial Guinea; Gabon; Ghana; Nigeria; Rwanda; Sudan; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 59); Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 554).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data for 7 specimens: Fa: 93.51 ± 5.246 mm, mass: 114.7 ± 35.86 g, wing loading: 19.7 ± 3.81 N/m^2, aspect ratio: 5.4 ± 0.43.

DETAILED MORPHOLOGY:
Dobson (1881: 686) provides a detailed description of the pharynx, larynx, and hyoid bones.

Chawana *et al.* (2013: 160) report an average brain mass of 2.42 g (n = 2).

FUNCTIONAL MORPHOLOGY:
Coimbra *et al.* (2016: 191) found that the eye of *E. franqueti* has a bright yellow tapetum lucidum, which covers almost the entire extension of its dorsal hemisphere. There are about 200,000 retinal ganglion cells. The minimum angle of resolution was approximately 0.167° (ca. 5-6 mm at 1 m distance).

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotype - In Kenya, Peterson and Nagorsen (1975) recorded 2*n* = 36. Haiduk *et al.* (1980) reported 2*n* = 36, FN = 68, BA = 34, a subtelocentric X chromosome and a subtelocentric Y chromosome for specimens from Cameroon. Haiduk *et al.* (1981: 224) mention 2*n* = 36, FN = 66. Primus *et al.* (2006) reported a male without Y chromosome (2*n* = 35) from Gabon.

Protein / allozyme - Unknown.

Dammann (2017: 160) refers to Ifuta *et al.* (1988: 379), who found that levels of T_4 (plasma concentrations of thyroxine) were about 10 times lower in this bat than in other mammals. These low values might be stress related as several hours elapsed between the capture of the bats and taking blood samples. However, these low values were not found for T_3 (Plasma concentrations of triiodothyronine). Dammann (2017) suggests that

the low levels of T_4 might be related to the longevity in bats.

Ekeolu and Adebiyi (2018: 391) investigated blood parameters in 17 *E. franqueti* specimens from Nigeria and found no significant sex-related differences, except for erythrocyte osmotic fragility, which was significantly higher in female than in male bats at 0.1 % NaCl.

HABITAT:
This species is associated with lowland tropical moist forest, where it has been recorded in both primary and secondary habitat. Populations are also present in the mosaic habitats of tropical moist forest with woodland and grassland (Bergmans, 1989). It is an adaptable species that can be found in disturbed areas, seemingly being only absent from heavily degraded or urban areas.

HABITS:
Bradbury (1977) [in McCracken and Wilkinson (2000: 351)] found that females and juvenile animals were feeding near the territory of a calling male, which would suggest that additional resources could be available in that area.

ROOST:
The species roosts alone or in small groups, often close to water, in the dense leave cover of shrubs or trees (Brosset, 1966c; Jones, 1972; Kunz, 1996: 44).

DIET:
In Congo, Kipalu (2009: 16) reported *E. franqueti* visiting/consuming fruits of *Chlorophora excelsa* (African teak) and *Ficus mucuso*.

Gembu Tungaluna (2012: 95 - 97) reported the following fruits being eaten in the Kisangani area (DRC) in the various seasons: First heavy rain season (September - November): *Persea americana* Mill., 1786 (avocado) (24%), *Carica papaya* L. (papaya) (16%), *Spondias cytherea* Sonnerat, 1782 (Ambarella, otaheite apple, great hog plum) (14%), *Annonidium mannii* (Oliv.) Engl. & Diels (Junglesop) (11%), *Musanga cecropioides* R.Br. & Tedlie (African corkwood tree, umbrella tree) (8%), *Ficus leprieuri* Miq., 1867 (8%), *Myrianthus arboreus* P.Beauvois, 1805 (giant yellow mulberry, bush pineapple, corkwood) (5%), *Elaeis guineensis* Jacq. (African oil palm, macaw-fat) (3%), *Ficus wildemanniana* Warb. (3%), *Musa* sp. (3%).
First mild rain season (December - February): *Musanga cecropioides* (40%), *Elaeis guineensis* (20%), *Myrianthus arboreus* (13%), *Carica papaya* (13%), *Ficus wildemanniana* (7%), *Ficus vallis-choudae* Delile (7%).
Second heavy rain season (March - May): *Carica papaya* (23%), *Dacryoides edulis* H.J. Lam (safou, African pear, bush pear, Nsafu, bush butter tree, butterfruit) (15%), *Musanga cecropioides* (15%), *Myrianthus arboreus* (8%), *Elaeis guineensis* (8%), *Oncoba welwitschii* Oliv. (8%), *Ficus* sp3 (8%), *Musa* sp. (8%), *Ficus leprieuri* (7%).
"Dry" season (June - August): *Ficus wildemanniana* (100%).

POPULATION:
Structure and Density - This is a common species (Mickleburgh *et al.*, 2008by; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008by; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
For a selection of sounds, check http://macaulaylibrary.org/search?taxon=Epomops_franqueti&taxon_id=11069435&taxon_rank_id=67&tab=audio

REPRODUCTION AND ONTOGENY:
From southern Sudan, Bates (1905: 72) reports on two females (probably of this species) carrying a half-grown young on 31 August and 1 September.

A male with probably active testes was caught on 2-3 November in Pointe Noire (Congo) by Bergmans (1979a: 171), and a lactating female with an embryo was captured in Brazzaville on 23 December. Furthermore, females with developed nipples were collected in March, May, November and December.

MATING:
Brosset (1966c) and Bradbury (1977) [in McCracken and Wilkinson (2000: 349)] indicate that males establish nocturnal display sites where females visit males for mating.

PARASITES:
BACTERIA
Gram-negative bacterium - Nowak *et al.* (2017: 6) tested three bats from the Republic of Congo of which two tested positive for *E. coli*.

HAEMOSPORIDA
Lutz *et al.* (2016: 9) examined 52 *E. franqueti* specimens from East Africa and found 35 of them infected with *Hepatocystis* sp. Perkins and Schaer (2016: Suppl.) refer to the presence of *Hepatocystis brosetti* Miltgen *et al.*, 1977 in Gabon, from where it was described by Miltgen *et al.* (1977: 589). Landau *et al.* (2012: 142) also mention it as type host for *Hepatocystis epomophori* (Rodhain, 1926). Boundenga *et al.* (2018: 10581) reported 21 out of 160 (13.12 %) bats from the Franceville (Gabon) area to be

infected by *Hepatocystis* sp. Surprisingly, Rosskopf *et al.* (2018: 31) were unable to find any *Hepatocystis* parasites in the 21 Gabonese bats they examined and they suggest that this might be linked with the fact their bats were collected during the dry season.

DIPTERA
Nycteribiidae: *Basila tenuispina* Theodor 1957 from Stanleyville, Congo (Democratic Republic of the) (Haeselbarth *et al.*, 1966: 111).

ACARI
Teinocoptidae: *Teinocoptes epomophori* Rodhain, 1923 was reported from an *E. franqueti* specimen from Stanleyville (=Kisangani), DRC by Fain (1967: 367).

VIRUSES:
Willoughby *et al.* (2017: Suppl.) report the following viruses: Marburg marburgvirus, Rift Valley fever phlebovirus, Shamonda orthobunyavirus, Zaire ebolavirus.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 to 1999 five individuals from Bandundu Province, DRC for antibody to SARS-CoV in sera, none were found to be positive (0/5).
Anthony *et al.* (2017b: Suppl.) mention the beta-coronavirus Eidolon_bat_CoV.

Filoviridae - Filo viruses
Ebolavirus
Pourrut *et al.* (2007) found homogeneous ZEBOV [Zaire Ebolavirus] infection in the wild populations of *E. franqueti* in Gabon and the Democratic Republic of the Congo. Eight out of 117 bats had immunoglobulin G (IgG) specific for Ebola in Gabon during a test performed by Leroy *et al.* (2005: 575). 10 out of 27 bats were found to be positive for EBOV antibodies in the Greater Accra region, Ghana (Hayman *et al.*, 2012d: 1208).

Bausch and Schwarz (2014: 1) and Pigott *et al.* (2014: 9) indicate that *E. franqueti* is one of the leading candidates for introducing Ebola in Guinea (together with *Hypsignathus monstrosus* and *Myonycteris torquata*). However, no proof has been provided that this was indeed the case.

Marburgvirus
Towner *et al.* (2007) tested 296 individuals from Gabon for Marburg virus RNA by conventional and real-time RT-PCR and 47 individuals for anti-Marburg virus IgG antibodies by ELISA; no positives were found.

Flaviviridae
Flavivirus
Maganga *et al.* (2014a: 5) tested 128 bats from Congo, of which 2 tested positive.

Nairoviridae
Nairovirus
Of the 99 specimens from Gabon and Congo tested by Müller *et al.* (2016: 3), 7 were positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Phenuiviridae
Phlebovirus
Fagre and Kading (2019: 4) report that Rift Valley fever virus (RVFV) was either isolated from this bat or that molecular evidence was found (see also de Jong *et al.* (2011: 11) and Luis *et al.* (2013: suppl.)).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that none of the 100 specimens they examined from Gabon, Congo, Ghana and the Central African Republic tested positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

In their overview table, Maganga *et al.* (2014a: 8) report that the following viruses were already found on *E. franqueti*: Zaire Ebola virus (ZEBOV), Reston Ebola virus, Marburg virus (MBGV), Flavivirus.

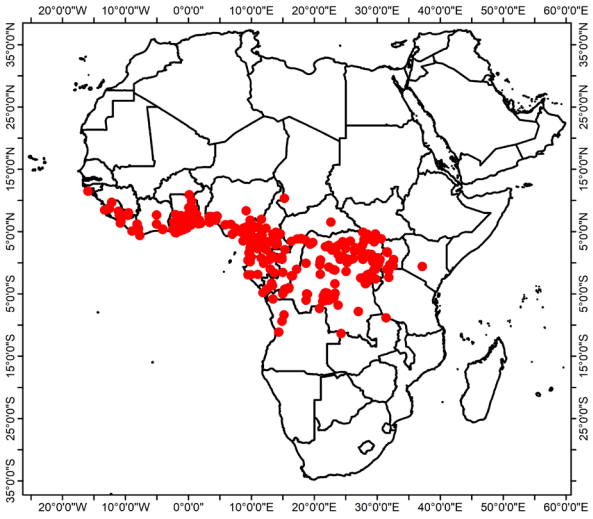


Figure 30. Distribution of *Epomops franqueti*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea-Bissau, Kenya, Liberia, Nigeria, Rwanda, Sierra Leone, South Sudan, Tanzania, Togo, Uganda, Zambia.

Genus ***Hypsignathus*** H. Allen, 1862

*1862. *Hypsignathus* H. Allen, Proc. Acad. nat. Sci. Philad., 13 (11): 156 (for 1861). Publication date: 1862 [Goto Description]. - Comments: Type species: *Hypsignathus monstrosus* H. Allen, 1861. Publication date: Volume 13 issue 11 covers the meetings of June-July 1861, but was probably only printed in 1862. - Etymology: From the Greek "*υψι*", meaning on high or aloft and "*γνάθος*", meaning jaw, possibly referring to the 'deeply arched mouth' (see Palmer, 1904: 343). (Current Combination)

1862. *Sphyrocephalus* A. Murray, Proc. zool. Soc. Lond., 1862, I: 8. Publication date: June 1862 [Goto Description]. - Comments: Type species: *Sphyrocephalus labrosus* Murray,1862 (=*Hypsignathus monstrosus* H. Allen, 1861). Preoccupied by *Sphyrocephala* Westwood, 1848, a dipteran and *Sphyrocephalus* Schmarda, 1859, a turbellarian (see Palmer, 1904: 642; Langevin and Barclay, 1990: 1). Andersen (1912b: 501 - footnote) also mentions "Murray probably originally intended to name this genus *Zygænocephalus* in allusion to the Hammer-headed Sharks *Zygæna*, and had that name printed on the plate, but for some reason or other changed it in the text to *Sphyrocephalus*.". - Etymology: From the Greek "*σφύρα*", meaning hammer and "*κεφαλή*", meaning head (see Palmer, 1904: 642; Murray, 1862: 8).

1862. *Zygænocephalus* A. Murray, Proc. zool. Soc. Lond., 1862, I: pl. 1. Publication date: June 1862. - Comments: Type species: *Zygænocephalus labrosus* Murray,1862 (=*Hypsignathus monstrosus* H. Allen, 1861). This name was attached to the plate illustrating Murray's description of *Sphyrocephalus* and serves as a replacement for *Sphyrocephalus* Murray, 1862: see Langevin and Barclay (1990: 1). - Etymology: From the Greek "*ξύγαινα*", a hammer-headed shark and "*κεφαλή*", meaning head (see Palmer, 1904: 717).

? *Epomophorus (Hypsignathus):* (Name Combination)

? *Hypsygnathus:* (Lapsus)

TAXONOMY:
Revised by Bergmans (1989). See Simmons (2005: 324).

Included in the Epomophorinii tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Hypsignathus*: ***monstrosus*** H. Allen, 1861.

COMMON NAMES:
Czech: kladivohlaví kaloni. English: Hammer-headed bats. French: Hypsignates. German: Hammerkopf-Flughunde.

Hypsignathus monstrosus H. Allen, 1862

*1862. *H[ypsignathus] monstrosus*H. Allen, Proc. Acad. nat. Sci. Philad., 13 (11): 157 (for 1861). Publication date: 1862. Type locality: "Africa": Western Africa: possibly Gabon (see Andersen, 1912b: 506). [Goto Description]. - Comments: Type specimen collected by Mr. Du Chaillu (Murray, 1862: 8); Allen (1861: 158) mentions the name as Duchaillu. Andersen (1912b: 508) mentions the type specimen as being an adult ♂, SS, in the collection of the Philadelphia museum. Publication date: Volume 13 issue 11 covers the meetings of June-July 1861, but was probably only printed in 1862, as Murray (1862: 8) indicates that he received a copy of this publication on 19 February 1862. But we also found a reference to issue 23 of volume 13 (for the meeting of 26 November 1861) having been published on 31 December 1861, which might indicate that issue 11 might have been published in 1861. (Current Combination)

1862. *Sphyrocephalus labrosus* A. Murray, Proc. zool. Soc. Lond., 1862, I: 8. Publication date: June 1862. Type locality: Nigeria: Eastern region: Old Calabar river [ca. 04 56 N 08 22 E] [Goto Description]. Holotype: BMNH 1862.1.23.1[b]: ad ♂, skull and alcoholic. Collected by: Reverend William C. Thomson. Presented/Donated by: Mr. A. Murray Esq. - Comments: The publication contains 14 January 1862 as date, but see Duncan (1937) for the actual publication date.

1862. *Zygaenocephalus labrosus:* A. Murray, Proc. zool. Soc. Lond., 1862, I: pl. 1. Publication date: June 1862. (Name Combination)

1876. *Epomophorus macrocephalus* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 474. Type locality: Gabon: Dongila. - Comments: Not of Ogilby (see Andersen, 1912b: 507).
1879. *Epomophorus monstrosus:* Dobson, Proc. zool. Soc. Lond., 1878, IV: 879. Publication date: April 1879. (Name Combination)
1896. *Epomophorus (Hypsignathus) monstrosus:* Pousargues, Ann. Sci. Nat., (8) 3: 250. (Name Combination)
1899. *Hypsignathus haldemani* Matschie, Sber. Ges. naturf. Freunde Berlin, 29. - Comments: Not *Pteropus haldemani* Halowell, 1846: See Langevin and Barclay (1990: 1).
1968. *Epomophorus monstruosus:* Andral, Brès, Sérié, Casals and Panthier, Bull. Wld. Hlth. Org., 38 (6): 860. (Lapsus)
1975. *Hypsignathus montrosus:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 362. (Lapsus)
1978. *Hypsignathus monstrousus:* Germain, Elsevier / North-Holland Biomedical Press - Amsterdam, 133. (Lapsus)
2019. *Hypsignathus monstruosus:* Kaswera Kyamakya, Nebesse Mololo and Gambalemoke Mbalitini, IJEAB, 4 (2): 330. Publication date: March-April 2019. (Lapsus)
? *Epomophorus (Hypsignathus) monstrosus:* (Name Combination)
? *Hypsignathus monstrosus:* (Current Combination)
? *Hypsygnathus monstrosus:* (Lapsus)

TAXONOMY:
See Langevin and Barclay (1990), Bergmans (1989) and Simmons (2005: 324).

COMMON NAMES:
Chinese: 锤头果蝠. Czech: kaloň kladivohlavý, kaloň štítohlavý. English: Hammer-headed bat, Hammer-headed Fruit Bat. French: Hypsignathe monstrueux, Chien volant à tête en marteau, chauve-souris à tête de marteau. German: Hammerkopf, Hammerkopf-Flughund. Kinande (DRC): Mulina. Spanish (Castillian): Cabeza Martillo. Tanoboase (Ghana): ahwenekron. Vai (Liberia): Tuña.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008az; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008az; IUCN, 2009). 2004 - LC ver 3.1 (2001) (IUCN, 2004; Mickleburgh *et al.*, 2004bw). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is locally threatened by habitat destruction, particularly the loss of riverine forests. In parts of its range it is hunted for subsistence food (Mickleburgh *et al.*, 2008az; IUCN, 2009).

Duke (1934: 74) provided some suggestions on how to shoot this bat as this seemed to be the only way to get rid of its terrible noice.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008az) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It has been recorded from Tai National Park (Côte d'Ivoire) and in view of its wide range, is presumably present in some other protected areas. Further studies are needed into the distribution of this species.

GENERAL DISTRIBUTION:
Hypsignathus monstrosus is widespread in West and Central Africa. It ranges from Guinea-Bissau in the west, to northwestern Angola in the south, and as far east as western Ethiopia and western Kenya (near Lake Victoria). It has been recorded to at least 1,800 m asl.

Native: Angola (Crawford-Cabral, 1989; Bergmans, 1989; Monadjem *et al.*, 2010d: 554); Benin; Burkina Faso (Kangoyé *et al.*, 2015a: 605); Cameroon; Central African Republic (Hayman *et al.*, 1966; Morvan *et al.*, 1999: 1195; Monadjem *et al.*, 2010d: 554); Congo (King and Dallimer, 2010: 65; Bates *et al.*, 2013: 333); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 554); Côte d'Ivoire (Heim de Balsac, 1934b: 24); Equatorial Guinea; Ethiopia (Lavrenchenko *et al.*, 2004b: 131); Gabon; Ghana (Decher and Fahr, 2007: 11); Guinea (Denys *et al.*, 2013: 281); Guinea-Bissau (Rainho and Ranco, 2001: 21); Kenya; Liberia (Monadjem and Fahr, 2007: 50); Nigeria (Happold, 1987; Capo-Chichi *et al.*, 2004: 161); Sierra Leone (Grubb *et al.*, 1998); Sudan; Togo; Uganda (Kityo and Kerbis, 1996: 59).
Presence uncertain: Gambia.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
The peculiar head of the males of this species, made Johnston (1906: 689) describe it as: "In these bats [Epomophori] the head is unusually

large and long; but it is so monstrous and hideous in the biggest of the sub-family - the hammer-headed bat, *Hypsignathus* - as to provoke the appropriate specific term of *monstrosus*. This animal is the creation of a nightmare imagination. It might be recommended to the designers of an instructive pantomime or Wagnerian opera." Duke (1934: 72) compares its head with the gargoyles of the Nôtre Dame, and described it as half hippo, half horse.

From western Uganda, Monadjem *et al.* (2011: 30) reported the following data: Fa: 115.7 mm, mass: 211 g, wing loading: 21.2 N/m^2, aspect ratio: 5.8.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
Eisenberg and Wilson (1978: 744) indicate that the cranial volume of *H. monstrosus* is slightly smaller than was expected from a regression line they calculated for all frugivorous bats. The lower score could be linked with the partially carnivorous diet of these bats as found by Van Deusen (1968).
Davies *et al.* (2013a: 4) provide an illustration of the bony labyrinth of *H. monstrosus*'s inner ear.

DETAILED MORPHOLOGY:
The average brain mass for two *H. monstrosus* specimens was found to be 3.81 g (Chawana *et al.*, 2013: 160).

FUNCTIONAL MORPHOLOGY:
The study of Coimbra *et al.* (2016: 191) found that the eye of *H. monstrosus* possesses a bright yellow tapetum lucidum, which covers almost the entire extension of its dorsal hemisphere. Its retinal area is about 200 mm^2 and contains about 3000,000 retinal ganglion cells. The minimum angle of resolution was approximately 0.122° (ca. 40 mm at 10 m distance).

Kawashima *et al.* (2017: 48) examined the postcranial skeleton of six *H. monstrosus* specimens and found that five had 15 thoracic vertebrae and one had 14; all had seven cervical, three lumbal and four sacral vertebrae.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Peterson and Nagorsen (1975) and Haiduk *et al.* (1980; 1981: 225) reported 2*n* = 36, FN = 68, BA = 34, a subtelocentric X chromosome and a subtelocentric Y chromosome for specimens from Kenya and Cameroon, respectively. 2*n* = 36 was also reported by Primus *et al.* (2006).
Protein / allozyme - Unknown.

ROOST:
During the day, *H. monstrosus* roosts in trees, in most cases as singles of either sex, but also in mixed sex groups of up to 17 individuals. Males typically roost at the periphery of larger groups (see Bradbury, 1977).

DIET:
Duke (1934: 72) indicates that *H. monstrosus* starts to feed soon after dark, and that it eats fruits of various kinds, especially guavas and certain kinds of wild figs. Gautier-Hion and Michaloud (1989: 1829) reported that 88 % of 133 oral swabs and fecal samples analysed from May to October in Makokou (Gabon) contained figs. They reported (p. 1831) that females forage at about 1 to 4 km from their roosts, whereas males travel up to 10 km, and also that figs only form 38 % of the females diet against 58 % in males.

Van Deusen (1968) [in Courts (1998: 190)] observed this bat attacking live chickens and scavenging the carcasses of small birds.

Seltzer *et al.* (2013: table S2) provided an overview of the plant species found beneath bat feeding roosts. For *H. monstrosus* this included *Milicia excelsa* (Welw.) C. C. Berg (African Teak - Moraceae).

From the Kisangani area (DRC), Gembu Tungaluna (2012: 99 - 100) reported the following fruits being eaten during the various seasons: First heavy rain season (September - November): *Persea americana* Mill., 1786 (avocado) (21%), *Annonidium mannii* (Oliv.) Engl. & Diels (Junglesop) (18%), *Carica papaya* L. (papaya) (14%), *Dacryoides edulis* H.J. Lam (safou, African pear, bush pear, Nsafu, bush butter tree, butterfruit) (14%), *Spondias cytherea* Sonnerat, 1782 (Ambarella, otaheite apple, great hog plum) (11%), *Uapaca guineensis* Müll.Arg., 1864 (Sugar plum, red cedar, false mahogany, rikio) (7%), *Myrianthus arboreus* P.Beauvois, 1805 (giant yellow mulberry, bush pineapple, corkwood) (4%), *Elaeis guineensis* Jacq. (African oil palm, macaw-fat) (4%), *Ficus wildemanniana* Warb. (4%), *Ficus leprieuri* Miq., 1867 (3%).
First mild dry season (December - February): *Myrianthus arboreus* (50%), *Musanga cecropioides* R.Br. & Tedlie (African corkwood tree, umbrella tree) (50%).
Second heavy rain season (March - May): *Musanga cecropioides* (75%), *Ficus leprieuri* (25%).
No data for the "Dry" season (June - August).

PREDATORS:
Neil (2017: 131) reported on a hammer-headed fruit bat being captured by a Long-tailed hawk, *Urotriorchis macrourus* (Hartlaub, 1855) in Gabon. The hawk left its wounded prey on the ground, after which the bat was able to escape.

POPULATION:
Structure and Density - It is a locally common species. Roosts can contain as many as 25 bats, but the average roost size is fewer than five animals (Mickleburgh *et al.*, 2008az; IUCN, 2009). Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008az; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Bradbury (1977) observed females hover in front of selected males before copulation.

Carpenter (1986: 90) and McGuire and Guglielmo (2009: 1291) reported that the respiratory quotient for this species indicates that fat provided 77 - 92 % of the fuel during flight, and a decline in respiratory quotient during long flights may prove that fat is indeed the only fuel source following initial carbohydrate use. Carpenter (1986: 93) also indicates that at airspeeds of 5.5 m/s the heart beats at a frequency of 620 beats per minute, whereas the respiration rate is 293 breadths per minute.

The courtship calls, which likely have a territorial function, consist of a simple syllable type in series (Bradbury, 1977 in Smotherman *et al.*, 2016: 538).

For a selection of sounds, check http://macaulaylibrary.org/search?taxon=Hypsignathus monstrosus&taxon_id=11075759&taxon_rank_id=67&tab=audio

REPRODUCTION AND ONTOGENY:
Tuttle and Stevenson (1982: 120, 121) indicate that females attain sexual maturity at 5 to 6 months of age, whereas males need 18 months. Kurta and Kunz (1987: 82) report that, at birth, the young weights about 16.2 % of the mother's body mass (38.0 g versus 234.0 g).

MATING:
Bradbury (1977) reported that *H. monstrosus* exhibit lek behaviour at their mating sites: Males form large choruses during the night that are visited by females, and they respond to the presence of females by increasing the repetition rate of their calls and by moving their wings. He also found that females favor larger males with bulbous muzzles and enormous hypertrophied larynxes, which are acting as resonating chambers. Male sites are spaced about 10 m apart, and individual males use the same site every night.

In Abidjan (Côte d'Ivoire), Niamien *et al.* (2015b: 230) found that *H. monstrosus* males prefered relatively low (5 - 10 m) *Terminalia catappa* L. trees (Indian almond - Combretaceae) for their leks. The individual trees were about 5 m apart. The males were present from August to October (small dry seaon to start of small wet season), and from February to May (end of large dry season to start of large wet season). In the other months no males were observed.

Bradbury (1977) [in Fasel *et al.* (2016: 2)] reported on uneven copulation rates, whereby harem males mate at a higher frequency than other males.

PARASITES:
BACTERIA
Gram-negative bacterium - Nowak *et al.* (2017: 6) tested two bats from the Republic of Congo, both of which were positive for *E. coli*.

HAEMOSPORIDA
Ayala *et al.* (1981: 21) examined blood smears from 142 *H. monstrosus* specimens from Gabon, and found 139 of them to be infected by hemosporidian parasites of the genus *Hepatocystis*. They also indicate that the bats probably became infected before the age of six months and that the infection rate varied according to sex, age and female reproductive status. Schaer *et al.* (2013a: 17416) report the same parasites in five out of 10 investigated bats. Perkins and Schaer (2016: Suppl.) mention *Hepatocystis carpenteri*, described by Miltgen *et al.* (1980), from Gabon and *H. epomophori* and *H.* sp. from various countries.
Hepatocystis sp. Infections were also reported by Boundenga *et al.* (2018: 10581) from bats from Gabon (1 out of 21 examined: 4.8%).

Hepatocystis gametocytes were reported from this bat for the first time in the DRC by Rodhain (1913), although he referred the bats erroneously to *Epomops franqueti franqueti* (see Miltgen *et al.*, 1977: 595).

Hepatocystis parasites were also found in the single *Hypsignathus* sp. from South Sudan examined by Schaer *et al.* (2017: 2).

ACARI
Fain (1967: 364) reported *H. monstrosus* from Epulu, DRC as new host for *Teincoptes auricularis* Fain, 1959 (Acari: Teinocoptidae). The parasites were found around the nipples of the host.

VIRUSES:
Willoughby *et al.* (2017: Suppl.) report the following viruses: Lagos bat lyssavirus, Marburg marburgvirus, Mokola lyssavirus, Nipah henipavirus, Reston ebolavirus, Zaire ebolavirus.

Nairoviridae

Orthonairovirus
Only one of the 101 specimens from Gabon and Congo tested by Müller *et al.* (2016: 3) was positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, 11 individuals from Bandundu Province, DRC for antibody to SARS-CoV in sera, one was found to be positive (9.1 %).

Filoviridae - Filo viruses
Ebolavirus
Pourrut *et al.* (2007) found homogeneous ZEBOV [Zaire Ebolavirus] infection in the wild populations of *H. monstrosus* in Gabon and the Democratic Republic of the Congo. Hayman *et al.* (2010) tested the blood of 3 adult females from Ghana for Ebola virus using indirect flurescent tests for antibodies against EBOV subtype Zaire, none tested positive. However, Hayman *et al.* (2012d: 1208) found 7 out of 16 bats to be positive for EBOV antibodies in Ghana's Greater Accra region. Four out of 17 bats had immunoglobulin G (IgG) specific for Ebola in Gabon during a test performed by Leroy *et al.* (2005: 575).

Bausch and Schwarz (2014: 1) and Pigott *et al.* (2014: 8) indicate that *H. monstrosus* is one of the leading candidates for introducing Ebola in Guinea (together with *Epomops franqueti* and *Myonycteris torquata*). However, no proof has been provided that this was indeed the case.

Marburgvirus
Towner *et al.* (2007) tested 56 individuals from Gabon for Marburg virus RNA by conventional and real-time RT-PCR and 12 individuals for anti-Marburg virus IgG antibodies by ELISA; no positives were found. Hayman *et al.* (2010) tested the blood of 3 adult females from Ghana for Marburg virus using indirect flurescent tests for antibodies against MARV subtype Leiden, none tested positive.

Peterson *et al.* (2007: 1547) indicate that the geographic distribution of *H. monstrosus* covers the entire range of the Ebola virus, but not that of the Marburg virus.

Henipaviridae
Henipavirus
Krüger *et al.* (2013: 13889) demonstrated that the surface glycoproteins F and G of an African henipavirus (M74) induce syncytium formation in a kidney cell line derived from *H. monstrosus*.

Paramyxoviridae
Hayman *et al.* (2008b) detected antibodies Nipah virus in one bat collected in Ghana in 2007.
Drexler *et al.* (2012a: Suppl. Table S1) reported that 2 out of 4 specimens they examined from Gabon, Congo, Ghana and the Central African republic tested positive for *Henipavirus* and *Rubulavirus*.

In their overview table, Maganga *et al.* (2014a: 8) reported that the following viruses were already found on *H. monstrosus*: Zaire Ebola virus (ZEBOV), Reston Ebola virus, Marburg virus (MBGV), Coronavirus (SARS-CoV), Nipah virus (NPHV).

Bennett *et al.* (2018: 65) studied viruses in the blood of *H. monstrosus* from the Republic of Congo and found that four out of five viruses are phylogenetically and genomically allied with viruses of arthropods: a nodavirus ("hypsignathus nodavirus", provisionally genus *Hypnovirus*, family Nodaviridae), a dicistrovirus ("hypsignathus dicistrovirus", genus *Cripavirus*, family Dicistroviridae), and two distinct variants of the recently recognized tombus-like viruses ("Hypsignathus monstrosus tombus-like virus 1 and 2", family Tombusviridae). The fifth virus was a novel hepatitis B-like virus ("Hypsignathus monstrosus hepatitis B virus (HMHBV)", family Hepadnaviridae), which is of mammalian origin. They also suggest that the viruses from arthropod origin might have been accidentally ingested, as the insects they are associated with, are themselves parasites of fruits eaten by the bats.
(In a Corrigendum to their paper, the authors indicate that the characterization of their putative HBV sequences should be considered inconclusive as contamination of reagents might have occurred.)

UTILISATION:
Bobo and Ntumwel (2010: 232) report that in the Korup area of Cameroon the whole animal is used for medicinal purposes, as it would render women fertile when consumed.

ANTHROPOPHILOUS:
Jeffreys (1944: 73) [referring to Goddard (1925)] mentions "From Sierra Leone comes an account of the gruesome habits of the large fruit bat. 'One of the most uncanny superstitions is that of the 'Boman' in which anthropologists will recognise the vampire of European superstition. This creature is said to suck the blood of sleeping children until they die: it can turn into a stone or snake at will. The 'Boman' is in reality the hammer-headed bat (*Hypsignathus monstrosus*), the largest fruit bat found in Africa; its dull and monotonous cry at the time when fruit is ripening has struck terror into many a village, whose inhabitants will sally forth

from their houses and beat tins to drive it away, cursing its father and mother and all its ancestors the while."

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Burkina Faso, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Nigeria, Sierra Leone, South Sudan, The Gambia, Togo, Uganda.

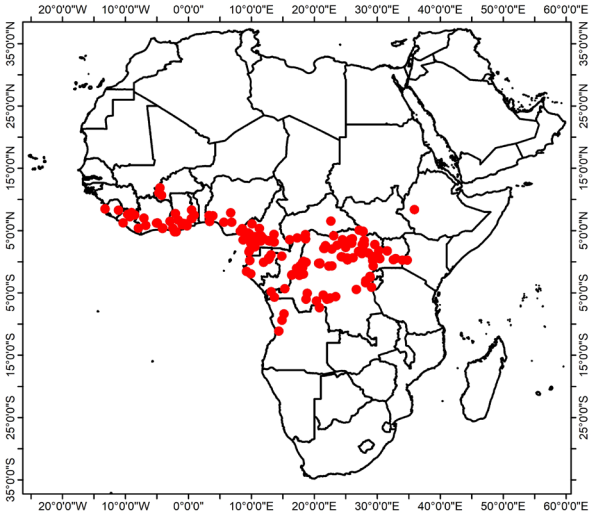


Figure 31. Distribution of *Hypsignathus monstrosus*

Genus ***Megaloglossus*** Pagenstecher, 1885

*1885. *Megaloglossus* Pagenstecher, Zool. Anz., 8 (193): 245. Publication date: 27 April 1885 [Goto Description]. - Comments: Type species: *Megaloglossus woermanni* Pagenstecher, 1885. - Etymology: From the Greek "*μέγας*" or "*μέγαλο*", meaning great or large and "*γλοσσα*", meaning tongue (see Palmer, 1904: 405). (Current Combination)

1891. *Trygenycteris* Lydekker, in: Flower and Lydekker, Mammals Living and Extinct, 655. - Comments: Type species: *Megaloglossus woermanni* Pagenstecher, 1885. Proposed to replace *Megaloglossus*, thought to be preoccupied by *Megaglossa* Rondani, 1865 (Diptera): see Allen (1939a: 63). - Etymology: From the Greek "*τρύγη*", meaning ripe fruit and "*νυκτερίς*", meaning bat (see Palmer, 1904: 696).

TAXONOMY:
Reviewed by Hill (1983).

Bergmans (1997: 69) suggests that *Megaloglossus* should be included in the tribe Myonycterini Lawrence & Novick, 1963 (together with the genera *Myonycteris* and *Lissonycteris*), within the subfamily Epomophorinae, and not within the Macroglossinae.

Included in the Myonycterini tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Megaloglossus*: ***azagnyi*** Nesi, Kadjo and Hassanin, 2012. ***woermanni*** Pagenstecher, 1885.

COMMON NAMES:
Czech: dlouhojazyční kaloni. English: African Long-tongued Fruit-bats, African Nectar Fruit-bats. French: Mégaloglosses. German: Afrikanische Langzungen-Flughunde.

Megaloglossus azagnyi Nesi, Kadjo and Hassanin, 2012

*2012. *Megaloglossus azagnyi* Nesi, Kadjo and Hassanin, in: Nesi, Kadjo, Pourrut, Leroy, Pongombo Shongo, Cruaud and Hassanin, Mol. Phylogenet. Evol., 66(1): 134. Type locality: Côte d'Ivoire: Lagunes region, Azagny National Park [0613007N 0501532W, 125m] [Goto Description]. Holotype: MNHN ZM-2011-993: ad ♀, alcoholic (skull not removed). Collection date: 5 December 2009; original number: G09095. Presented/Donated by: [No Name]. Locality: Côte d'Ivoire; Lagunes region; Azagny National Park; 0613007N 0501532W. Paratype: MNHN ZM-2011-1000: ad ♂. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Azagny, near; Gboyo. Paratype: MNHN ZM-2011-1001: sad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Azagny, near; Gboyo. Paratype: MNHN ZM-2011-1002: ad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lagunes

region; Azagny National Park; 0613007N 0501532W. Paratype: MNHN ZM-2011-994: ad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lamto Reserve. Paratype: MNHN ZM-2011-995: ad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lamto Reserve. Paratype: MNHN ZM-2011-996: ad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lagunes region; Azagny National Park; 0613007N 0501532W. Paratype: MNHN ZM-2011-997: sad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lagunes region; Azagny National Park; 0613007N 0501532W. Paratype: MNHN ZM-2011-998: ad ♂. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lagunes region; Azagny National Park; 0613007N 0501532W. Paratype: MNHN ZM-2011-999: ad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lagunes region; Azagny National Park; 0613007N 0501532W. Paratype: MNHN ZM-G09052: sad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lamto Reserve. Paratype: MNHN ZM-G09070: ad ♂. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Lagunes region; Azagny National Park; 0613007N 0501532W. Paratype: MNHN ZM-G09133: ad ♀. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Côte d'Ivoire; Azagny, near; Gboyo. Paratype: MNHN ZM-GAN005: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Locality: Liberia; Mt. Nimba. Paratype: MNHN ZM-GAN028: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. (Current Combination)

TAXONOMY:
Nesi *et al.* (2012) examined cytochrome *b* sequences and found West African *Megaloglossus* to be significantly different from Central African specimens.

COMMON NAMES:
German: Westlicher Woermanns Langzungen-Flughund.

GENERAL DISTRIBUTION:
This species occurs in Côte d'Ivoire, Liberia, and probably Guinea and Sierra Leone to Ghana and Togo.

In their study, Nesi *et al.* (2012) did not include specimens from the area between the Dahomey Gap and the Niger delta, but Herkt *et al.* (2017: Appendix S9) found their maps predicted moderately high habitat suitability for *M. azagnyi* in this area whereas suitability for *M. woermanni* was estimated to be very low. Therefore, they assigned the specimens from this area to *M. azagnyi*.

Native (mostly reported as *M. woermanni*): Benin; Côte d'Ivoire (Heim de Balsac, 1934b: 24); Ghana (Decher and Fahr, 2007: 12); Liberia (Monadjem *et al.*, 2016y: 364); Nigeria (West of the Niger Delta); Sierra Leone; Togo.

HABITAT:
In the Mount Nimba area, Happold (2013dh: 364) report this species to occur in old growth or secondary forest at relatively low altitudes (450 - 690 m) on both the Liberian and Guinean sides.

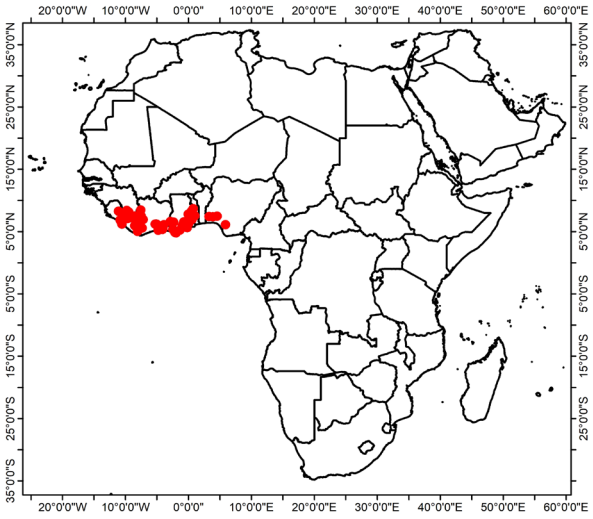


Figure 32. Distribution of *Megaloglossus azagnyi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Côte d'Ivoire, Ghana, Liberia, Nigeria, Sierra Leone, Togo.

Megaloglossus woermanni Pagenstecher, 1885

*1885. *Megaloglossus woermanni* Pagenstecher, Zool. Anz., 8 (193): 245. Publication date: 27 April 1885. Type locality: Gabon: Ssibange farm [00 25 N 09 28 E] [Goto Description]. Holotype: ZMB 54589: ad ♀, mounted skin and skull. Collected by: H. Soyaux; collection date: 21 January 1885; original number: 9489. Bergmans (1997: 60, 63) mentions old number "9489", but this is a writing error in the file card; see Turni and Kock (2008). - Etymology: In honour of Mr. Adolf Woermann (see Pagenstecher, 1885c: 128). (Current Combination)

1966. *Megaloglossus woermanni prigoginei* Hayman, in: Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: 26. Type locality: Congo (Democratic Republic of the): Kiliza [03 42 S 28 10 E, 1 370 m]. Holotype: RMCA 32577: ad ♂, skin and skull. Collected by: Dr. Alexandre Prigogine; collection date: 25 May 1964; original number: 1248. See Bergmans (1997: 60). Paratype: RMCA 20429: ♂. Collected by: Dr. Alexandre Prigogine; original number: 494. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 21586: Collected by: Schepens; original number: 6. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 32394: juv ♀. Collected by: Dr. Alexandre Prigogine; original number: 1226. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 32578: ♀. Collected by: Dr. Alexandre Prigogine; original number: 1249. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 32579: ♀. Collected by: Dr. Alexandre Prigogine; original number: 1250. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 32580: ♀. Collected by: Dr. Alexandre Prigogine; original number: 1251. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 32581: ♀. Collected by: Dr. Alexandre Prigogine; original number: 1252. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 32582: ♀. Collected by: Dr. Alexandre Prigogine; original number: 1253. Presented/Donated by: ?: Collector Unknown. Paratype: RMCA 32583: ♀. Collected by: Dr. Alexandre Prigogine; original number: 1254. Presented/Donated by: ?: Collector Unknown.

1993. *prigoginii:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 154. (Lapsus)

2003. *Megaloglossus woermani:* Giannini and Simmons, Cladistics, 19 (6): 508. (Lapsus)

? *Megaloglossus woermanni woermanni:* (Name Combination)

TAXONOMY:
See Bergmans and Van Bree (1972), Bergmans (1997) and Simmons (2005: 326 - 327).

COMMON NAMES:
Czech: kaloň dlouhojazyčný. English: Woermann's Long-tongued Fruit-bat, Woermann's Bat, Woermann's Fruit bat, Nectar Bat, African Long-tongued Bat. French: Macroglosse de Woermann, Mégaloglosse de Woermann. German: Woermann's Langzungen-Flughund, Afrikanischer Langzungen-Flughund. Spanish (Castillian): Murciélago de Lengua Larga.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008p; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008p; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004w; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
It is locally threatened by habitat loss and degradation, often resulting from conversion of land to agricultural use or the harvesting of timber and firewood (Mickleburgh *et al.*, 2008p; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008p) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, however, in view of the species wide range it seems possible that it is present within some protected areas. Further studies are needed into the distribution and natural history of this species.

GENERAL DISTRIBUTION:
Megaloglossus woermanni was formerly considered to occur throughout much of West and Central Africa. However, Nesi *et al.* (2012) assigned the West African specimens to a separate species, restricting the distribution area to Cameroon and from here south and east into

Equatorial Guinea, Congo, Central African Republic, Democratic Republic of the Congo, Angola and western Uganda.

In their study, Nesi *et al.* (2012) did not include specimens from the area between the Dahomey Gap and the Niger delta, but Herkt *et al.* (2017: Appendix S9) found their maps predicted moderately high habitat suitability for *M. azagnyi* in this area whereas suitability for *M. woermanni* was estimated to be very low. Therefore, they assigned the specimens from this area to *M. azagnyi*.

Native: Angola (Crawford-Cabral, 1989; Bergmans, 1997; Monadjem *et al.*, 2010d: 554); Cameroon; Central African Republic (Morvan *et al.*, 1999: 1195); Congo (King and Dallimer, 2010: 65); Congo (The Democratic Republic of the) (Schouteden, 1944; Dowsett *et al.*, 1991: 259; Bergmans, 1997; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 554); Equatorial Guinea (Fahr and Ebigbo, 2003: 128); Gabon; Nigeria (East of the Niger delta); Uganda (Kityo and Kerbis, 1996: 58).

Presence uncertain: Bioko.

DETAILED MORPHOLOGY:
Chawana *et al.* (2013: 160) indicate that the average brain mass is 0.60 g (n = 2).

FUNCTIONAL MORPHOLOGY:
Coimbra *et al.* (2016: 191) mention that the retinal area covers about 40 - 50 mm^2. The eye contains about 90,000 retinal ganglion cells. The minimum angle of resolution was about 0.227° (ca. 8 mm at 1 m distance).

Kulzer and Storf (1980: 409) investigated the thermoregulatory response by measuring body temperature and rate of oxygen consumption. At high ambient temperatures, the bats increase their oxygen consumption and at low ambient temperatures, they enter a lethargic sleep.

MOLECULAR BIOLOGY:
DNA - Hollar and Springer (1997), Juste B. *et al.* (1999), Teeling *et al.* (2000), Colgan and da Costa (2002) and Cantrell *et al.* (2008).
Karyotype - Haiduk *et al.* (1980, 1981: 228) reported 2*n* = 34, FN = 62, BA = 30, a metacentric X chromosome and a metacentric Y chromosome for specimens from Cameroon. The same karyotype was reported by Primus *et al.* (2006) for specimens from Gabon.
Protein / allozyme - Unknown.

HABITAT:
Juste B. and Perez del Val (1995: 144) found *M. woermanni* to occur to 1,800 m altitude on Bioko Island, where it occurred more frequently in cultivated areas than in lowland rainforests.

HABITS:
Weber *et al.* (2009) found that spatial use was characterized by small home ranges and high site-fidelity, mean home range sizes (minimum convex polygon) were larger in females (139.0 and 146.8 ha) than in males (99.8 and 102.9 ha) in Lama Forest Reserve, southern Benin.

Kulzer and Storf (1980) [in Lovegrove (2011: 152)] indicate that *M. woermanni* uses daily torpor.

DIET:
Pettersson *et al.* (2004: 162) indicate that *M. woermanni* is the only nectar specialist in Africa, whereas there are 14 such specialists in Asia, Australia and Polynesia.

Weber *et al.* (2009) frequently observed *M. woermanni* visiting flowers of cultivated bananas.

In Cameroon, Grünmeier (1993: 35) reported the following pollen from the gut and faeces: *Anthocleista* sp. (Gentianaceae), *Mucuna flagellipes* Hook.f. (Fabaceae), *Kigelia africana* (Lam.) Benth. (Bignoniaceae), *Celtis* sp. (Cannabaceae), *Citrus* sp.(Rutaceae), Bombacaceae indet.

POPULATION:
Structure and Density - It is a locally abundant species (Mickleburgh *et al.*, 2008p; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008p; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Czekala and Benirschke (1974: 220) mention an adult female, collected in January 1973 by M. Eisentraut, containing two foetuses of different size, probably due to implantation occurring at two different times (p. 229).

Two females collected in Dimonika (Congo) on 10 March were pregnant with a large embryo (Bergmans, 1979a: 181).

VIRUSES:
Filoviridae - Filo viruses
Marburgvirus
Towner *et al.* (2007) tested 37 individuals from Gabon for Marburg virus RNA by conventional and real-time RT-PCR and 20 individuals for anti-Marburg virus IgG antibodies by ELISA; no positives were found.

Flaviviridae
Pegivirus (BPgV) - Quan *et al.* (2013: Table S5) reported 1 out of 3 examined specimens from the Democratic Republic of the Congo to be infected by clade H type *Pegivirus*.

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) reported that one of the 34 specimens they examined from Gabon, Congo, the Democratic Republic of the Congo, the Central African Republic, and Ghana tested positive for a *Rubulavirus* that was found to be closely related to human mumps virus.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Equatorial Guinea, Gabon, Nigeria, Uganda.

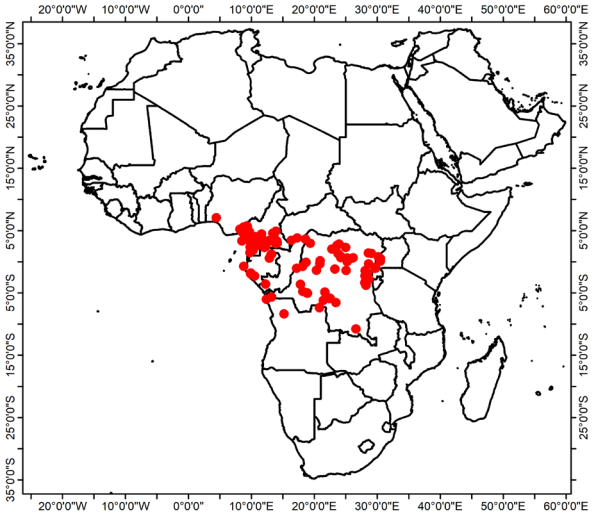


Figure 33. Distribution of *Megaloglossus woermanni*

Genus ***Micropteropus*** Matschie, 1899

*1899. *Micropteropus* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 36, 57 [Goto Description]. - Comments: Type species: *Epomophorus pusillus* Peters, 1867. Described as subgenus of *Epomophorus* Bennett, 1836. Matschie dated his introduction on 14 May 1899. - Etymology: From the Greek "*μικρός*", meaning small and "Pteropus", meaning wing-footed (see Palmer, 1904: 423; Owen-Ashley and Wilson, 1998: 4). (Current Combination)
1978. *Micropterus:* Arata and Johnson, in: Pattijn, Ebola Virus Haemorrhagic Fever, 135. (Lapsus)
? *Epomophorus:* - Comments: Not of Bennett, 1836.

TAXONOMY:
Revised by Bergmans (1989), who transferred *grandis* from this genus to *Epomophorus*. See Simmons (2005: 327).

Included in the Epomophorinii tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Micropteropus*: ***intermedius*** Hayman, 1963; ***pusillus*** (Peters, 1868).

COMMON NAMES:
Czech: nigerijští kaloni. English: Lesser Fruit-bats, Dwarf epauletted fruit bats. French: Microptères. German: Kleine Epaulettenflughunde.

PARASITES:
BACTERIA
Bartonellae
Kamani *et al.* (2014: 628) tested 11 Nigerian "*Micropterus*" sp., and found at least 6 of them testing positive for *Bartonella* DNA.

HAEMOSPORIDA
31 of the 35 (89 %) South Sudanese *Micropteropus* specimens examined by Schaer *et al.* (2017: 2) was infected by *Hepatocystis*.

DIPTERA
Nycteribiidae:
Kamani *et al.* (2014: 628) reported the presence of *Cyclopodia greeffi* Karsch, 1884 on "*Micropterus*" bats from Nigeria.

Micropteropus intermedius Hayman, 1963

1889. *Epomophorus pusillus:* Noack, Zool. Jb. Syst., 4: 206. - Comments: Not of Peters, 1868. Partim. See Kock (1987b: 220).
1953. *Micropteropus grandis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 49. - Comments: Not of Sanborn, 1950. In part. See Kock (1987b: 220).

1956. *Micropterus grandis:* Leleup, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., 46: 76. - Comments: Not of Sanborn, 1950. (Lapsus)
*1963. *Micropteropus intermedius* Hayman, Publ. Cult. Comp. Diamantes Angola, Lisboa, 66: 100, fig. 8. Type locality: Angola: Lunda: Dundo [07 22 S 20 50 E] [Goto Description]. Holotype: BMNH 1962.2073: ad ♀, skull and alcoholic. Collected by: Dr. A. de Barros Machado; collection date: June - July 1953. (Current Combination)
1969. *Micropteropus pusillus:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 24. - Comments: Not of Peters, 1868. In Part. See Kock (1987b: 220).
? *Micropterus (sic) intermedius:* (Name Combination, Lapsus)
? *Micropterus intermedius:* (Emendation)

TAXONOMY:
See Bergmans (1989) and Simmons (2005: 327).

COMMON NAMES:
Czech: kaloň Haymannův. English: Hayman's Lesser Fruit-bat, Hayman's Lesser Fruit Bat, Hayman's Dwarf Epauletted Fruit Bat, Hayman's Epauletted Fruit Bat. French: Microptère de Hayman, Roussette naine de Hayman. German: Haymans Kleiner Epaulettenflughund.

CONSERVATION STATUS:
Global -

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008ba; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004t; IUCN, 2004). 2000 - DD (Hilton-Taylor, 2000). 1996 - VU (Baillie and Groombridge, 1996). 1994 - Rare (Groombridge, 1994).

MAJOR THREATS:
The threats to this species are not well known, but may include general habitat loss through ongoing deforestation (Mickleburgh *et al.*, 2008ba; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ba) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further surveys are needed to locate populations of this species, and to record additional details on natural history and possible threats.

GENERAL DISTRIBUTION:
This species has only been recorded from four localities in northern Angola (the type locality of Dundo) and southern Democratic Republic of the Congo (Luluabourg, Banana/Netonna, and Thysville).

Native: Angola (Bergmans, 1989; Monadjem *et al.*, 2010d: 554); Congo (The Democratic Republic of the) (Bergmans, 1989; Monadjem *et al.*, 2010d: 554).

POPULATION:
Structure and Density - It is currently only known from four specimens. Some of these records are old, and the species does not appear to have been recorded since the 1950s (Mickleburgh *et al.*, 2008ba; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ba; IUCN, 2009).

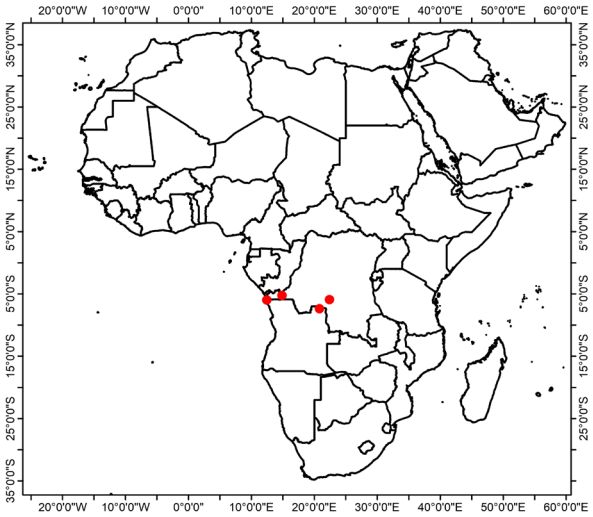


Figure 34. Distribution of *Micropteropus intermedius*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Congo (Democratic Republic of the).

Micropteropus pusillus (Peters, 1868)

1860. *Epomophorus schoensis:* Tomes, Proc. zool. Soc. Lond., 28: 55 - 56.
1860. *Epomophorus schoënsis:* Tomes, Proc. zool. Soc. Lond., 1860, I: 56. Publication date: February - May 1860. - Comments: Not of Rüppell, 1842.
*1868. *Epomophorus pusillus* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 870 (for 1867). Type locality: Nigeria: S Nigeria: Yoruba. Holotype: ZMB 3438: imm ♀, skull and alcoholic.

Collected by: A. Mann; collection date: 1862. Presented/Donated by: F. von Krauss. Holotype designated by Bergmans (1989: 96, 99); see Turni and Kock (2008: 9). - Comments: For a discussion on the type locality, see Bergmans (1989). Grubb *et al.* (1998: 70) state that "Peters in effect renamed *Epomophorus schoënsis* Tomes and therefore Tomes's type locality [="Gambia" - fixed by Andersen, 1912b: 559] must stand, even though his syntypes are evidently no longer in existence". However, see Kock *et al.* (2002: 82) for a discussion on the type locality. - Etymology: From the Latin "*pusillus*" (=very small) (see Owen-Ashley and Wilson, 1998: 4).

1974. *Micropteropus pussilus:* Ayensu, Ann. Missouri Bot. Gard., 61: 706. (Lapsus)
1978. *Micropterus pusillus:* Arata and Johnson, in: Pattijn, Ebola Virus Haemorrhagic Fever, 135. (Lapsus)
1990. *Micropteropus pusilis:* King, Davies and Lawrie, Vet. Microbiol., 23 (1-4): 168. Publication date: June 1990. (Lapsus)
2007. *Micropteropus prusillus:* Lameed, Biodiversity, 8 (4): 8. (Lapsus)
? *Epomophorus (Micropteropus) pusillus:* (Name Combination)
? *Micropteropus pusillus:* (Name Combination, Current Combination)
? *Nanonycteris veldkampi:* - Comments: Not of Jentink, 1888.

Taxonomy:

See Bergmans (1989), Owen-Ashley and Wilson (1998) and Simmons (2005: 327).

Common Names:

Chinese: 非洲小狐蝠. Czech: kaloň nigerijský. English: Peters' Lesser Epauletted Fruit Bat, Peters' Lesser Fruit-bat, Peters's Dwarf Epauletted Fruit Bat, Dwarf Epauletted Fruit Bat. French: Petit microptère, Roussette naine de Peters. German: Peters' Kleiner Epaulettenflughund, Peter's Zwergepaulettenflughund. Kiluba (DRC): Mulima. Spanish (Castillian): Murciélago Enano.

Conservation status:

Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008q; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008q; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004s; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Major threats:

There appear to be no major threats to this species as a whole (Mickleburgh *et al.*, 2008q; IUCN, 2009).

Conservation actions:

Mickleburgh *et al.* (2008q) [in IUCN (2009)] report that in view of the species wide range it seems probable that it is present in many protected areas. In general, no direct conservation measures are currently needed for this species as a whole.

General distribution:

Distributed in West Africa, Central Africa and East Africa. It ranges from Senegal and The Gambia, throughout much of West Africa to Cameroon, from here it is distributed into Equatorial Guinea (Rio Muni), Gabon, Congo, Central African Republic, the Democratic Republic of the Congo, Sudan, Uganda and western Ethiopia and Kenya. It is found as far south as central Angola and Zambia.

Native: Angola (Hayman, 1963; Crawford-Cabral, 1989; Bergmans, 1989; Lopes and Crawford-Cabral, 1992; Monadjem *et al.*, 2010d: 554); Benin (Capo-Chichi *et al.*, 2004: 161); Burkina Faso (Kangoyé *et al.*, 2015a: 605); Cameroon; Central African Republic (Morvan *et al.*, 1999: 1195); Chad; Congo (King and Dallimer, 2010: 66); Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 554); Côte d'Ivoire (Heim de Balsac, 1934b: 24); Equatorial Guinea; Ethiopia; Gabon; Gambia; Ghana; Guinea (Fahr and Ebigbo, 2003: 128; Denys *et al.*, 2013: 281; Decher *et al.*, 2016: 261); Guinea-Bissau (Monard, 1939; Bergmans, 1989; Rainho and Ranco, 2001: 28); Kenya; Liberia (Fahr, 2007a: 103); Mali (Meinig, 2000: 104); Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Sudan; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 59); Zambia (Ansell, 1974; Monadjem *et al.*, 2010d: 554).
Presence uncertain: Burundi.

Molecular Biology:

DNA - Unknown.
Karyotype - Haiduk *et al.* (1980; 1981: 226) reported $2n = 35$, FN = 64, a subtelocentric X and two Y chromosomes for males from Cameroon (XY_1Y_2) (see also Nesi *et al.*, 2011: 552).
Protein / allozyme - Unknown.

ROOST:
M. pusillus roosts singly or in pairs in the dense leave cover of shrubs and trees (Kunz, 1996: 44). In Ghana, Ayivor *et al.* (2017: 3) found these bats to roost together with *E. gambianus*, where *M. pusillus* occupied the lower parts of the trees.

DIET:
Ayensu (1974) reports the following plant species being visited by *M. pusillus* during foraging: *Kigelia africana* (Sausage tree), *Anacardium occidentale* (Cashew tree), *Psidium guajava* (Guava tree), and *Spathodea campanulata* (African Tulip tree).

Seltzer *et al.* (2013: table S2) provided an overview of the plant species found beneath bat feeding roosts. For *M. pusillus* these include *Milicia excelsa* (Welw.) C. C. Berg (African Teak - Moraceae) and *Psidium guajava* L. (apple guava - Myrtaceae).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the African harrier-hawk (*Polyboroides typus* Smith, 1829) as diurnal avian predator.

POPULATION:
Structure and Density - This is generally considered to be one of the most common African bats. Large numbers are often recorded from fruit trees (Mickleburgh *et al.*, 2008q; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008q; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Thomas and Marshall (1984) reported that females mated at the age of six months and gave birth at 12 months. Males reached puberty at the age of seven months. They also found that there is a clear relation between the bimodal births and the bimodality of the rainfall.

11 out of 18 females reported by Bergmans (1979a: 177) from Pointe Noire and Loandjili (Congo) were pregnant between 25 November and 13 December.

In Sierra Leone, Weber *et al.* (2019: 19) found two pregnant females on 30 and 31 March and five lactating on 6 and 7 April and 28 May.

MATING:
Haft (2002) [in Nesi *et al.* (2011: 552)] indicates that the male's courting call has a frequency of 2800 Hz.

PARASITES:
Held *et al.* (2016: 119) reported one out of 26 examined Gabonese *M. pusillus* specimens to be infected by the bacterium *Staphylococcus aureus*.

Schaer *et al.* (2013a: 17416) report the presence of hemosporidian parasites of the genus *Hepatocystis* in 68 out of 72 investigated bats.

Hirst (1923: 980) indicates that a specimen from Gambia was the host for a mite that was probably referrable to *Ancystropus æthiopicus* Hirst, 1923.

Fain (1967: 367) reported *Teinocoptes epomophori* Rodhain, 1923 (Acari: Teinocoptidae) from a *M. pusillus* specimen from Boma, DRC. He also reported *T. auricularis* Fain, 1959 on this host species from Kabinda, Boma and Beno, DRC.

VIRUSES:
Willoughby *et al.* (2017: Suppl.) report the following viruses: Lagos bat lyssavirus, Rift Valley fever phlebovirus, Zaire ebolavirus.

Coronaviridae - Coronaviruses
Maganga *et al.* (2014a: 5) tested 533 animals from Congo and found only two testing positive.
Anthony *et al.* (2017b: Suppl.) mention the beta-coronavirus Kenya_CoV_BtKY56.

Filoviridae - Filo viruses
Ebolavirus
Muyembe-Tamfum *et al.* (2012: 9) refer to Pourrut *et al.* (2005) who found ZEBOV-specific antibodies.
Marburg
Towner *et al.* (2007) tested 149 individuals from Gabon for Marburg virus RNA by conventional and real-time RT-PCR and 19 individuals for anti-Marburg virus IgG antibodies by ELISA; no positives were found.

Nairoviridae
Orthonairovirus
Only two of the 100 specimens from Gabon and Congo tested by Müller *et al.* (2016: 3) were positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that none of the 152 specimens they examined from the Democratic Republic of the Congo, the Central African Republic, Gabon, Congo, and Ghana tested positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

Phenuiviridae
Phlebovirus

de Jong *et al.* (2011: 11) and Luis *et al.* (2013: suppl.) report the occurrence of Rift Valley fever virus.

Rhabdoviridae
Lyssavirus - Rabies related viruses
2006 in Nigeria, Dzikwi *et al.* (2010: 269) tested 55 brains by direct fluorescent antibody (DFA) and mouse inoculation test (MTIT) and all tested negative for lyssavirus antigens.
Lagos bat virus (LBV) - Sureau *et al.* (1977) isolated Lagos bat virus in African Central Republic, from where Greenbaum and Carr (2005: 168) also reported monoclonal antibodies. In 2006, 21 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), none tested positive for neutralizing anitibodies (Dzikwi *et al.*, 2010: 269).
Mokola virus (MOKV) - King *et al.* (1990: 168) found monoclonal antibodies for MOKV in bats from the Central African Republic. They also found antibodies for Duvenhage and Denmark bat virus.
In 2006, 21 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), where none tested positive for neutralizing anitibodies (Dzikwi *et al.*, 2010: 269).

In their overview table, Maganga *et al.* (2014a: 8) report the following viruses were found on *M. pusillus*: Lagos Bat Virus (LBV), Coronavirus, Zaire Ebola Virus (ZEBOV), Marburg virus (MBGV), Rift Valley Fever virus (RVF).

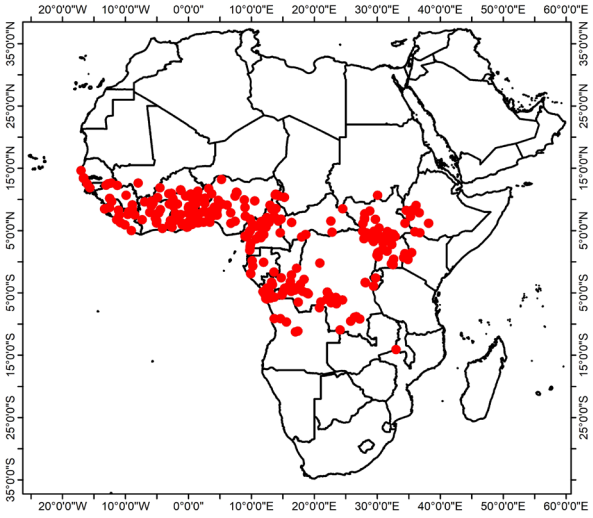


Figure 35. Distribution of *Micropteropus pusillus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Mali, Nigeria, Rwanda, Senegal, Sierra Leone, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia.

Genus ***Myonycteris*** Matschie, 1899

*1899. *[Xantharpyia (]Myonycteris[)]* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 61, 63 [Goto Description]. - Comments: Type species: *Cynonycteris torquata* Dobson, 1878. Originally described as subgenus of *Xantharpyia*. Matschie dated his introduction on 14 May 1899. - Etymology: Derived from the Greek "*mys*" (= mouse) and "*nycteris*" (= bat) meaning mouse-like bat.
1912. *Myonycteris:* K. Andersen. - Etymology: From the Greek "*μύξ*" or "*μυός*", meaning mouse and "*νυκτερισ*", meaning bat (see Palmer, 1904: 440). (Name Combination, Current Combination)
2012. *Lissonycteris:* Nesi, Kadjo, Pourrut, Leroy, Pongombo Shongo, Cruaud and Hassanin, Mol. Phylogenet. Evol., 66 (1): 126.
2015. *Cyonycteris:* Lanza, Funaioli and Riccucci, The bats of Somalia and neighbouring areas, 60. - Etymology: From the Greek adjective "*λισός*" (lissós), meaning "smooth" and the feminine Greek substantive "*νυκτερίς*" (nykterís) [genitive "*νυκτερίδος*" (nikterídos)] meaning "bat", or combined "smooth bat", referring to the smooth fur of the species (see Lanza *et al.*, 2015: 59). (Lapsus)

TAXONOMY:
Two subgenera are presently recognized *Myonycteris* and *Phygetis* (Koopman, 1994; Simmons, 2005: 328). Revised by Bergmans (1976; 1997).

Lawrence and Novick (1963) separated *Lissonycteris* from *Rousettus* because of ethological differences concerning the use of the limbs, and the absence of echolocation in *Lissonycteris*. Juste B. *et al.* (1997) presented allozyme evidence corroborating earlier chromosome studies (Haiduk *et al.* (1980, 1981),

DNA-hybridisation results (Kirsch *et al.*, 1995) and cladistic analysis (Springer *et al.*, 1995) that support the recognition of *Lissonycteris* as a distinct genus. Bergmans (1994: 79; 1997: 136), Lavrenchenko *et al.* (2004b: 136), and Simmons (2005: 325) also consider *Lissonycteris* to be a valid genus.

Included in the Myonycterini tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Myonycteris*: ***angolensis*** (Bocage, 1898), ***brachycephala*** (Bocage, 1889); ***leptodon*** K. Andersen, 1908; ***relicta*** Bergmans, 1980; ***torquata*** (Dobson, 1878).

COMMON NAMES:
Czech: límcoví kaloni, měkkosrstí kaloni. English: Collared Fruit-bats, Little Collared Fruit-bats, Dwarf Epauletted Bat, Lesser Epauletted Bat, Smooth-haired Fruit-bats, Soft-furred Fruit-bats. French: Lissonyctères, Myonyctères, Roussettes à collier. German: Halskrausen-Flughunde, Samtfell-Flughunde.

PARASITES:
Szentiványi *et al.* (2019: Suppl.) indicated that a non specified Ugandan *Myonycteris* was parasitized by a *Dipseliopoda* bat fly (Nycteribiidae), which was infected by Kanyawara virus (KYAV).

VIRUSES:
Goldberg *et al.* (2017: 3, 4) described a new virus from Uganda (Kanyawara virus, genus *Ledantevirus, Rhabdoviridae*, Mononegavirales) from a new nycteribiid bat fly (genus *Dipseliopoda* Theodor, 1955, which in turn was captured on a (probably) new species of bat belonging to the genus *Myonycteris*. The bat was originally identified as *M. angolensis*, but an analysis of its mitochondrial DNA showed it to belong to an outgroup.

Myonycteris angolensis (Bocage, 1898)

*1898. *Cynonycteris Angolensis* Bocage, J. Sci. mat. phys. nat., ser. 2, 5 (19): 133, 138, text-fig. Publication date: June 1898. Type locality: Angola: Quibula, Cahata, north of Quanza River: Pungo Andongo [09 40 S 15 35 E, 1 200 m] [Goto Description]. Syntype: BMNH 1897.8.6.1: juv ♀, skull and alcoholic. Collected by: José Alberto de Oliveira Anchieta; collection date: 1891. Presented/Donated by: Lisbon Museum. See Andersen (1912b: 54), Bergmans (1997: 37). Syntype: MLZA T113 [a]: ad ♀, mounted skin (skull missing). Collected by: José Alberto de Oliveira Anchieta; collection date: 1891. Destroyed by fire in 1978; see Bergmans (1997: 37). Syntype: MLZA T113 [b]: juv, mounted skin (skull not removed). Collected by: José Alberto de Oliveira Anchieta; collection date: 1891. Destroyed by fire in 1978; see Bergmans (1997: 37). - Comments: From the feminine scientific Latin adjective *angolènsis,* meaning "Angolan" referring to the country where the type specimen was collected (see Lanza *et al.*, 2015: 60). - Etymology: Referring to the country where the type specimen was collected.

1920. *Rousettus (Lissonycteris) crypticola* Cabrera, Bol. r. Soc. espan. Hist. nat. , 20 (3 - 4): 106. Type locality: Equatorial Guinea: Bioko: Malabo, Basilé: San Fernando, cave of [03 44 N 08 49 E, 1 100 m]. Holotype: MNCN 53 / 20-II-25-5: ad ♀, complete skeleton. Collected by: D. Manuel M. de la Escalera; collection date: 26 July 1919; original number: 2.057. See Cabrera (1920: 107); Ibáñez and Fernández (1989: 7); Bergmans (1997: 35). Publication date: March - April 1920. Paratype: MNCN 54: juv ♂, skin only. Collected by: D. Manuel M. de la Escalera; collection date: 26 July 1919. See Ibáñez and Fernández (1989: 7); Bergmans (1997: 35).

2007. *Lyssonycteris angolensis:* Müller, M. A.; Paweska, J. T.; Leman, P. A.; Drosten, C.; Grywna, K.; Kemp, A.; Braack, L. E. O.; Sonnenberg, K.; Niedrig, M.; Swanepoel, R., Emerg. Inf. Dis., 13 (9): 1368. (Lapsus)

2013. *Myonycteris angolensis:* Nesi, Kadjo, Pourrut, Leroy, Pongombo Shongo, Cruaud and Hassanin, Mol. Phylogenet. Evol., 66 (1): 135. Publication date: 10 October 2012. (Name Combination, Current Combination)

? *Lissonycteris angolensis:* (Name Combination)

? *Rousettus (Lissonycteris) angolensis:* (Name Combination)

? *Rousettus angolensis angolensis:* (Name Combination)

? *Rousettus angolensis:*

TAXONOMY:
Peterson *et al.* (1995: 48), Schaer *et al.* (2013a), and Kerbis Peterhans *et al.* (2013: 189) include *angolensis* in the genus *Myonycteris*. Simmons (2005: 325) recognizes *goliath*, *petraea*, *ruwenzorii* and *smithii* as subspecies of *angolensis*, indicating that more than one species may be present in this complex.

Known subspecies of *M. angolensis*: ***angolensis*** (Bocage, 1898); ***goliath*** Bergmans, 1997; ***petraea*** Bergmans, 1997; ***smithii*** (Thomas, 1908).

COMMON NAMES:
Afrikaans: Bocage se vrugtevlermuis, Bocage-vrugtevlermuis. Chinese: 安哥拉领果蝠. Czech: kaloň měkkosrstý. English: Angolan Soft-furred Fruit-bat, Angolan Long-haired Fruit-bat, Angolan Rousette, Angolan Fruit Bat, Bocage's Fruit-bat, Long-haired Rousette, Canon Smith's Rousette. French: Lissonyctère d'Angola, Roussette d'Angola, Roussette de Bocage, Roussette à longs poils. German: Angolanischer Samtfell-Flughund, Angola-Weichfellflughund. Italian: Lissonittèride angolàna, Lissonictèride angolàna. Kiluba (DRC): Mulima. Kinande (DRC): Mulima. Portuguese: Morcego Frugivoro de Bocage. Spanish (Castillian): Ruseta de Angola.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) [as *Lissonycteris angolensis*] in view of its wide distribution, presumed large population, its occurrence in a number of protected areas, its tolerance of a degree of habitat modification, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008o; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed including *L. goliath*, *L. petraea*, *L. ruwenzorii*, *L. smithii* as synonyms] (Mickleburgh *et al.*, 2008o; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004z; IUCN, 2004). 2003 - LR/lc [assessed as *Rousettus angolensis*] (IUCN, 2003). 1996 - LR/lc [assessed as *Rousettus angolensis*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Mickleburgh *et al.*, 2008o; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008o) [in IUCN (2009)] report that this species is present in a number of protected areas.

GENERAL DISTRIBUTION:
Myonycteris angolensis is widely distributed at elevations ranging from sea level to 4,000 m asl, in West Africa, Central Africa and East Africa, with some distinct populations present within southern Africa. It ranges from Senegal and The Gambia in the west, through most of West Africa to Cameroon; from here it ranges southwards into Congo, eastern Democratic Republic of the Congo and Angola, and eastwards into Central African Republic, southern Sudan, eastern and southern Democratic Republic of the Congo and Rwanda and Burundi. In East Africa it is distributed from Ethiopia in the north through Uganda, Kenya and Tanzania. In southern Africa has been recorded from northwestern Angola, central and southern Cameroon, Central African Republic, central Congo, Equatorial Guinea (Bioko, Mbini), Gabon, eastern Nigeria, and northwestern and southwestern Democratic Republic of the Congo.

Native: Angola (Crawford-Cabral, 1989; Bergmans, 1997; Monadjem *et al.*, 2010d: 554); Burkina Faso (Kangoyé *et al.*, 2015a: 605); Burundi; Cameroon; Central African Republic; Congo (Bates *et al.*, 2013: 333); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 554); Côte d'Ivoire; Equatorial Guinea; Ethiopia; Gambia; Ghana; Guinea (Denys *et al.*, 2013: 281); Guinea-Bissau (Veiga-Ferreira, 1948; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 35); Kenya; Liberia; Mozambique; Nigeria; Rwanda; Senegal; Sierra Leone; Sudan; Tanzania (Stanley and Goodman, 2011: 40); Togo; Uganda; Zambia (Ansell, 1967; Ansell, 1974; Monadjem *et al.*, 2010d: 554); Zimbabwe.
Presence uncertain: Benin; Gabon.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data for 8 specimens: Fa: 77.70 ± 1.634 mm, mass: 78.1 ± 7.31 g, wing loading: 17.7 ± 1.52 N/m^2, aspect ratio: 15.9 ± 0.46.

An albino specimen - of "*Lissonycteris angolensis*?" - was reported from a cave in Uganda by Neal (1971) and Lucati and López-Baucells (2016: Suppl.).

DETAILED MORPHOLOGY:
Chernova (2002) studied the structure of the cuticle of guard hairs of several Pteropodid bats and found that the structure of these hairs in *angolensis* was nonring-forming as in *Epomophorus wahlbergi* as oposed to ring-forming as in *Myonycteris angolensis* [as *Rousettus*].

FUNCTIONAL MORPHOLOGY:
Mainoya and Howell (1979: 164) found no glandular cells in the neck skin patch of male "*Rousettus angolensis*", and concluded that this patch serves as a visual cue during social encounters.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Haiduk *et al.* (1980, 1981: 223) reported 2*n* = 36, FN = 66, BA = 32, and a subtelocentric X chromosome. Denys *et al.* (2013: 281) also reported 2*n* = 36 and Fna = 66, but with two medium-sized submetacentric X chromosomes.
Protein / allozyme - Unknown.

ROOST:
Weber and Fahr (2006: 4) indicate that [as *Lissonycteris angolensis*] largely or exclusively depends on the availability of caves as day roosts.

POPULATION:
Structure and Density - This species can be common in some localities (Mickleburgh *et al.*, 2008o; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008o; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Stanley and Goodman (2011: 38) reported pregnant females collected in the West and East Usambara Mountains (Tanzania) on 1 July 1991, and between 25 July and 5 August 1992. They also found six pregnant females in the South Pare Mountains between 18 and 23 July 1993, and on 25 August 1994.

In Sierra Leone, Weber *et al.* (2019: 20) captured two lactating females on 25 March.

PARASITES:
Adam (1973: 3) reported *Plasmodium voltaicum* Van Der Kaay, 1964 (Haemosporida) from the Republic of Congo. He also mentioned that this parasite can be detected in the blood of the bats six to eight days after infection and then persists chronically for an persistent period. Schaer *et al.* (2013a: 17416) recorded the same parasite in three out of three investigated bats, and Perkins and Schaer (2016: Suppl.) mention it furthermore from Ghana and Guinea.

Adam (1973: 4) also reported on a [as *Lissonycteris angolensis*] specimen that was transported from the Republic of Congo to Paris and that was infected by *Hepatocystis perronae*.

ACARI

Teinocoptidae; Fain (1967: 363) described *Teinocoptes ituriensis* from "*Rousettus (Lissonycteris) angolensis*" from Saliboko, Lake Albert, Ituri, Congo.
Trombiculidae: *Trombigastia (Trombigastia) rousetti* was described by Vercammen-Grandjean and Fain (1958: 16) from "*Rousettus (Lissonycteris) angolensis*" from Nyakibanda, Rwanda (Stekolnikov, 2018a: 120). They also described (p. 18) *Trombigastia (Trombigastia) hirsuta* from bats from Katana, N of Bukavu, DRC (Stekolnikov, 2018a: 118). Fain (1959a: 346) mentions *Nycteridocoptes macrophallus* Fain, 1958 from "*R. angolensis*" from Mulungu, DRC. Stekolnikov (2018a: 130, 152) also reported *Chiroptella adami* Taufflieb, 1972 on "*Lissonycteris angolensis smithii*" from Senegal, and *Microtrombicula hexasternalis* Vercammen-Grandjean, 1965 on bats from Bukavu, DRC.

DIPTERA
Nycteribiidae: *Eucampsipoda africanum* Theodor 1955, widely distributed over the Ethiopian region and recorded from localities in Senegal to the Sudan and southwards mirroring the hosts distribution (Haeselbarth *et al.*, 1966: 115). *Dipseliopoda biannulate* (Oldroyd 1953) distributed over the tropical parts of Africa and recorded from localities in Nigeria, Cameroon, the Congo and the Sudan and Kenya (Haeselbarth *et al.*, 1966: 116). *Cyclopodia greeffi* Karsch 1884 found in a belt across central Africa, between lat. 10° south and north, while in West Africa it occurs further north up to lat. 20° (Haeselbarth *et al.*, 1966: 117).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) [as *Lyssonycteris angolensis*] tested between 1986 to 1999, for antibody to SARS-CoV in sera in 16 individuals from Oriental Province, DRC, one was tested positive (1/16, 6.3 %) and two individuals from Bandundu Province, DRC, none tested positive (0/2) (1/18, 5.6 %).
None of the nine Kenyan specimens tested by Tao *et al.* (2017: Suppl.) were positive for CoV.

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that none of the 3 specimens they examined from the Democratic Republic of the Congo tested positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

Polyomaviridae
Polyomavirus - Conrardy *et al.* (2014: 259) tested 11 specimens from the Kakamega cave (Kenya) and found one of them to test positive for this virus.

This was also the case for the single specimen from Kisumu.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Burkina Faso, Burundi, Cameroon, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Ghana, Guinea, Kenya, Liberia, Malawi, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, Uganda, Zambia

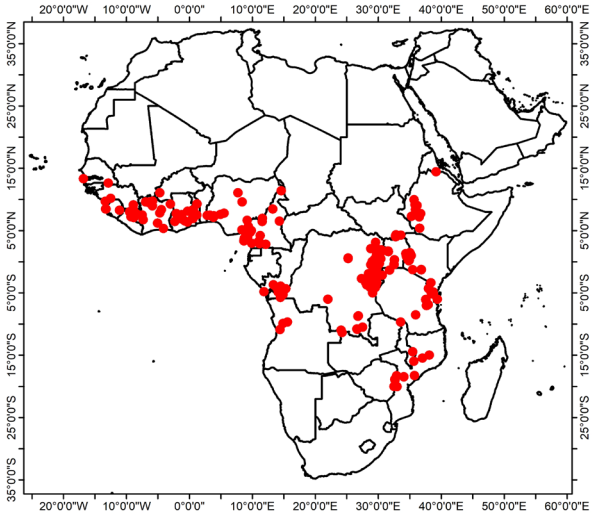


Figure 36. Distribution of *Myonycteris angolensis*

.

Myonycteris angolensis angolensis (Bocage, 1898)

*1898. *Cynonycteris Angolensis* Bocage, J. Sci. mat. phys. nat., ser. 2, 5 (19): 133, 138, text-fig. Publication date: June 1898. Type locality: Angola: Quibula, Cahata, north of Quanza River: Pungo Andongo [09 40 S 15 35 E, 1 200 m] [Goto Description]. Syntype: BMNH 1897.8.6.1: juv ♀, skull and alcoholic. Collected by: José Alberto de Oliveira Anchieta; collection date: 1891. Presented/Donated by: Lisbon Museum. See Andersen (1912b: 54), Bergmans (1997: 37). Syntype: MLZA T113 [a]: ad ♀, mounted skin (skull missing). Collected by: José Alberto de Oliveira Anchieta; collection date: 1891. Destroyed by fire in 1978; see Bergmans (1997: 37). Syntype: MLZA T113 [b]: juv, mounted skin (skull not removed). Collected by: José Alberto de Oliveira Anchieta; collection date: 1891. Destroyed by fire in 1978; see Bergmans (1997: 37). - Comments: From the feminine scientific Latin adjective *angolènsis,* meaning "Angolan" referring to the country where the type specimen was collected (see Lanza *et al.*, 2015: 60). - Etymology: Referring to the country where the type specimen was collected.

2015. *Myonycteris angolensis angolensis:* ACR. (Name Combination, Current Combination)

? *Lissonycteris angolensis angolensis:* (Name Combination)

GENERAL DISTRIBUTION:
Recorded from northwestern Angola, central and southern Cameroon, Central African Republic, central Congo, Equatorial Guinea [Bioko, Mbini], Gabon, eastern Nigeria, and northwestern and southwestern Democratic Republic of the Congo.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Cameroon, Congo, Congo (Democratic Republic of the), Equatorial Guinea, Nigeria.

Myonycteris angolensis goliath (Bergmans, 1997)

*1997. *Lissonycteris angolensis goliath* Bergmans, Beaufortia, 47 (2): 46. Publication date: 20 June 1997. Type locality: Zimbabwe: Inyanga: Gleneagles (Estate) [18 17 S 32 54 E] [Goto Description]. Holotype: NHMZ 59831: ad ♀, skin and skull. Collected by: Michael P. Stuart Irving *et al.*; collection date: 19 March 1970; original number: T1854. 8 paratypes; see Bergmans (1997: 46). Paratype: ZMA MAM.24710: ad ♀, skin and skull. Collected by: S. Irwin; collection date: 19 March 1970; original number: T1853. Presented/Donated by: ?: Collector Unknown. Paratype: ZMA MAM.24719: ♀, skin and skull. Collected by: S. Irwin; collection date: 19 March 1970; original number: T1853. Presented/Donated by: ?: Collector Unknown. Locality: Gleneagles (18 15 - 18 30 S, 32 45 - 33 0 E, 6000ft), see Bergmans (2011: 841). - Etymology: Referring to the biblical giant with the same name.

2001. *Lissonycteris goliath:* Cotterill, Durban Mus. Novit., 26: 53. (Name Combination, Current Combination)

2015. *Myonycteris angolensis goliath:* ACR. (Name Combination, Current Combination)

TAXONOMY:
Bergmans (1997) showed that craniological characters also distinguish *Lissonycteris* from *Rousettus*, and assigned the specimens from Zimbabwe to a new subspecies (*L. a. goliath*). Liberally applying the evolutionary species concept, which holds that any diagnosable or allopatric population is a valid species, Cotterill (2001e) elevated *goliath* to full species rank. Bergmans (2011: 841) still considers it a subspecies, at most.

COMMON NAMES:
English: Harrison's fruit bat. French: Lissonyctère goliath. German: Harrisons Samtfell-Flughund.

CONSERVATION STATUS:
Global - VU A3c+4c ver 3.1 (2001) (IUCN, 2004; Mickleburgh *et al.*, 2004ar); LC ver 3.1 (2001) included as a synonym of *L. angolensis* (Mickleburgh *et al.*, 2008o; IUCN, 2009).

MAJOR THREATS:
May be threatened by loss of habitat resulting from logging operations, and disturbance of cave roosting sites. It is possible that some populations of this species are threatened by over harvesting for subsistence food (Mickleburgh *et al.*, 2008o; IUCN, 2009).

CONSERVATION ACTIONS:
There is a need to protect the habitat (Mickleburgh *et al.*, 2008o; IUCN, 2009).

GENERAL DISTRIBUTION:
Lissonycteris goliath is known from four localities in south-east Africa (the border area of Mozambique and Zambia) between sea level and 1,800 m asl.

Native: Mozambique (Monadjem *et al.*, 2010d: 554; Monadjem *et al.*, 2010c: 376); Zambia; Zimbabwe (Monadjem *et al.*, 2010d: 554).

Myonycteris angolensis petraea (Bergmans, 1997)

*1997. *Lissonycteris angolensis petraea* Bergmans, Beaufortia, 47 (2): 44. Publication date: 20 June 1997. Type locality: Ethiopia: Ilubabor province: 10 km from Agaro: Jimma, road to [07 50 N 36 38 E] [Goto Description]. Holotype: MNHN ZM-MO-1972-482a: ad ♂, skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4017. Presented/Donated by: ?: Collector Unknown. 10 paratypes; see Bergmans (1997). Paratype: MNHN ZM-MO-1972-482b: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4018. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482c: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4019. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482d: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4024. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482e: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4027. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482f: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4032. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482g: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4044. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482h: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4045. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482i: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4046. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1972-482j: skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10 - 13 June 1968; original number: 4051. Presented/Donated by: ?: Collector Unknown. Paratype: ZMA MAM.25180: ad ♂, skull and alcoholic. Collected by: Jean Pierre Dorst *et al.*; collection date: 10-13 June 1968. Presented/Donated by: ?: Collector Unknown. Locality: 10 km from Agaro (07 50 N 36 38 E), at the road to Jimma (07 39 N 36 47 E), Ethiopia, 1650 m (see: Bergmans, 2011: 842).

2001. *Lissonycteris petraea:* Cotterill, Durban Mus. Novit., 26: 53. (Name Combination)

2015. *Myonycteris angolensis petraea:* ACR. (Name Combination, Current Combination)

TAXONOMY:
Simmons (2005: 325) states that the status of *petraea* remains unclear, but recognized it as a subspecies of *angolensis*.

COMMON NAMES:
English: Petra fruit bat. French: Lissonyctère d'Ethiopie. German: Äthiopischer Samtfell-Flughund.

CONSERVATION STATUS:
Global - VU A4c ver 3.1 (2001) (IUCN, 2004; Mickleburgh *et al.*, 2004ab); LC ver 3.1 (2001) included as a synonym of *L. angolensis* (Mickleburgh *et al.*, 2008o; IUCN, 2009).

CONSERVATION ACTIONS:
There is a need to protect the habitat (Mickleburgh *et al.*, 2008o; IUCN, 2009).

GENERAL DISTRIBUTION:
Found only in Ethiopia, where it has been recorded from six localities between 1,190 and 2,600 m asl.

Native: Ethiopia.

Myonycteris angolensis ruwenzorii (Eisentraut, 1965)

*1965. *Rousettus angolensis ruwenzorii* Eisentraut, Bonn. zool. Beitr., 16 (1/2): 3, fig. 1. Type locality: Uganda: Ruwenzori East [1 575 m] [Goto Description]. Holotype: BMNH 1906.12.4.1: ♂. Presented/Donated by: ?: Collector Unknown. - Etymology: Referring to the country where the type specimen was collected.
2015. *Myonycteris angolensis ruwenzorii:* ACR. (Name Combination, Current Combination)
? *Lissonycteris angolensis ruwenzorii:* (Name Combination)

COMMON NAMES:
English: Ruwenzori Long-haired rousette. French: Lissonyctère du Ruwenzori, Roussette à long poils du Ruwenzori. German: Ruwenzori-Langhaarflughund.

GENERAL DISTRIBUTION:
M. a. ruwenzorii has been recorded from Ethiopia, Kenya, Mozambique, Rwanda, southern Sudan, Tanzania, Uganda, northeastern and southeastern Democratic Republic of the Congo, Zambia and Zimbabwe.

Myonycteris angolensis smithii (Thomas, 1908)

*1908. *Rousettus smithii* Thomas, Ann. Mag. nat. Hist., ser. 8, 2 (10): 375. Publication date: 1 October 1908. Type locality: Sierra Leone: Freetown [08 30 N 13 15 W] [Goto Description]. Holotype: BMNH 1908.9.11.1: sad ♀. Collected by: Canon F.C. Smith. Presented/Donated by: Canon F.C. Smith. - Comments: Grubb *et al.* (1998: 67) mention that the type locality is almost certainly Freetown, according to Rosevear (1965: 84).
1974. *Lissonycteris angolensis smithi:* Bergmans, Bellier and Vissault, Rev. Zool. afr., 88 (1): 38. (Name Combination)
2012. *Myonycteris angolensis smithii:* Nesi, Kadjo, Pourrut, Leroy, Pongombo Shongo, Cruaud and Hassanin, Mol. Phylogenet. Evol., suppl. 3. (Name Combination, Current Combination)
? *Lissonycteris angolensis smithii:* (Name Combination)
? *Lissonycteris smithii:* (Name Combination)
? *Rousettus angolensis smithi:* (Name Combination)
? *Rousettus smithi:* (Name Combination, Alternate Spelling)

TAXONOMY:
Mentioned as *smithii* by Allen (1939a: 63), Meester *et al.* (1986: 30), Koopman (1993a), Bergmans (1997: 33), Grubb *et al.* (1998: 67), Kock *et al.* (2002: 79), but as *smithi* by Peterson *et al.* (1995: 48), who also consider it a valid species in the genus *Myonycteris*. Kock *et al.* (2002: 79) include it as subspecies in *angolensis*, due to clinal differentiation (as does Bergmans, 1997: 33). Simmons (2005: 325) follows Kock *et al.* (2002), who support Bergmans (1997), in treating *smithii* as a subspecies of *angolensis*.

COMMON NAMES:
English: Smith's fruit bat. French: Lissonyctère de Simth. German: Smiths Samtfell-Flughund.

CONSERVATION STATUS:
Global - LC ver 3.1 (2001) (IUCN, 2004; Mickleburgh *et al.*, 2004u); LC ver 3.1 (2001) included as a synonym of *L. angolensis* (Mickleburgh *et al.*, 2008o; IUCN, 2009).

GENERAL DISTRIBUTION:
Distributed in the lowlands of western Africa, where its distribution follows the savanna and forest zone, it is found up to 1,400 m asl on Mount Nimba.

Native: Bioko; Burkina Faso; Ghana; Guinea (Decher *et al.*, 2016: 262); Guinea Bissau; Côte d'Ivoire; Liberia; Nigeria; Sierra Leone; Senegal; Togo.

HABITAT:
Monadjem *et al.* (2016y: 364) indicate that the (sub)species is restricted to montane forests in West Africa.

Myonycteris brachycephala (Bocage, 1889)

*1889. *Cynonycteris brachycephala* Bocage, J. Sci. mat. phys. nat., ser. 2, 1 (3): 198. Publication date: December 1889. Type locality: São Tomé and Principé: São Tomé Island. Holotype: MLZA 449a: ad ♀, mounted skin and skull. Collected by: F. Newton and Pires; collection date: 1868. Holotype number "T114"; destroyed by fire in 1978: see Bergmans (1997: 53).
1898. *Cynonycteris brachycephalus:* Seabra, J. Sci. mat. phys. nat., ser. 2, 5: 170. (Alternate Spelling)
1995. *M[yonycteris] brachyptera:* Peterson, Eger, and Mitchell, : 48. - Comments: Mentioned by Peterson *et al.* (1995: 48) only with the remark "La situation exacte de ce taxon suppose une étude plus poussée". [The exact situation of this taxon needs a more thorough study]. (Lapsus)
? *Myonycteris (Myonycteris) brachyptera:* (Lapsus)
? *Myonycteris (Phygetis) brachycephala:* (Name Combination)
? *Myonycteris brachycephala:* (Name Combination, Current Combination)

TAXONOMY:
Reviewed by Bergmans (1997). See Simmons (2005: 328).

COMMON NAMES:
Czech: kaloň tomášský. English: Sao Tomé Collared Fruit Bat. French: Myonyctère de São Tomé, Chauve-souris frugivore à collier de São Tomé. German Halskrausen-Flughund, São Tomé Halskrausen-Flughund.

CONSERVATION STATUS:
Global - Listed as Endangered because its extent of occurrence is less than 1,000 km^2, all individuals are in a single location (the uplands of Sao Tomé), and there is continuing decline in the extent and quality of its habitat (Juste *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - EN B1ab(iii) ver 3.1 (2001) (Juste *et al.*, 2008a; IUCN, 2009). 2004 - EN B1ab(iii) ver 3.1 (2001) (Juste *et al.*, 2004b; IUCN, 2004). 2000 - EN (Hilton-Taylor, 2000). 1996 - VU (Baillie and Groombridge, 1996). 1994 - VU (Groombridge, 1994).

MAJOR THREATS:
Within the species' relatively limited range it is threatened by ongoing habitat loss, presumably related to logging activities and the conversion of land to agricultural use (Juste *et al.*, 2008a; IUCN, 2009).
Rainho *et al.* (2010b: 257) indicate that hunting might also be a problem for this island endemic.

CONSERVATION ACTIONS:
Juste *et al.* (2008a) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. There is a need to protect suitable areas of remaining natural habitat for this species, with additional research required into the persistence of populations in modified habitats (such as cocoa plantations). Further surveys are needed to identify additional localities for this species, and to better understand its natural history.

GENERAL DISTRIBUTION:
Myonycteris brachycephala is endemic to the uplands of São Tomé Island of São Tomé and Príncipe. It is absent from the northern part of the island. It has only been recorded from three localities, and no colonies have been reported. Individuals have been recorded between 300 and 1,200 m asl.

Native: Sao Tomé and Principe (Bergmans, 1997; Simmons, 2005: 328; Rainho *et al.*, 2010a: 18).

DENTAL FORMULA:
Juste and Ibáñez (1993a: 221) report on an asymmetric dental formula in *M. brachycephala*, which resulted from the absence of a lower internal incisor, either in the left or right mandible. They indicate that this might be related to a developmental instability associated with the colonization by the island species.

POPULATION:
Structure and Density - It appears to be a naturally rare species (Juste *et al.*, 2008a; IUCN, 2009).
Trend - 2008 - Decreasing (Juste *et al.*, 2008a; IUCN, 2009; Rainho *et al.*, 2010b: 257).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
São Tomé and Principé.

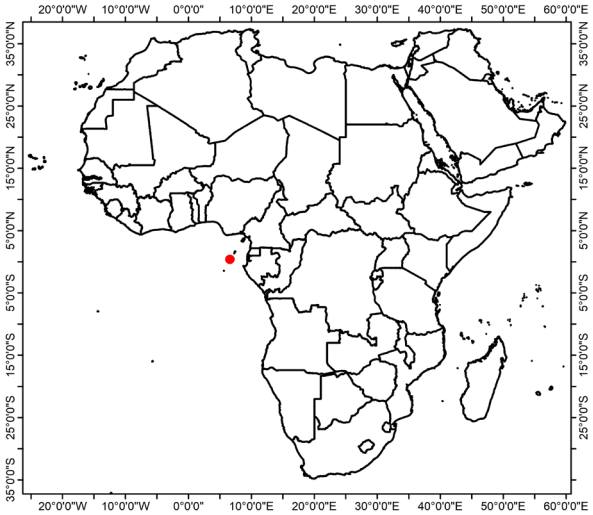


Figure 37. Distribution of *Myonycteris brachycephala*

Myonycteris leptodon K. Andersen, 1908

*1908. *Myonycteris leptodon* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 2 (11): 450. Publication date: 1 November 1908. Type locality: Sierra Leone: "Sierra Leone" [Goto Description]. Holotype: BMNH 1891.2.13.1: ad ♂. Collected by: J. Hickman Esq. Collection date: prior to 1891. (Current Combination)
1971. *M[yonycteris (Myonycteris)] t[orquata] leptodon:* Hayman and Hill, in: Meester and Setzer, The mammals of Africa. Order Chiroptera. (Name Combination)
1971. *Myonycteris torquata leptodon:* Jones, J. Mamm., 52 (1): 129. Publication date: February 1971. (Name Combination)
? *Myonycteris (Myonycteris) leptodon:* (Name Combination)
? *Myonycteris (Myonycteris) torquata leptodon:* (Name Combination)

TAXONOMY:
Based on the study of cytochrome *b* sequences, Nesi *et al.* (2012) concluded that West African *Myonycteris torquata* (Dobson, 1878) differed considerably from those from Central African.

COMMON NAMES:
German: Sierra-Leone Halskrausen-Flughund

ETYMOLOGY OF COMMON NAME:
From the Greek λεπτός meaning slender or narrow and όδους meaning tooth.

GENERAL DISTRIBUTION:
Nesi *et al.* (2012) indicated that the *M. torquata* specimens from West Africa were considerably different from those from the remaining part of the continent, but they did not include specimens from the area between the Dahomey Gap and the Niger delta. Herkt *et al.* (2017: Appendix S9) were not able to determine a preferential habitat type in that area for either *M. torquata* or *M. leptodon*. They were, however, able to determine that the Dahomey Gap was a pronounced break in the habitat suitability predictions of both species. Therefore, they considered the specimens on the western side of the Gap to belong to *leptodon* and on the eastern side to *torquata*.

Native: Native: Côte d'Ivoire (Heim de Balsac, 1934b: 24); Ghana (Decher and Fahr, 2007: 12); Guinea (Simmons, 2005: 328; Denys *et al.*, 2013: 281; Decher *et al.*, 2016: 263); Liberia (Monadjem and Fahr, 2007: 50); Sierra Leone (Simmons, 2005: 328); Togo.

HABITAT:
In the Mount Nimba area, Monadjem *et al.* (2016y: 364) recorded this species from a wide range of forested habitats on both Liberian and Guinean sides, between 450 m and 1,350 m.

REPRODUCTION AND ONTOGENY:
Weber *et al.* (2019: 20) captured one lactating female on 7 April in Sierra Leone.

PARASITES:
HAEMOSPORIDA
Schaer *et al.* (2013a: "2") report the presence of hemosporidian parasites of the genus *Hepatocystis* in 11 out of 63 investigated bats.

VIRUSES:
Filoviridae - Filo viruses
Ebolavirus
Nesi *et al.* (2012: 126) suggest that the high nucleotide distance between Ebola virus Côte d'Ivoire and Ebola virus Zaire can be correlated with the Plio/Pleistocene divergence between their putative reservoir host species, i.e., *Myonycteris leptodon* and *Myonycteris torquata*, respectively.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Côte d'Ivoire, Ghana, Guinea, Liberia, Sierra Leone, Togo.

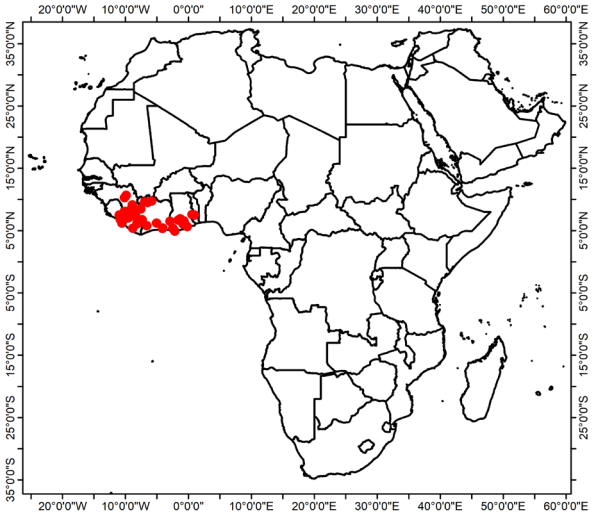


Figure 38. Distribution of *Myonycteris leptodon*

Myonycteris relicta Bergmans, 1980

*1980. *Myonycteris relicta* Bergmans, Zool. Meded. RMNH, Leiden, 55 (14): 171, 173, figs 1 - 10. Publication date: 4 March 1980. Type locality: Kenya: Coast province: Kwale district: Shimba Hills, Lukore area: Mukanda River [ca. 04 13 S 39 25 E] [Goto Description]. Holotype: RMNH MAM.27909: ad ♂. Collected by: Robert N. Kyongo; collection date: 30 July 1978. See Bergmans (1997: 56). Paratype: ZMB 54936: ad ♂, skull and alcoholic. Collection date: January 1900. See Turni and Kock (2008). Paratype: ZMB 54937: ad ♀, skull and alcoholic. Collection date: January 1900. See Turni and Kock (2008). (Current Combination)
? *Myonycteris (Myonycteris) relicta:* (Name Combination)

TAXONOMY:
Bronner *et al.* (2003) state that *Myonycteris relicta* was described by Bergmans (1980) based on the re-identification of a specimen from the Nguru Mountains, and two specimens from the Usambara Mountains, in Tanzania. Peterson *et al.* (1995: 48) regarded *M. relicta* as a species of *Rousettus*, in contrast to Koopman (1982), Corbet and Hill (1980), Koopman (1993a: 143), Bergmans (1997) and Simmons (2005: 328) who retained this taxon in *Myonycteris*.

COMMON NAMES:
Chinese: 孤领果蝠. Czech: kaloň východoafrický. English: East African Collared Fruit-bat, Relict Collared Fruit-bat, East African Little Collared Fruit Bat, Bergmans's Small Fruit Bat, Bergmans's Collared Fruit Bat. French: Myonyctère d'Afrique orientale, Chauve-souris frugivore à collier d'Afrique orientale, Roussette du Kenya. German: Reliktärer Halskrausen-Flughund.

ETYMOLOGY OF COMMON NAME:
First described by Wim Bergmans after examining and reclassifying specimens previously ascribed to *Rousettus* (*Lissonycteris*) *angolensis* and following his discovery of the type specimen from the Mukonda River in Kenya (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Vulnerable because it is suspected that a population decline, estimated to be more than 30% would be met over a ten-year period which is ongoing from the recent past to the near future, inferred from the loss of its forest habitat (Mickleburgh *et al.*, 2008ao; IUCN, 2009).

Assessment History -
2008 - VU A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2008ao; IUCN, 2009). 2004 - VU A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2004bd; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996). 1994 - VU (Groombridge, 1994).

MAJOR THREATS:
Although the natural history of this species is little known, there is considerable ongoing habitat loss within the species range (through logging, harvesting of firewood and conversion of land to agricultural use) (Mickleburgh *et al.*, 2008ao; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ao) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species. In Zimbabwe it has been recorded from the Haroni and Rusitu protected areas, but the forest has still been declining at these localities over the past three decades. Further surveys are needed to better determine the full extent of this species range. There is a need to conserve remaining lowland forest throughout much of East Africa.

GENERAL DISTRIBUTION:
Bergmans (1997) reports that the species is known from the Shimba Hills in southeast Kenya, the Usambara and Nguru Mountains in Tanzania. Several other unpublished localities in Tanzania and more recently from eastern Zimbabwe and Mozambique.

A female specimen captured in Haroni Forest (Zimbabwe) in 1973 and originally identified incorrectly as *Rousettus* (=*Lissonycteris*) *angolensis*, was re-identified as *Myonycteris relicta* (Cotterill, 1995; Bergmans, 1997).

Native: Kenya (Simmons, 2005: 328); Mozambique (Simmons, 2005: 328;: 554; Monadjem *et al.*, 2010c: 376); Tanzania (Simmons, 2005: 328; Stanley and Goodman, 2011: 40); Zimbabwe (Simmons, 2005: 328; Monadjem *et al.*, 2010d: 554).

HABITAT:
All localities known with some accuracy are in East African Zanzibar-Inhambane coastal mosaic: forest patches or in undifferentiated Afromontane vegetation bordering on East African Zanzibar-Inhambane coastal mosaic (Bergmans, 1997). The holotype specimen was caught over the Mukanda River, bordered by big thorn trees and fig trees, in the Shimba Hills, which are covered with a mosaic of open country and forest patches (Bergmans, 1997).

POPULATION:
Structure and Density -There is little known about the population of this species. Nearly all collections have been of single specimens caught in mist nets (Mickleburgh *et al.*, 2008ao; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008ao; IUCN, 2009).

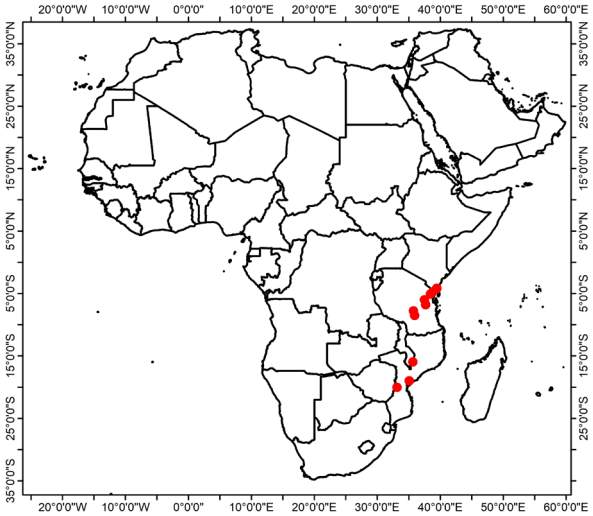


Figure 39. Distribution of *Myonycteris relicta*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Kenya, Malawi, Mozambique, Tanzania, Zimbabwe.

Myonycteris torquata (Dobson, 1878)

1870. *Cynopterus collaris* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 123. Type locality: Angola: "Angola" [Goto Description]. Holotype: BMNH 1843.9.27.2:. - Comments: Not of Kolenati, 1860 [=*Rousettus leachi*] not of Geoffroy. Cat. Monkeys, Lemurs, Fruit-eating Bats Brit. Mus., p. 123. Type locality "W Africa, Lower Congo; Angola" see Allen (1939a: 58). Andersen (1912b: 581) mentions "The type was obtained 'near Congo' by one Mr. Currer, from whom it came into the hands of Dr. (afterwards Sir) J. Richardson, who presented it to the British Museum. Gray's statement that the specimen is 'young' is incorrect; his quotation of 'Gray, List Mamm. B. M. (1843),' where the specimen is stated to have been mentioned under the name *Xantharpyia collaris*, does not refer to the printed text of that book, but to a hand-written addition by Gray in his own copy of the book.".

*1878. *Cynonycteris torquata* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, xxxvii, 71, 76, pl. 5, fig. 1. Publication date: June 1878. Type locality: Angola: N Angola: Lower Cuanza region: Golungo Alto [Goto Description]. Lectotype: BMNH 1866.1.20.4: ad ♂, skull and alcoholic. Collected by: F. Welwitsch; collection date: 1853 - 1860. See Bergmans (1997: 49). - Comments: Grubb *et al.* (1998: 68) indicate "definite restriction of the type locality is not possible at present (Bergmans, 1976: 210 - 211)". Bergmans (1997: 49) indicates that Bergmans (1976) restricted the type locality to "Lower Cuanza Region" and the area was restricted to Golungo Alto by Crawford-Cabral (1989).

2014. *Myonycteris tarquata:* Ndara R., IJISR, 12 (1): 253. Publication date: November 2014. (Lapsus)
? *Myonycteris (Myonycteris) torquata:* (Name Combination)
? *Myonycteris torquata:* (Name Combination, Current Combination)
? *Myopterus torquata:* (Name Combination, Lapsus)

TAXONOMY:
See Hayman and Hill (1971), Peterson *et al.* (1995), Bergmans (1976; 1997) and Simmons (2005: 328). Subspecies follow Koopman (1994), but see Bergmans (1997).

In their study on cytochrome *b* sequences, Nesi *et al.* (2012) concluded that West African *Myonycteris torquata* (Dobson, 1878) differed considerably from the specimens from Central African, which resulted in the recognition of *M. leptodon* as a separate species.

COMMON NAMES:
Czech: kaloň límcový. English: Little Collared Fruit-bat, Little Collared Fruit Bat. French: Petit Myonyctère, Petite Chauve-souris frugivore à collier. German: Kleiner Halskrausen-Flughund, Kleiner Halsbandflughund. Spanish (Castillian): Zorra Voladora de Collar.

CONSERVATION STATUS:
Global - Listed as Least Concern in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bb; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bb; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004bz; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There are generally no major threats to this species. It is threatened in parts of its range by severe habitat loss, presumably through general logging operations and the conversion of land to agricultural use (Mickleburgh *et al.*, 2008bb; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bb) [in IUCN (2009)] reported that the species has been recorded from Tai National Park (Côte d'Ivoire) and it seems probable that it is present in a number of West African and Central African protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Myonycteris torquata used to be considered widespread in West Africa and Central Africa, ranging into western East Africa, but since the recognition of *M. leptodon* as a separate species, its distribution range starts from Nigeria and Cameroon into Equatorial Guinea (Rio Muni and Bioko), Gabon, Congo, Central African Republic, Democratic Republic of the Congo, Angola, extreme northwestern Zambia, Rwanda, Uganda and possibly southern Sudan. It is a lowland species found up to 800 m asl.

Nesi *et al.* (2012) did not include specimens from the area between the Dahomey Gap and the Niger delta, and Herkt *et al.* (2017: Appendix S9) were not able to determine a preferential habitat type in that area for either *M. torquata* or *M. leptodon*. However, they were able to determine that the Dahomey Gap was a pronounced break in the habitat suitability predictions of both species. Therefore, they considered the specimens on the western side of the Gap to belong to *leptodon* and on the eastern side to *torquata*.

Native: Angola (Bergmans, 1997; Simmons, 2005: 328; Monadjem *et al.*, 2010d: 554); Cameroon; Central African Republic (Morvan *et al.*, 1999: 1195); Congo (King and Dallimer, 2010: 65); Congo (The Democratic Republic of the) (Bergmans, 1997; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 554); Ethiopia (Lavrenchenko *et al.*, 2004b: 136); Equatorial Guinea (Bioko) (Fahr and Ebigbo, 2003: 128; Simmons, 2005: 328); Gabon; Nigeria (Capo-Chichi *et al.*, 2004: 161); Rwanda; Uganda (Kityo and Kerbis, 1996: 59; Simmons, 2005: 328); Zambia (Bergmans, 1997; Simmons, 2005: 328; Monadjem *et al.*, 2010d: 554).

Presence uncertain: Sudan.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Haiduk *et al.*, 1980; 1981: 223) reported $2n$ = 36, FN = 66, BA = 32, a subtelocentric X chromosome and an acrocentric Y chromosome for specimens from Cameroon. Identical karyotypes were reported by Primus *et al.* (2006) for specimens from Gabon.
Protein / allozyme - Unknown.

DIET:
In Cameroon, Grünmeier (1993: 35) found the following pollen in the gut and faeces: *Mucuna flagellipes* Hook.f. (Fabaceae), *Anthocleista* sp. (Gentianaceae), *Kigelia africana* (Lam.) Benth. (Bignoniaceae), *Elaeis* cf. *guineensis* Jacq. (Arecaceae), *Musa* sp. (Musaceae), Bombacaceae indet., and Mimosaceae indet.

In Congo, Kipalu (2009: 16) reported *M. torquata* visiting/consuming fruits of *Chlorophora excelsa* (African teak) and *Ficus mucuso*.

Gembu Tungaluna (2012: 102 - 104) reported the following fruits being eaten in the Kisangani area (DRC) during the various seasons: First heavy rain season (September - November): *Uapaca guineensis* Müll.Arg., 1864 (Sugar plum, red cedar, false mahogany, rikio) (19%), *Ficus leprieuri* Miq., 1867 (17%), *Carica papaya* L. (papaya) (11%), *Musanga cecropioides* R.Br. & Tedlie (African corkwood tree, umbrella tree) (11%), *Pseudospondias microcarpa* (A. Rich.) Engl. (8%), *Persea americana* Mill., 1786 (avocado) (8%), *Dacryoides edulis* H.J. Lam (safou, African pear, bush pear, Nsafu, bush butter tree, butterfruit) (8%), *Ficus wildemanniana* Warb. (6%), *Ficus vallis-choudae* Delile (6%), *Ficus mucoso* Welw. (3%), *Spondias cytherea* Sonnerat, 1782 (Ambarella, otaheite apple, great hog plum) (3%).
First mild rain/dry season (December - February): *Elaeis guineensis* Jacq. (African oil palm, macaw-fat) (50%), *Myrianthus arboreus* P.Beauvois, 1805 (giant yellow mulberry, bush pineapple, corkwood) (50%).
Second heavy rain season (March - May): *Pseudospondias microcarpa* (17%), *Musanga cecropioides* (14%), *Spondias cytherea* (9%), *Ficus leprieuri* (8%), *Ficus* sp1 (8%), *Uapaca guineensis* (8%), *Annonidium mannii* (Oliv.) Engl. & Diels (Junglesop) (6%), *Ficus vallis-choudae* (6%), *Ficus wildemanniana* (3%), *Ficus* sp2 (3%), *Dacryoides edulis* (3%), *Elaeis guineensis* (3%), *Parinari excelsa* Sabine (Guinea plum) (3%), Musa sp. (3%)
Second mild rain/dry season (June - August): *Ficus leprieuri* (34%), *Myrianthus arboreus* (33%), *Annonidium mannii* (Junglesop) (33%).

POPULATION:
Structure and Density - Although the species is infrequently caught in ground level nets, it is commonly caught in canopy nets. In Tai National Park (Côte d'Ivoire) its one of the most common fruit bats (Mickleburgh *et al.*, 2008bb; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008bb; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
In Congo, Bergmans (1979a: 169) caught a female with a large foetus on 25 November, and a male with large, but not active testes on 28 November.

PARASITES:
BACTERIA
Gram-negative bacterium - Of the 40 bats tested by Nowak *et al.* (2017: 6) in the Republic of Congo, 22 tested positive for *E. coli*. One isolate was identified as *E. albertii*.

HAEMOSPORIDA
Lutz *et al.* (2016: 9) examined 7 *M. torquata* specimens from East Africa and found four of them infected with *Hepatocystis* sp. Perkins and Schaer (2016: Suppl.) mention the presence of *Hepatocystis perronae* Landau and Adam, 1971 in bats from the Republic of Congo and the Central African Republic (see also Adam, 1973: 4; Miltgen *et al.*, 1977: 595).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999 for antibodies to SARS-CoV in sera of seven individuals from Bandundu Province, DRC, one specimen tested positive (1/7, 14.3 %).

Filoviridae - Filo viruses
Ebolavirus
Pourrut *et al.* (2007) showed that there is a homogeneous ZEBOV [Zaire Ebolavirus] infection in the wild populations of *M. torquata* in Gabon and the Democratic Republic of the Congo. Four out of 58 bats had immunoglobulin G (IgG) specific for Ebola in Gabon during a test performed by Leroy *et al.* (2005: 575).

Bausch and Schwarz (2014: 1) and Pigott *et al.* (2014: 9) indicate that *M. torquata* is one of the leading candidates for introducing Ebola in Guinea (together with *Epomops franqueti* and *Hypsignathus monstrosus*). While Vogel (2014: 140) names *M. torquata* the leading suspect for the Ebola outbreak in Guinea in the beginnig of 2014. However, no proof has been provided that this was indeed the case.

Marburgvirus
Towner *et al.* (2007) tested 264 individuals from Gabon for Marburg virus RNA by conventional and real-time RT-PCR and 55 individuals for anti-Marburg virus IgG antibodies by ELISA; no positives were found.

Nairoviridae
Orthonairovirus

Only three of the 100 specimens from Congo tested by Müller *et al.* (2016: 3) were positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that three of the 111 specimens (2.7 %) they examined from Gabon, Congo and the Democratic Republic of the Congo tested positive for *Henipavirus*.

Rhabdoviridae
Kalemba *et al.* (2017: 409) reported that out of 6 bats examined from the DRC, two tested positive for Lagos Bat Virus neutralizing antibodies.

In their overview table, Maganga *et al.* (2014a: 8) reported that the following viruses were already found on *M. torquata*: Zaire Ebola virus (ZEBOV), Coronavirus (SARS-CoV), Henipavirus.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Equatorial Guinea, Gabon, Ghana, Nigeria, Uganda, Zambia.

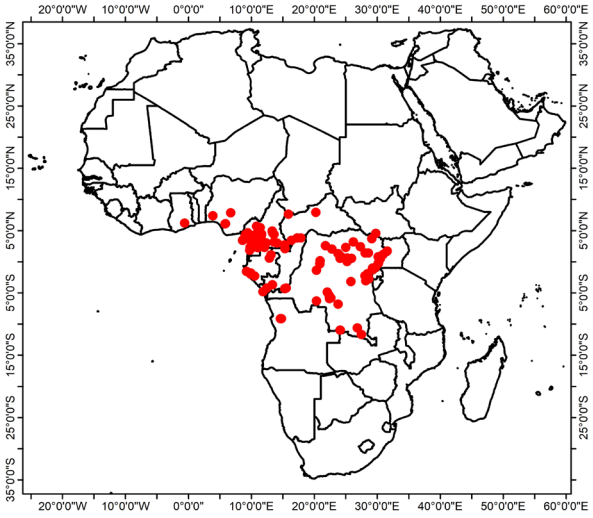


Figure 40. Distribution of *Myonycteris torquata*

Myonycteris torquata torquata (Dobson, 1878)

*1878. *Cynonycteris torquata* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, xxxvii, 71, 76, pl. 5, fig. 1. Publication date: June 1878. Type locality: Angola: N Angola: Lower Cuanza region: Golungo Alto [Goto Description]. - Comments: Grubb *et al.* (1998: 68) indicate "definite restriction of the type locality is not possible at present (Bergmans, 1976: 210 - 211)". Bergmans (1997: 49) indicates that Bergmans (1976) restricted the type locality to "Lower Cuanza Region" and the area was restricted to Golungo Alto by Crawford-Cabral (1989).
1971. *M[yonycteris (Myonycteris)] t[orquata] torquata:* Hayman and Hill, in: Meester and Setzer, The mammals of Africa. Order Chiroptera, 12. (Name Combination)
? *Myonycteris (Myonycteris) torquata torquata:* (Name Combination)
? *Myonycteris torquata torquata:* (Name Combination)

VIRUSES:
Nesi *et al.* (2012: 126) suggest that the high nucleotide distance between Ebola virus Côte d'Ivoire and Ebola virus Zaire can be correlated with the Plio/Pleistocene divergence between their putative reservoir host species, i.e., *Myonycteris torquata leptodon* and *Myonycteris torquata torquata*, respectively.

Myonycteris torquata wroughtoni K. Andersen, 1908

*1908. *Myonycteris wroughtoni* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 2 (11): 450. Publication date: 1 November 1908. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Likandi river [=Litaki river] [03 20 N 26 10 E] [Goto Description]. Holotype: BMNH 1907.7.8.25: ad ♂, skin and skull. Collected by: The Alexander-Gosling Expedition; collection date: 18 April 1906. See Andersen (1908c: 450); Bergmans (1997: 50). Paratype: BMNH 1907.7.8.26: ♂. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of Mr. Robert Charles Wroughton, who assisted in working out the mammals collected during the Alexander-Gosling Expedition: see Andersen (1908c: 450).
1971. *M[yonycteris (Myonycteris] t[orquata] wroughtoni:* Hayman and Hill, in: Meester and Setzer, The mammals of Africa. Order Chiroptera, 13. (Name Combination)

1971. *Myonycteris torquata wroughtoni:* Jones, J. Mamm., 52 (1): 129. Publication date: February 1971. (Name Combination, Current Combination)
? *Myonycteris (Myonycteris) torquata wroughtoni:* (Name Combination, Current Combination)

Genus ***Nanonycteris*** Matschie, 1899

*1899. *[Epomophorus (]Nanonycteris[)]* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, 35, 58 [Goto Description]. - Comments: Described as a subgenus of *Epomophorus* Bennett, 1836. Type species: *Epomophorus veldkampii* Jentink, 1888. Matschie dated his introduction on 14 May 1899. - Etymology: From the Greek "*νάνος*", meaning dwarf and "*νυκτερια*", meaning bat (see Palmer, 1904: 448).
1943. *Nannonycteris:* Pohle, Sber. Ges. naturf. Freunde Berlin, 78 (for 1942). (Lapsus)
2007. *Nnonycteris:* Lameed, Biodiversity, 8 (4): 8. (Lapsus)
2019. *Nanonycteri:* Mbu'u, Mbacham, Gontao, Kamdem, Nlôga, Groschup, Wade, Fischer and Balkema-Buschmann, Vector-Borne Zoon. Dis., xxx: "6".. Publication date: 13 April 2019. (Lapsus)
? *Epomophorus:* - Comments: Not of Gray, 1836.
? *Nanonycteris:* (Name Combination, Current Combination)

TAXONOMY:
Revised by Bergmans (1989). See Simmons (2005: 328).

Included in the Epomophorinii tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Nanonycteris*: ***veldkampii*** (Jentink, 1888).

COMMON NAMES:
Czech: Veldkampovi kaloni. English: Dwarf Fruit-bats, Little Flying Cow. French: Roussettes naines. German: Zwergflughunde.

Nanonycteris veldkampii (Jentink, 1888)

*1888. *Epomophorus veldkampii* Jentink, Notes Leyden Mus., 10: 51 (for 1887). Publication date: April 1888. Type locality: Liberia: Fisherman Lake: Buluma [06 43 N 11 14 W] [Goto Description]. Holotype: RMNH [unknown]: ad ♀, alcoholic (skull not removed). Collected by: Johan Büttikofer and C.F. Sala; collection date: Jan-April 1882. - Etymology: Jentink (1887b: 52) states: "I call this new species *veldkampii*, as Büttikofer wishes to connect the name of one of his Liberian friends with this new acquisition. Mr. Veldkamp, at present Consul for the Netherlands in Liberia, has helped our travellers as much as he could, has promoted their investigations in every way and finally assisted to Sala's funeral.".
2000. *Nanonycteris weldkampi:* Konstantinov, Pema, Labzin and Farafonova, Plecotus et al., 3: 145. (Lapsus)
2015. *N[anonycteris] Weldkampi:* Sylla, Pourrut, Diatta, Diop, Ndiaye and Gonzalez, Afr. J. Microbio. Res., 9 (22): 1464. Publication date: 3 June 2015. (Lapsus)
? *Epomophorus (Nanonycteris) veldkampii:* (Name Combination)
? *Nanonycteris veldkampii:* (Name Combination, Current Combination)

TAXONOMY:
See Bergmans (1989) and Simmons (2005: 328).

COMMON NAMES:
Czech: kaloň Veldkampův. English: Veldkamp's Dwarf Fruit-bat, Veldkamp's Bat, Little Flying Cow, Flying Calf. French: Roussette naine de Veldkamp, Chauve-souris de Veldkamp, Nanonyctère, Petite vache-volante. German: Veldkamps Zwergflughund.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of

a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008be; IUCN, 2009).

Assessment Histroy -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008be; IUCN, 2009). 2004 - LC ver 3.1 (2001) [as *Nononycteris veldkampi*] (Mickleburgh *et al.*, 2004cb; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
In general there appear to be no current major threats to this species as a whole. The species is dependent on certain food trees where they visit flowers, and habitat degradation might be a problem in parts of the range (Mickleburgh *et al.*, 2008be; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008be) [in IUCN (2009)] report that, in view of the species wide range, it seems probable that it is present in a number of protected areas. There is a need to determine if there have been any local declines in this species resulting from the loss of food trees.

GENERAL DISTRIBUTION:
Nanonycteris veldkampii is widely distributed in West Africa and western parts of Central Africa. It ranges from Guinea and Sierra Leone in the west, through each country in West Africa to Cameroon, with a single record from the southern region of Central African Republic. It is generally a lowland species, but has been recorded up to 1,200 m asl.

Native: Benin (Capo-Chichi *et al.*, 2004: 161); Burkina Faso (Kangoyé *et al.*, 2012: 6023; 2015a: 605); Cameroon; Central African Republic; Côte d'Ivoire (Heim de Balsac, 1934b: 24); Ghana (Decher and Fahr, 2007: 12); Guinea (Denys *et al.*, 2013: 281); Liberia (Monadjem and Fahr, 2007: 50); Nigeria; Sierra Leone; Togo.

HABITAT:
Monadjem *et al.* (2016y: 364) indicate that this species occurs in forested habitats between 500 and 1200 m in the Mount Nimba area of Liberia and Guinea.

ROOST:
N. veldkampii roosts singly or in small groups of well-spaced individuals (Kunz, 1996: 44).

MIGRATION:
Thomas (1983) [in Kangoyé *et al.* (2015a: 605)] reported that this species migrates during the wet season from the forest zone to the northern Sudanian zone.

DIET:
Ayensu (1974) reports feeding visits to *Parkia clappertonia* (Dawadawa), *Ceiba pentandra* (Silk-Cotton tree or Kapok tree), *Psidium guajava* (Guava tree), and *Carica papaya* (Papaya or pawpaw).

Fahr (2011a: 114) shows a picture of *N. veldkampii* feeding on *Cola cordifolia*.

Seltzer *et al.* (2013: table S2) provide an overview of the plant species found beneath bat feeding roosts. For *N. veldkampii* this included *Psidium guajava* L. (apple guava - Myrtaceae).

POPULATION:
Structure and Density - This species can be abundant, although this partly depends on migration patterns (Mickleburgh *et al.*, 2008be; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008be; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Weber *et al.* (2019: 20) reported on five pregnant (25, 30, 31 March, 2 April) and 11 lactating (25, 27, 30, 31 March, 1, 3, 7, 8 April) in Sierra Leone.

PARASITES:
HAEMOSPORIDA
Witsenburg *et al.* (2012: Suppl. Table 1) report on GenBank data for *Hepatocystis*, retrieved from *N. veldkampii*. These parasites were also reported by Schaer *et al.* (2013a: "2") from six out of 8 investigated bats.

VIRUSES:
Filoviridae - Filoviruses
Ebolavirus
One out of four specimens tested by Hayman *et al.* (2012d: 1208) in the Greater Accra region, Ghana, was positive for EBOV antibodies.

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) reported that none of the 23 specimens they examined from Ghana tested positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

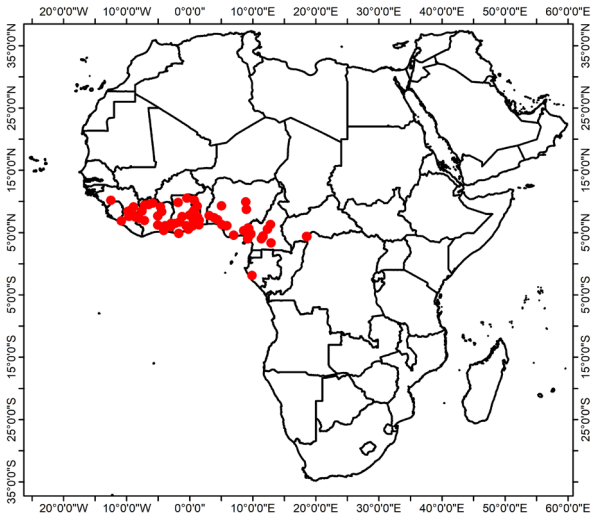


Figure 41. Distribution of *Nanonycteris veldkampii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Gabon, Ghana, Guinea, Liberia, Nigeria, Sierra Leone, Togo.

Genus ***Plerotes*** K. Andersen, 1910

*1910. *Plerotes* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 5 (25): 97. Publication date: 1 January 1910. - Comments: Type species: *Epomophorus anchietæ* Seabra, 1900. - Etymology: From the Greek "*πλεροτες*", meaning one who renders full or complete. (Current Combination)
2014. *Plerote:* Ndara R., IJISR, 12 (1): 253. Publication date: November 2014. (Lapsus)

TAXONOMY:
Revised by Bergmans (1989). See Simmons (2005: 333).

Included in the Plerotini tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Plerotes*: ***anchietae*** (Seabra, 1900).

COMMON NAMES:
Czech: pyložraví kaloni. English: Plerote Fruit-bats, Plerotes Fruit-bats. French: Plérotes. German: Breitgesicht-Flughunde.

Plerotes anchietae (Seabra, 1900)

*1900. *Epomophorus anchietæ* Seabra, J. Sci. mat. phys. nat., ser. 2, 6: 116. Publication date: August 1900. Type locality: Angola: Benguela district: East of Hanha: Galanga [12 04 S 15 09 E]. Holotype: MLZA 481a: ♀, mounted skin and skull. Collected by: José Alberto de Oliveira Anchieta. Presented/Donated by: ?: Collector Unknown. Neotype: CZL 31-59026: imm ♀. Collected by: Jaime V. Santos; collection date: 8 December 1959. Presented/Donated by: ?: Collector Unknown. Designated by Bergmans (1989: 144). - Comments: Andersen (1912b: 487) mentions: "Type, in the Lisbon Museum, an adult female, mounted, skull extracted, obtained by Sr. Anchieta.".
2014. *Plerote anchetae:* Ndara R., IJISR, 12 (1): 253. Publication date: November 2014. (Lapsus)
? *Epomophorus anchietae:* (Name Combination)
? *Epomophorus n. sp.:*
? *Nanonycteris veldkampii:* - Comments: Not of Jentink, 1888. (Lapsus)
? *Plerotes ancheilae:* (Lapsus)
? *Plerotes anchietae:* (Name Combination, Current Combination)
? *Plerotes anchietai:* (Lapsus)

TAXONOMY:
Koopman (1993a: 145) mentions this name as *anchietai*, whereas Allen (1939a: 59) and Kock (1969a: 114) use *anchietae*. See Simmons (2005: 333).

Almeida *et al.* (2016: 82) found that the only adult male specimen (SMF 85744 from Malawi) showed some interesting morphological features (i.e. a ruff of enlarged, clustered glandular hairs) that link *Plerotes* to the myonycterines (*Megaloglossus* and *Myonycteris*).

COMMON NAMES:
Czech: kaloň pyložravý. English: Anchieta's Plerote Fruit-bat, Benguela Fruit-bat, D'Anchieta's Fruit Bat, Anchieta's Fruit Bat. French: Plérote d'Anchieta, Chauve-souris frugivore d'Anchieta. German: Anchietas Breitgesicht-Flughund. Kiluba (DRC): Mulima.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Mickleburgh *et al.*, 2008br; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008br; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004ch; IUCN, 2004). 2000 - DD (Hilton-Taylor, 2000). 1996 - VU (Baillie and Groombridge, 1996). 1994 - Rare (Groombridge, 1994).

MAJOR THREATS:
Within the Angolan and Malawian parts of the species range it may be threatened by habitat destruction resulting from agricultural development, collection of timber and firewood, and setting of fires by poachers (Mickleburgh *et al.*, 2008br; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008br) [in IUCN (2009)] report that although there appear to be no direct conservation measures in place, it has been recorded from a number of protected areas in Malawi and the Democratic Republic of the Congo. Further field surveys are needed to better determine the current status of this poorly known species.

GENERAL DISTRIBUTION:
Plerotes anchietae is largely known from scattered records in Central Africa. Most reports of this species are from the 1950's in Angola, the Democratic Republic of the Congo, Malawi and Zambia. A single specimen was collected in Malawi in 1997. It has been recorded between 1,000 and 2,000 m asl (Bergmans, 1989).

Native: Angola (Bergmans, 1989; Monadjem *et al.*, 2010d: 555; Taylor *et al.*, 2018b: 60); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Bergmans, 1989; Monadjem *et al.*, 2010d: 555); Malawi (Kock *et al.*, 1998a; Monadjem *et al.*, 2010d: 555); Zambia (Bergmans, 1989; Monadjem *et al.*, 2010d: 555).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Harrison (1960c: 68) described the colour of the hairs on the dorsal surface of a subadult male from Zambia as "terminally a uniform light brown (nearest to Suntan Merida+Mayfair Tan-, Plates 13 and 7B, Maerz and Paul, 1950), becoming a little more rufous on the tibiae. The bases of the hairs are paler, buffy coloured". On the ventral surface, the pelage is "pale greyish buff, without any indication of a darker neck band".

DENTAL FORMULA:
The dental formula is i $^{1}/_{2}$ c $^{1}/_{1}$ p $^{3}/_{3}$ m $^{1}/_{3}$. Harrison (1960c: 69) also indicates that almost all known specimens of the genus *Plerotes* have some difference in the dental formula.

FUNCTIONAL MORPHOLOGY:
Harrison (1960c: 69) indicates that the tongue is 20 mm long (sub-equal to the mandibular length) and 9.5 mm wide at the base of the epiglottis. The dorsal tip and anterior quarter is covered with filiform papillae.

POPULATION:
Structure and Density - It appears to be a rare, or at least a rarely recorded, species (Mickleburgh *et al.*, 2008br; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008br; IUCN, 2009).

VIRUSES:
Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that single specimen they examined from Gabon did not test positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

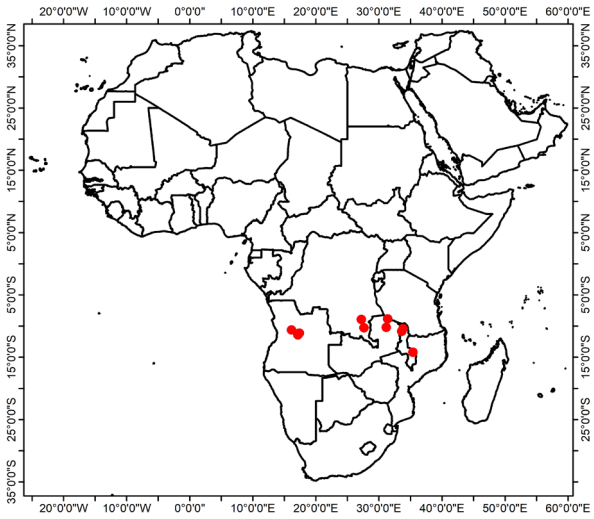


Figure 42. Distribution of *Plerotes anchietae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Angola, Congo (Democratic Republic of the), Malawi, Zambia.

Genus ***Rousettus*** Gray, 1821

*1821. *Rousettus* Gray, London Med. Repos., 15: 299. Publication date: 1 April 1921. - Comments: Type species: *Pteropus Egyptiacus* E. Geoffroy Saint-Hilaire, 1810. Not *Pteropus aegyptiacus* Geoffroy, 1818 (see Corbet and Hill, 1992: 67). - Etymology: From the French "*rousette*" for the rosette of glandular hairs on the neck of males (see Flannery, 1995a: 304) or from the French "*rousse*" for reddish or reddish brown, referring to the fur colour of the earliest specimens taken in Egypt (see Kwiecinski and Griffiths, 1999: 7). (Current Combination)

1829. *Cercopteropus* Burnett, Quart. J. Sci., Lit. and Art, pt. 1, art. 5, p. 269. Publication date: April - June 1829. - Comments: Type species: *Pteropus aegyptiacus* E. Geoffroy Saint-Hilaire, 1818 (Designated by Andersen, 1912b: 23). Burnett (1829: 269) did mention both *Ægyptiacus* and *Amplexicaud* [for *amplexicaudata*] as being included in his genus. - Etymology: From the Greek "*κέρκος*", meaning tail and "*Pteropus*" (see Palmer, 1904: 172).

1843. *Xantharpyia* Gray, Catalogue of the species of mammals of the British Museum, xix, 37. Publication date: 13 May 1843. - Comments: Type species: *Pteropus amplexicaudatus* E. Geoffroy Saint-Hilaire, 1810. - Etymology: From the Greek "*ξανθός*", meaning yellow and *Harpyia* from the characteristic colour (see Palmer, 1904: 710).

1844. *Eleutherura* Gray, Mammalia, in Voyage "Sulphur", Zool., 1: 29. - Comments: Type species: *Pteropus leachii* A. Smith, 1829 (=*Pteropus aegyptiacus* E. Geoffroy Saint-Hilaire, 1810). Andersen (1912b: 24) mentions *Pteropus hottentotus* Temminck, 1832 as type species, which is a synonym of *P. leachi* A. Smith 1829. Preoccupied by *Eleutherura* Gray, 1843; nom. nud. (Andersen, 1912b: 16; Meester *et al.*, 1986: 28; Pavlinov *et al.*, 1995: 61). Allen (1939a: 61) indicates that Gray (1843 - List. Spec. Mamm. Brit. Mus., p. xix) is a nomen nudum, but that it is redescribed in the 1844 publication. - Etymology: From the Greek "*ἐλεύθερος*", meaning free and "*οὐρά*", meaning tail, referring to having the tail free from the interfemoral membrane (see Palmer, 1904: 255).

1852. *Cynonycteris* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 25 [Goto Description]. - Comments: Type species: *Pteropus collaris* Liechtenstein [not Illiger] (=*Pteropus aegyptiacus* E. Geoffroy Saint-Hilaire, 1810). - Etymology: From the Greek "*κύων*" or "*κυνός*", meaning dog and "*νυκτερις*", meaning bat, probably referring to the dog-like head (see Palmer, 1904: 212).

1870. *Senonycteris* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 115. - Comments: Type species: *Pteropus seminudus* Kelaart, 1850 (=*Pteropus lechenaulti* Desmarest, 1820). Described as subgenus of *Xantharpyia*.

1899. *Mynonycteris* Matschie, Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde, p. 63.

1906. *Roussettus (Xantharpyia):* Johnston, Liberia, Volume II: 690. (Name Combination, Lapsus)
1906. *Roussettus:* Johnston, Liberia, Volume II: 688. (Lapsus)
1992. *Rosetus:* Agrawal, Das, Chakraborty, Ghose, Mandal, Chakrabo, Zoological Survey of India, State Fauna Series 3, 49. - Comments: Lapsus. See Bergmans (1994: 82). (Lapsus)
1999. *Rosettus:* Buffenstein, Maloney and Bronner, S. Afr. J. Zool., 34 (1): 16. (Lapsus)
2007. *Rousetus:* Nel and Markotter, Crit. Rev. Microbiol., 33 (4): 308. (Lapsus)
2015. *Rousettes:* Lee, Kulcsar, Elliott, Khiabanian, Nagle, Jones, Amman, Sanchez-Lockhart, Towner, Palacios and Rabadan, BMC Genomics, 16 (1033): 1. Publication date: 7 December 2015. (Lapsus)

TAXONOMY:
Meester *et al.* (1986) mention that the inclusion of *Lissonycteris* as a subgenus of *Rousettus* is open to question. Lawrence and Novick (1963) maintain that *Lissonycteris* should be regarded as a valid genus, more closely related to *Myonycteris* Matschie, 1899, than to *Rousettus*. In this, they are followed by Rosevear (1965), Ansell (1978), Corbet and Hill (1980), Almeida *et al.* (2011a), and Patterson and Webala (2012). Koopman (1975), on the other hand, concludes that although there is a close relationship between *Lissonycteris* and *Myonycteris*, the relationship of *Lissonycteris* with *Rousettus* is sufficiently close for it to be retained as subgenus. Koopman (1982) again treats *Lissonycteris* as a subgenus, as is done also by Hayman and Hill (1971). Bronner *et al.* (2003), following Lawrence and Novick (1963), separated *Lissonycteris* from *Rousettus* because of ethological differences concerning the use of the limbs, and the absence of echolocation in *Lissonycteris*. Juste B. *et al.* (1997) presented allozyme evidence corroborating earlier chromosome studies (Haiduk *et al.*, 1980, 1981), DNA-hybridisation results (Kirsch *et al.*, 1995) and cladistic analysis (Springer *et al.*, 1995) that support the recognition of *Lissonycteris* as a distinct genus. Three subgenera are often recognized (*Rousettus*, *Boneia*, and *Stenonycteris*), although Bergmans (1994), rejected the use of subgenera for the African species (Simmons, 2005: 347).

A key to the species is provided by Kwiecinski and Griffiths (1999: 1, Mammalian Species, 611).

Included in the Rousettini tribe by Almeida *et al.* (2016: 83).

Known species of *Rousettus*: ***aegyptiacus*** (E.Geoffroy, 1810); *amplexicaudatus* (E. Geoffroy, 1810) – Cambodia, Thailand, Burma, and Laos, Peninsular Malaysia through Indonesia, Java, and Bali, Philippines; New Guinea, Bismarck Archipelago, Solomon Islands (Simmons, 2005: 347); *celebensis* K. Andersen, 1907- Sulawesi, Mangole, Sanana, Sangihe Islands (Indonesia) (Simmons, 2005: 347); *leschenaulti* (Desmarest, 1820) – Sri Lanka, Pakistan to Vietnam and southern China, Peninsular Malaysia, Sumatra, Java, Bali, and Mentawai Islands (Indonesia) (Simmons, 2005: 348); *linduensis* Maryanto and Yani, 2003 – central Sulawesi (Simmons, 2005: 348); ***madagascariensis*** G. Grandidier, 1928; ***obliviosus*** Kock, 1978; *shortridgei* Thomas and Wroughton, 1909 – Indonesia (Bali, Java, Lombok); *spinalatus* Bergmans and Hill, 1980 – Sumatra, Borneo (Simmons, 2005: 348); *tangkokoensis* Lengkong, Arisoesilaningsih, Hakim and Sudarto, 2016 – Indonesia (Sulawesi).

COMMON NAMES:
Czech: egyptští kaloni, noční kaloni, psi noční. English: Rousettes, Rousette Fruit-bats. French: Roussettes. German: Höhlenflughunde. Italian: Rossétti.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Horácek *et al.* (2013b: 1) report on two tooth fragments from the Middle Pleistocene Israeli site Qesem Cave, which they tentatively attribute to cf. *Rousettus* sp. If this identification is confirmed, they suggest that the current Mediterranean population of *R. aegyptiacus* could be seen as a paleochoric element. However, the teeth they report on are larger than similar teeth in extant *R. aegyptiacus* specimens, so they might be from a different species or there might have been phenotypic rearrangements such as increased body size (as they suggest on page 13).

BIOGEOGRAPHY:
Several hypotheses have been proposed about the origin of the genus *Rousettus* on the phylogenetic inference, and centers of diversity pinpoint a southeastern Asian origin (Juste B. *et al.*, 1999). Three separate routes have been suggested for western expansion of pteropodids into Africa, via a middle Asian-European-Gibraltar route, a middle-Asian, Middle Eastern route, and an Indian subcontinent-western Indian Ocean, east African route (Juste B. *et al.*, 1999). Giannini and Simmons (2003, 2005) support the Middle Eastern route with the Afrotropical clade

composed of *R. aegyptiacus* and *R. madagascariensis* being the sister group to *R. leschenaulti*.

Almeida *et al.* (2016: 82) indicate that *Rousettus* expanded from Asia into Africa in the late Pliocene or early Pleistocene, where the continental *R. aegyptiacus* already split off in the early Pleistocene, slightly later followed by a split of the two island forms.

PARASITES:
ACARI

Trombiculidae: Stekolnikov (2018a: 50) reported *Rousettus* sp. to be the type host of *Whartonia oweni* Vercammen-Grandjean and Brennan, 1957.

DIPTERA
Nycteribiidae: *Tripselia blainvillii* (Leach 1817) single record (Haeselbarth *et al.*, 1966: 113). Morse *et al.* (2013: Suppl. 1) refer to *Dipseliopoda biannulata* collected from a non-specified Kenyan *Rousettus* specimen. This bat fly was itself infected by an *Arsenophonus* sp. bacteria (Szentiványi *et al.*, 2019: Suppl.).

Rousettus aegyptiacus (E. Geoffroy St.-Hilaire, 1810)

*1810. *Pteropus Egyptiacus* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 15: 96. Type locality: Egypt: Giza province: Giza: Great Pyramid [30 01 N 31 13 E]. Holotype: MNHN A.70: ad ♀. Presented/Donated by: ?: Collector Unknown. Allotype: MNHN A.69: ♂, mounted skin (skull not removed). Collected by: Etienne Geoffroy-Saint-Hilaire. Rode (1941: 234) also mentions numbers 762A and 167a. Andersen (1912b: 32) mentions that there were several specimens, but only one was still present: an adult male (A.69). - Comments: Type locality originally "la basse Egypte - le plafond d'une des chambres de la grande Pyramide". See Kwiecinski and Griffiths (1999: 1). Type MNHN A.70 (ad ♀, alcoholic and skull: Qumsiyeh, 1985: 13). - Etymology: The name is derived from the fact that the species was originally described from a specimen from the Great Pyramid of Giza in Egypt (see Smithers, 1983: 63).

1818. *Pteropus aegyptiacus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 134, pl. 3, No 2. Holotype: MNHN A.70: ad ♀, skull and alcoholic. Collected by: Etienne Geoffroy-Saint-Hilaire. See Qumsiyeh (1985: 13). Number 167 in Rode (1941). - Comments: Emendation of *egyptiacus*. Unjustified according to Corbet and Hill (1992: 67), justified according to Kock (2001c). - Etymology: From the scientific Latin masculine adjective *aegyptiàcus*, meaning "Egyptian", as the species was described from an Egyptian specimen (see Lanza *et al.*, 2015: 69). (Emendation)

1823. *Pteropus collaris* Lichtenstein, Verzeichniss der Doubletten des Zool. Mus. K. Univ. Berlin, 3, 5. Type locality: South Africa: "Terra Caffrorum". - Comments: Preoccupied by *Pteropus collaris* Illiger, 1815; see Kwiecinski and Griffiths (1999: 1).

1825. *Pteropus geoffroyi* Temminck, Monogr. Mamm, 1 (5): 197, pl. 15, f. 14, 15. Type locality: Senegal: Senegal and north coast of Africa. - Comments: Meester *et al.* (1986: 29) mention that the type locality is restricted to Giza, Egypt by Koopman (1975: 361). Andersen (1912b: 32) mentions it as a replacement name for *R. aegyptiacus*, since "vu que l'espèce se trouve au Sénégal, et probablement sur toute la côte septentrionale d'Afrique," [= "in view of the fact that the species occurs in Senegal and probably over the the entire northern coast of Africa."].

1827. *Pteropus amphiplexicaudatus:* Temminck, Monogr. Mamm. Type locality: South Africa: Cape. - Comments: Probably a lapsus which should be assigned to Roberts (1951: 55) since that author mentions it as "not of Geoffroy", which would probably refer to *amplexicaudatus*. (Lapsus)

1829. *Pteropus Leachii* A. Smith, Zool. Journ., 4 (16): 433. Publication date: May 1829. Type locality: South Africa: Gardens about Cape Town [ca. 33 56 S 18 28 E] [Goto Description]. Paratype: SMF 891: juv ♂, skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Cotype: BMNH 1875.11.3.2: ad ♀, alcoholic (skull not removed). Collected by: Sir Andrew Smith. Exchanged by G.E. Dobson (see Andersen, 1912b: 28). - Etymology: In honour of the celebrated naturalist, Dr. Leach, F.R.S. (see Smith, 1829: 433).

1832. *Pteropus hottentottus*Temminck, in: Smuts, Enumer. Mamm. Capensium, 3. Type locality: South Africa: Cape province: originally ""circa urbem apensem" see Andersen (1912b: 28), restricted to Capt Town.: Cape Town [33 56 S 18 28 E] [Goto Description]. - Comments: Mentioned as "*hottentotus*" by), Simmons (2005), but as *hottentottus* by Allen (1939a: 62), Roberts (1951: 55), Meester *et al.* (1986: 29), Kwiecinski and Griffiths (1999). Andersen

(1912b: 29) mentions that the type is in the RMNH, but also indicates that there are "authentic specimens" in the BMNH: 1837.4.28.33-34, 38, 40, 67 (4 ad + 1 imm; sks and skulls), from "near Cape Town" (J. Smuts), and purchased from the Leyden Museum.

1862. *Xantharpyia ægyptiaca:* Gerrard, Catalogue of the bones of Mammalia in the collection of the British Museum, 57. Type locality: Egypt. (Name Combination)

1862. *Xantharpyia leachii:* Gerrard, Catalogue of the bones of Mammalia in the collection of the British Museum, 57.

1870. *Eleutherura unicolor* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 117. Type locality: Gabon: "Gabon" [Goto Description]. Holotype: BMNH 1862.8.26.1: ad ♂, skin and skull. Purchased Verreaux: see Andersen (1912b: 32).

1906. *R[oussettus (Xantharpyia)] collaris:* Johnston, Liberia, Volume II: 690. (Lapsus)

1908. *Rousettus sjöstedti* Lönnberg, Wiss. Ergebn. Swedischen Zool. Exp. u. Leitung Sjöstedt, Kilimandjaro-Meru, 1 (2): 7. Type locality: Tanzania: near Tanga: Mkulumusi caves. [Goto Description]. Holotype: NRM [unknown]: ad ♀, alcoholic (skull not removed). Collected by: Bror Yngve Sjöstedt; collection date: 4 May 1905. Kilimandjaro-Meru Expedition. See Lönnberg (1908b: 7) and Andersen (1912b: 810).

1911. *Cynonycteris collaris:* Mitchell, Proc. zool. Soc. Lond., 1911, II: 444. Publication date: 6 July 1911.

1958. *Rousettus aegypticus:* Griffin, Novick and Kornfield, Biol. Bull., 115 (1): 107. Publication date: August 1958. (Lapsus)

1960. *Rousettus aegyptiacus occidentalis* Eisentraut, Bonn. zool. Beitr., 10: 231, figs 8, 13 (for 1959). Publication date: 10 January 1960. Type locality: Cameroon: N side of Mount Cameroon: Mueli [04 23 N 09 07 E, ca. 600 m]. Holotype: ZFMK 1959.0450: ad ♂, skin and skull. Collected by: Prof. Dr. Martin Eisentraut; collection date: 20 February 1958; original number: 648. Paratype: ZFMK 1961.0575: Collected by: Prof. Dr. Martin Eisentraut; collection date: January 1958. Lager IV [= Camp IV], near lake Koto Barombi, 120 m, N side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0576: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0577: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0578: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0579: Collected by: Prof. Dr. Martin Eisentraut; collection date: January 1958. Lager IV [= Camp IV], near lake Koto Barombi, 120 m, N side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0580: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0581: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0582: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0583: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0584: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0585: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0586: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0587: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0588: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0589: Collected by: Prof. Dr. Martin

Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0590: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0591: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0592: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0593: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0594: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0595: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0596: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0597: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0598: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0599: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0600: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0601: Collected by: Prof. Dr. Martin Eisentraut; collection date: January 1958. Lager IV [= Camp IV], near lake Koto Barombi, 120 m, N side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1961.0602: Collected by: Prof. Dr. Martin Eisentraut; collection date: February 1958. Lager V [= Camp V], above Mueli, 600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0208a: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0208b: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0208c: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0208d: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0208e: Collected by: Prof. Dr. Martin Eisentraut; collection date: March 1958. Lager VI [= Camp VI], Isobi, 30 m, W side Mount Cameroon (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0209a: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0209b: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0209c: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0209d: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0209e: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10). Paratype: ZFMK 1963.0209f: Collected by: Prof. Dr. Martin Eisentraut; collection date: November 1957. Lager I [= Camp I], above Buea, 1,600 m (see Hutterer, 1984: 29; Hutterer and Peters, 2010: 10).

1974. *Rousettus aegyptiacus unicolor:* Bergmans, Bellier and Vissault. (Name Combination)
1993. *Rousettus aegyptiacus thomensis* Feiler, Haft and Widmann, Faun. Abh. Mus. Tierk. Dresden, 19 (4): 22. Publication date: 1 July 1993. Type locality: São Tomé and Principé: São Tomé Island: Generosa [ca. 800 m] [Goto Description]. Holotype: SMTD 16753: ad ♂, skin and skull. Collection date: 26 March 1991. See Feiler *et al.* (1993: 22 - 23). Paratype: SMTD ad ♂, skin and skull. See: 22 - 23). Paratype: SMTD ad ♀, skin and skull. See: 22 - 23).
1993. *Rousettus aegyptiacus tomensis* Juste and Ibáñez, Zool. J. Linn. Soc., 107: 124. Type locality: São Tomé and Principé: São Tomé Island: Bindá (Santa Catarina) [00 16 N 06 29 E].
1993. *Roussetus aegyptiacus princeps* Juste and Ibáñez, Zool. J. Linn. Soc., 107: 123. Type locality: São Tomé and Principé: Principé Island: 2 km S of Santo Antonio de Principé: Roça Bela Vista [ca. 01 37 N 07 27 E].
2006. *Rousettus egyptiacus:* Nogales, Rodríguez-Luengo and Marrero, Mammal Rev., 36 (1): 49. Publication date: January 2006. (Lapsus)
2008. *Rousettus aegyptiacu:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 249. (Lapsus)
2008. *Rousettus occidentalis:* Benda, Vespertilio, 12: 109. (Name Combination)
2011. *Rousettus aegyptiacusi:* Hickey, Jüllig, Aitken, Loomes, Hauber, and Phillips, Ageing Res. Revs, 11 (2): 249 (for 2012). Publication date: 13 December 2011. (Lapsus)
2012. *R[ousettus] a[egyptiacus] egyptiacus:* Hulva, Marešová, Dundarova, Bilgin, Benda, Bartonicka and Horácek, Mol. Ecol., 21 (24): 6105. Publication date: 24 October 2012. (Lapsus)
2015. *Rousettus aegypticus leachii:* Kaipf, Rudolphi and Meinig, NABU - Biodiversity Assessment in Kafa, Ethiopia, 7. (Lapsus)
2015. *Rousettus aegypticus occidentalis:* Sylla, Pourrut, Diatta, Diop, Ndiaye and Gonzalez, Afr. J. Microbio. Res., 9 (22): 1468. Publication date: 3 June 2015. (Lapsus)
2019. *Rousettus aegypti:* Siya, Bazeyo, Tuhebwe, Tumwine, Ezama, Manirakiza, Kugonza and Rwego, BMC Public Health, 19 (136): 1. Publication date: 31 January 2019. (Lapsus)
2019. *Rousettus aegyptiacusi:* Malmlov, Bantle, Aboellail, Wagner, Campbell, Eckley, Chotiwan, Gullberg, Perera, Tjalkens and Schountz, PLoS Negl.Trop.Dis., 13 (2) e0007071: 3. Publication date: 4 February 2019. (Lapsus)
? *Cynonycteris ægyptiaca:* - Comments: see: Günther (1880: 741) as synonym of *Cynonycteris collaris*. (Name Combination)
? *Pteropus ægyptiacus* - Comments: Günther (1880: 741) refers to a list by Kotschy and published in Unger and Kotschy's 'Die Insel Cypern'. (Alternate Spelling)
? *Rousettus (Rousettus) aegyptiacus leachii:* (Name Combination)
? *Rousettus (Rousettus) aegyptiacus:* (Name Combination)
? *Rousettus aegyptiacus aegyptiacus:* (Name Combination)
? *Rousettus aegyptiacus arabicus:* (Name Combination)
? *Rousettus aegyptiacus leachi:* (Name Combination)
? *Rousettus aegyptiacus leachii:* (Name Combination)
? *Rousettus aegyptiacus leacii:* (Lapsus)
? *Rousettus aegyptiacus:* (Name Combination, Current Combination)
? *Rousettus arabicus:*
? *Rousettus collaris:* - Comments: .
? *Rousettus leachi:*

TAXONOMY:
Andersen (1912b) recorded *R. aegyptiacus*, *R. arabicus* and *R. leachii* as species in the genus *Rousettus*. Miller (1912) and Ellerman and Morrison-Scott (1951) recognized *R. arabicus* as a valid species. Harrison (1964a) stated that *R. aegyptiacus* is represented by the subspecies *R. a. aegyptiacus* and *R. a. arabicus*. Bergmans (1994) recognised *R. a. aegyptiacus*, *R. a. leachii*, *R. a. unicolor*, and *R. a. arabicus* as valid subspecies.

Corbet and Hill (1992) corrected Geoffroy Saint-Hilaire's spelling of *Rousettus aegyptiacus* to *R. egyptiacus*, a change endorsed by Koopman (1993a: 152) and Bergmans (1994). Kock (2001c), however, has presented a detailed and convincing case for regarding *egyptiacus* as an incorrect original spelling and treating *aegyptiacus* as the valid name (Bronner *et al.* (2003). Kock (1969a: 16), Qumsiyeh *et al.* (1992: 104) and Horácek *et al.* (2000) state that Geoffroy Saint-Hilaire (1818: 134) already corrected the spelling

to *aegyptiacus*. Allen (1939a: 62) also indicates that it was a misprint in the 1810 publication, which was corrected in the 1818 publication.
Meester *et al.* (1986) state that, while *leachii* is clearly the Southern African subspecies extending well beyond the limits of this subregion, Hayman and Hill (1971) mention that intergradation with *aegyptiacus* may occur in the equatorial zone. Koopman (1975: 361) indicates that in the Sudan there is a hiatus between the ranges of these two sub-species, and he remarks that if they make contact it will be in Ethiopia, north of the equator. See Simmons (2005: 347).

Horácek *et al.* (2010: 175) indicate that the specimens from the Mediterranean area differ with more than 10 % in their mtDNA from the Sub-Saharan populations, which might suggest that these specimens represent a different species. Benda *et al.* (2012b: 1230) showed that, although two size morphotypes were found, the Palaearctic populations of *R. aegyptiacus* represent only one form, which is uniform in genetic traits (mitochondrial genome [nd1 and cyt *b*]) but plastic in metric traits.

Avery and Avery (2011: 539 - 540) report that a separation between the ancestor of *R. aegyptiacus* and those of genera such as *Myotis* and *Kerivoula* occurred some 64 million years ago. The separation with *Rhinolophus* and *Hipposideros* occurred slightly less than 60 million years ago, and that with *Pteropus* some 22 million years ago.

COMMON NAMES:
Afrikaans: Egiptiese vrugtevlermuis. Albanian: Lakuriq nate egjiptian i frutave. Arabian: Khafash El Fawakeh, Khafash Masri, Khaffash, Wat-Wat. Armenian: Եգիպտական մեծաչղջիկ. Azerbaijani: Misir meyvə yarasası. Basque: Fruitu-saguzar egiptoar. Belarusian: Крылан егіпецкі Bosnian: Egipatski letipas. Breton: Lgodenn-dall rous Egipt. Bulgarian: Египетски плодояден прилеп. Castilian: Murciélago de la fruta egípcio, Ruseta Egipicia. Catalan: Ratpenat egipci. Chewa (Malawi): Karuru. Chinese: 北非果蝠. "Congolese": Kubukubo, Papo. Croatian: Egipatski plodojedi šišmiš. Czech: Kaloň egyptský ý, Upír egypeckýý, Kaloň nilskýý. Danish: Egyptisk flyvehund. Dutch: Nijlrousette, Nijlrousettus. English: Egyptian Fruit Bat, Egyptian Rousette, Egyptian Rousette Bat, West African Rousette, Egyptian Xantharpy. Estonian: Egiptuse öötiibur. Finnish: Ronkko. French: Roussette egyptienne, Roussette d'Égypte. Frisian: Nylrûsette. Galician: Morcego exipcio. Georgian: ეგვიპტური მფრინავი ძაღლი. German: Nilflughund (Ägyptischer Höhlenflughund), Egyptischer fliegender Hund. Greek:Αιγυπτιακή φρουτονυχτερίδα. Hebrew: Atalef Perot. Hungarian: Nílusi repülő kutya. Italian: Rossétto egiziàno, Rossétto del Nìlo, Rossetta. Irish Gaelic: Ialtóg meas Éigipteach. Kinande (DRC): Mulima. Latvian: Eģiptes augļ sikspā rnis. Lithuanian: Egiptinis vaisė dis. Luxembourgish: Nilfluchhond. Macedonian: Египетски овошен лилјак. Maltese: Farfett il-Lejl tal-Frott ta' L-Eġ ittu. Montenegrin: Egipatski letipas. Norwegian: Afrikagrotteflygehund. Polish: Rudawka nilowa. Portuguese: Morcego-frugívoro-egípcio, Morcego frugivoro do Egipto. Rhaeto-Romance: Chaun sgulant da l'Egipta. Romanian: Liliacul fructivor egiptean. Russian: Крылан египетский. Serbian: Обични пећински летипас [= Obič ni peć inski letipas]. Scottish Gaelic: Ialtag meas Èipheiteach. Slovak: Kaloň egyptský. Slovenian: Egipč anski leteč i pes. Swedish: Nilflyghund. Turkish: Mısır Meyve Yarasası. Ukrainian: Крилан єгипетський. Welsh: Ystlum-ffrwythau yr Aifft.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Hildebrand *et al.* (2010: 268) recorded this species from the Kumali site in southern Ethiopia.

Van Neer (1990) reported on the presence of archeozoological material from this species in a number of localities in Central Africa.

CONSERVATION STATUS:
Global - This species is broadly distributed and abundant, and is unlikely to be declining at nearly the rate required to qualify for listing in a threatened category, hence is listed as Least Concern (LC ver 3.1 (2001)) (Benda *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Benda *et al.*, 2008a; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004ct; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Markotter *et al.*, 2016). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
This species faces a number of threats, but none of them are considered a serious threat to the species at the global level. Hunted for food in some cave systems in Africa. Cave disturbance and persecution are also a problem in parts of the range. The species is considered as a pest by fruit farmers and consequently cave roosts have been fumigated and destroyed in Israel, Turkey and Cyprus, resulting in incidental killing of many insectivorous bats of the genera *Rhinolophus* and *Myotis* (Benda *et al.*, 2008a; IUCN, 2009). The

Israeli Nature Conservation Society is trying to prevent this lethal control (D. Kock, *pers. comm.*, in Benda *et al.*, 2008a, in IUCN, 2009), as campaigns during the 1950s led to the unintended death of 90 % of the insectivorous bats that roosted in the same caves (Makin and Mendelssohn, 1985 [in Guyton and Brook, 2014: 77]).

Sherwin *et al.* (2012: 174) identified that *R. aegyptiacus*'s frugivory and long-distance dispersal are major risk factors linked with climatic change.

MacEwan (2016: 3) reports on *R. aegyptiacus* as fatalities of wind turbine blades.

Monadjem *et al.* (2016y: 364) report that the species has disappeared from the Liberian side of Mount Nimba, possibly as a result of hunting.

CONSERVATION ACTIONS:
Benda *et al.* (2008a) [in IUCN (2009)] report on International legal obligations for protection through the Bonn Convention (Eurobats) in areas where this applies. Included in Annex IV of the EU Habitats Directive in areas where this applies. Occurs in a number of protected areas. There is a need to enforce measures to protect this species, especially to prevent the fumigation of caves.

GENERAL DISTRIBUTION:
Rousettus aegyptiacus is patchily distributed across sub-Saharan Africa and North Africa; also ranges outside of Africa through south-west Asia to Iran, Pakistan and India; also on Cyprus.
In the Western Palaearctic it occurs as two forms: *R. a. arabicus* (Iran, southern Arabia, Pakistan), *R. a. aegyptiacus* (rest of range). For more details on the Palaearctic distribution, see Benda *et al.* (2011a). In sub-Saharan Africa occurs as four forms: subspecies *leachi* is found in SW Ethiopia, S Sudan, E and S DR Congo, Uganda, Kenya, Tanzania (including the islands of Pemba and Unguja [see O'Brien (2011: 286]), Zambia, Malawi, Zimbabwe, Mozambique, and the extreme E and south of South Africa, including Swaziland and Lesotho; subspecies *princeps* is endemic to Principe Island in the Gulf of Guinea; subspecies *tomensis* is endemic to São Tomé; and subspecies *unicolor* is found from Senegal and the Gambia east to Liberia, Côte d'Ivoire, Ghana, Togo, south to northern central Nigeria and W Cameroon and Bioko Island, then south from Gabon and Congo to western DRC and W Angola. Elevational range: from sea level to 4,000 m asl.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 692,896 km^2. In the RSA, its distribution is best predicted by geology (Babiker Salata, 2012: 50).

Nogales *et al.* (2006: 52) report on a population of *R. aegyptiacus*, which escaped in 2000 from two zoos on Tenerife, where they were kept from around 1992. This population was eradicated in 2009 (see Simons *et al.*, 2014: 2091).

Native: Angola (Crawford-Cabral, 1989; Bergmans, 1994; Monadjem *et al.*, 2010d: 555); Burkina Faso (Kangoyé *et al.*, 2012: 6024; 2015a: 607); Burundi; Cameroon; Central African Republic (Morvan *et al.*, 1999: 1195); Congo; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 555); Côte d'Ivoire; Cyprus; Egypt (Benda *et al.*, 2008f: 1); Equatorial Guinea (Fahr and Ebigbo, 2003: 128); Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 135); Gabon; Gambia; Ghana; Greece (Strachinis *et al.*, 2018: 611); Guinea (Denys *et al.*, 2013: 281; Decher *et al.*, 2016: 263); Guinea-Bissau (Rainho and Ranco, 2001: 33); India (Rainho *et al.*, 2010a), Iran, Islamic Republic of; Israel; Jordan; Kenya; Lebanon; Lesotho; Liberia (Monadjem and Fahr, 2007: 50); Libyan Arab Jamahiriya; Macaronesian islands (Tenerife island (Fajardo, 2002; Rodriguez-Luengo and Garacia Casanova, 2002; Trujillo, 2003; Nogales *et al.*, 2006; Masseti, 2010)); Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988: 28; Bergmans, 1994; Monadjem *et al.*, 2010d: 555); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 555; Monadjem *et al.*, 2010c: 377); Nigeria (Capo-Chichi *et al.*, 2004: 161); Oman; Pakistan; Palestinian Territory, Occupied; Rwanda; São Tomé and Principé (Juste and Ibáñez, 1993b: 906; Rainho *et al.*, 2010a: 19 as *R. a. tomensis*); Saudi Arabia; Senegal; Sierra Leone; South Africa (Monadjem *et al.*, 2010d: 555); Sudan; Syrian Arab Republic; Tanzania (Stanley and Goodman, 2011: 40); Togo; Turkey; Uganda (Kityo and Kerbis, 1996: 59); United Arab Emirates (Anonymus, 2008: 38); Yemen (Benda *et al.*, 2011b: 26) ; Zambia (Ansell, 1969; Bergmans, 1994; Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 555); Zimbabwe (Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 555).

BIOGEOGRAPHY:
Horácek *et al.* (2013a: 71) suggest a few hypotheses about the presence of *R. aegyptiacus* in the eastern Mediterranean. These populations might be the result of immigration from sub-Saharan Africa or southern Arabia, although they also indicate that the Mediterranean form might have been the source population for the spread of *R. aegyptiacus* towards Africa.

Hulva *et al.* (2013: 74) indicate that the colonisation of northeastern Africa and the Middle East was connected with the spread of agricultural plants, and might therefore have an anthropogenic component.

DETAILED MORPHOLOGY:
Baculum - See Albayrak *et al.* (2008) for samples from Turkey.

Brain - Chawana *et al.* (2013: 160) reported the average brain mass for two specimens to be 2.01 g. Maseko *et al.* (2007) used immunohistochemical techniques to describe the nuclear parcellation and neuronal morphology of the cholinergic, catecholaminergic and serotonergic systems within the brain of three adult female *R. aegyptiacus*, captured from a cave adjacent to Legalametse Nature Reserve, Limpopo Province, South Africa. Naumann *et al.* (2015) investigated the medial entorhinal cortex architecture in layer 2 of the bat's brain.

The cytoarchitecture of *R. aegyptiacus*'s brain was investigated by Rodenas-Cuadrado *et al.* (2018: 1237) to determine the expression patterns of *FoxP2, FoxP1*, and *Cntnap2*, which are implicated in human speech and language phenotypes.

Schönenberger and Lane (1971: 653) studied the peripherical nervous system in the wings of *R. aegyptiacus*. The nerve bundle consists of a number of fasciles and each of these contains both myelinated and non-myelinated fibres. They also found that some of these nerves react positively to an histochimical test for catecholamine. The accompanying veins and arteries were studied by Lane *et al.* (1971).

Tongue - The arrangement of mechanical filiform papillae and gustatory papillae is regarded as being useful for the efficient uptake of semiliquid food and also an adaptation to a fruit diet (Jackowiak *et al.*, 2009). Abumandour and El-Bakary (2013: 230) report four types of lingual papillae: two mechanical (filiform and conical)l and two gustatory (fungiform and circumvallate) in which the shape, size, number, distribution, nomenclature and orientation of these lingual papillae are region specific according and in relation to feeding habits and food types. Abumandour (2014: 1407) distinguishes four types of lingual papillae, of which the filiform papillae can be subdivided into six subtypes: three on the anterior part (small, conical and giant), two on the middle part (cornflower and leaf-like papillae), and rosette shape filiform papillae on the posterior part.

Stomach - The histomorphological characters of the stomach were studied by Abumandour and Pérez (2017), who concluded that this had special characters different to other mammals. The C-shaped stomach is divided into three parts: an elongated fundic cecal region with a blunt end, a long and narrow tubular pyloric part, and a small cardiac vestibular part. These characteristics of frugivorous species will help in their adaptations to accumulate large quantities of bulky food material.

Eye - Bojarski and Bernard (1988: 155) found that the retina shows a marked folding due to papillae projecting inwards from the inner choroid layer. These papillae are directed towards the nodal point of the dioptric apparatus, which makes that light coming in from an angle onto the papillae produces no shadow on the retina, which would otherwise result in the formation of an incomplete image. The eye of *R. aegyptiacus* possesses a tapetum lucidum, which increases the visual sensitivity by reflecting more light onto the retina and causes a faint red eyeshine observed while collecting the specimens.

The eyes of this bat contain an average of 160,000 retinal ganglion cells (Coimbra *et al.*, 2016: 191). These authors also calculated the minimum angle of resolution as about 0.167° (ca. 5-6 mm at 1 m distance). Surprisingly, the eye of *R. aegyptiacus* contained a horizontal streak, which is generally found in species which roost in open environments (e.g. *E. helvum, E. franqueti* or *E. wahlbergi*. The horizontal streak of high retinal ganglion cell density in megachiropterans may afford increased resolution across the horizon, potentially assisting with predator surveillance (Coimbra *et al.*, 2016: 195).

Skull - Curtis and Simmons (2018: 1390) described the extensive calcification of the external rostral cartilages surrounding the dorsolateral sides of the nostrils. These elements do not seem to be composed of bone as no porosity nor trabeculae were found.

Michelmore *et al.* (1998: 319) and Meng *et al.* (2016: 1) reported that the endocrine component of the pancreas occupied 9.1 % of the total volume, which is at least nine times higher than in humans. The former authors (p. 324) also indicated that the endocrine structure of the pancreas is more similar to that of snakes than that of other mammals.

FUNCTIONAL MORPHOLOGY:
Holland and Walters (2005: 83) report on the movements of the pinnae in free flight and demonstrated that the ears have a greater sensitivity to click stimuli in front of the animal when directed forwards than when directed back and to the side. They also indicated (p. 87) that

echolocation signals are significantly more likely to be emitted during the forward sweep of the ears.

Lancaster *et al.* (1997: 110) studied the wing temperature during flight and found that, on average, the wing surface temperatures were about 15 °C below the body temperature, and only some 1.8 (± 0.5) °C above the ambient temperature. Barclay *et al.* (2017: 572) found that the bat's body temperature exhibited a circadian cycle, with an average temperature of 37.7 °C when returning from foraging and decreasing to 35.5 °C by mid-day. Just before leaving for foraging, the temperature was on average 37 °C. Korine and Arad (1993: 61) indicated that the thermoneutral zone ranged between 31 and 36 °C, and that the bat's oxygen consumption in this range averaged 0.95 ± 0.15 ml g^{-1} h^{-1}.

In their study on the kinematics of the chiropteran shoulder girdle in flight, Panyutina *et al.* (2013: 393) found that the scapula and clavicle are making a very minor contribution to the wing movement as compared to the input of humerus movements relative to scapula in the shoulder joint. The shoulder girdle moves relative to thorax as a crank mechanism, where the clavicle plays the role of crank, and the scapula the role of connecting rod.

Amador *et al.* (2015: 447) refer to Norberg (1972), who provided a detailed description of the left wrist of *R. aegyptiacus*. From this (and their own study of the handwing of a number of yangochiropteran bats), they concluded that the "dactylopatagium brevis" (the small piece of wing between the thumb and the second digit) functionally belongs to the propatagium (the piece of wing in front of the arm, between the thumb and the body).

Greville *et al.* (2018: 974) studied the flight membrane healing in *R. aegyptiacus* and found that wounds in the plagiopatagium took about 50 % longer to heal than wounds in the chiropatagium.

The interaction between vision and echolocation was investigated by Danilovich and Yovel (2019), who found that the bats learn the 3D shape of objects through vision and that they can classify objects using echolocation. During navigation, both senses are used: vision to decide where to fly and echolocation when approaching an obstacle.

SEXUAL DIMORPHISM:
See Albayrak *et al.* (2008) for samples from Turkey.

In South Africa, Jacobsen and Du Plessis (1976: 272) found that females were on average 18 g lighter than males during winter and spring. Females had a slightly larger average forearm length (92.3 versus 89 mm).

ECHOLOCATION:
Griffin *et al.* (1958: 112) performed a number of experiments in total darkness where *R. eagyptiacus* bats were able to avoid vertically placed metallic wires of 3 mm diameter in 85 % of the time. For 1.07 mm wires, the succes percentage was reduced to 68 %, and for 0.46 mm wires it dropped to 45 %, which was still better than chance.

Rainho *et al.* (2010a: 21) report the calls for 8 individuals from Saõ Tomé.

Waters and Vollrath (2003: 209) found that the sonar clicks have a duration of about 250 micoseconds, with most of its energy occurring during the first 100 microseconds. With these clicks, the bats can detect and avoid wires of at least 6 mm in diameter.

Yovel *et al.* (2011b: 515, 522) indicate that the sonar clicks produced by *Rousettus* species do not have a long duration as was generally believed, but are actually extremely short: 50 - 100 microseconds. The peak energy of the click is at 30 kHz, and the bandwidth is about 57 kHz. These signals could be, in some parameters, as good or even better than the signals used by *Eptesicus fuscus* (see Geva *et al.*, 2010: 147). Davies *et al.* (2013b: Table S8) report a peak energy frequency of 35.03 kHz and a range between 12 and 70 kHz.

Benda *et al.* (2012a: 182) report the following data for Iranian specimens: Start frequency: 29.7 ± 3.5 (25.7 - 31.8) kHz, end frequency: 23.4 ± 4.0 (19.1 - 26.9) kHz, FMAXE: 30.7 ± 3.9 (23.3 - 35.0) kHz, pulse duration: 1.4 ± 0.2 (1.0 - 1.5) msec, interpulse interval: 29.8 ± 16.5 (7.0 - 66.3) msec.

Yovel *et al.* (2011a: 2) found that the intensity of the click emissions alters when they approach and lock their sonar on a target, and that *R. aegyptiacus* uses an undescribed strategy to change the spatial region ("field-of-view") their sonar covers: They increase the angle between the sonar beam axes of the click-pairs they emit. Lee *et al.* (2017) studied this further and concluded that the observed beam features can be captured by inducing changes to the pattern of phase differences through moving tongue location (see also Kling, 2018).

Danilovich *et al.* (2015: R1124) also found that the click rate increases prior to landing, indicating that they adjust biosonar sampling in a task-dependent manner.

From tests in a laboratory environment, Danilovich *et al.* (2014: S32) found that *R. aegyptiacus* can transfer information acquired using echolocation to the visual modality, suggesting they can create an echo-based representation of the world that is accessible to other sensory modalities.

As to the value of echolocation for fruit-eating bats, Fenton (1994: 27) suggests it permits access to the relative safety of dark, underground roosts, a situation analogous to the nesting situations of the echolocating birds. However, Danilovich *et al.* (2015: R1124) found that *R. aegyptiacus* not only relies on echolocation in dark caves, but also during orientation and foraging in diverse light environments. The click rate and intensity increased at lower light levels, where visual information was limited.

Fenton (2013: 1) indicated that it remains to be determined if the tongue click signals can be used to monitor the activities of this species as these calls are much less conspicuous than the high intensity call used by other bats.

Boonman *et al.* (2014: 2965) mentioned that they recently recorded wing clicks produced by wild *R. aegyptiacus* bats while they were flying in the field.

Burchardt *et al.* (2019: 2) indicate that wingbeat and echolocation calls in *R. aegyptiacus* are tightly coupled
around 5 - 12 Hz (the so-called theta frequencies: brain wave frequencies which are known to play a role in active movement and stimulus intake), suggesting a neuronal correlation.

A large amount of vocalizations was collected by Prat *et al.* (2017) (for samples see: https://doi.org/10.6084/m9.figshare.c.3666502).

MOLECULAR BIOLOGY:
DNA - See Ali (2011).

Teeling *et al.* (2017: 32) mention the estimated genome size for *R. aegyptiacus* to be 2.11 C, and the assembly size 1.91 Gb.

Szczesniak *et al.* (2013) presented the complete sequence of the mitochondrial genome of "*R. leschenaulti*" (16,704 nt, GenBank record KC702803). However, as pointed out by Botero-Castro *et al.* (2014), the sequence actually pertains to *R. aegyptiacus*.

Lee *et al.* (2015: 2) reported on a "de novo transcriptome assemby of *R. aegyptiacus*" and assessed its quality and biological validity.

In their phylogenetic study, Hassanin *et al.* (2016: 524) found that the *Cytb* from individuals collected in the eastern Mediterranean region (Cyprus and Egypt) differed by 13 mutations from populations of sub-Saharan Africa. Additionally, some *Cytb* haplotypes of southeastern Africa were found to be highly divergent from the others, whereas the population from West Africa did not differ significantly from that of Central Africa.

Karyotype - 2*n* = 36, FNa = 66, BA = 32, and a submetacentric X chromosome (Đulic and Mutere, 1973b; 1977; Haiduk *et al.*, 1981: 223 from South Africa; Albayrak *et al.*, 2008 for samples from Turkey). Albayrak *et al.* (2008) reported FN = 70 for a female and Fna = 66 from Turkey. Sayed (2011: 658) reported FN = 68 for Egyptian specimens and indicates the X chromosome is a medium sized submetacentric and the Y is a minute acrocentric one. She also reported that the metacentric autosomal pair 10 has a secondary constriction near its centromere and is of variable size within the same genome. Pairs 7 and 8 also show polymorphism. Pairs 9, 14, and 15 show a G-negative band in their short arm, and pair 10 has a broad G-negative band around its centromere. Pair 17 has complete heterochromatin, and displays polymorphism, with sometimes one autosome being subacrocentric and the other submetacentric.
Denys *et al.* (2013: 281) report the karyotype of four specimens from the Guinean Mount Nimba area as 2*n* = 36, Fna = 66, with 12 metacentric pairs, two subtelocentric pairs and one small acrocentric pair. The Y chromosome is the smallest in the set.

Protein / allozyme - Unknown.

Hoenerhoff and Williams (2004: 592) reported hepatic copper values for 7 individuals, which ranged from 5.42 to 99.20 parts per million on dry weight basis.

Águeda-Pinto *et al.* (2019: 4) studied the *S100A7* (S100 Calcium Binding Protein A7 = psoriasin) gene in a number of bats and found that *R. aegyptiacus* possessed three copies of this gene, which might contribute to the bat's enhanced tolerance for infections.

HABITAT:
Sclater (1868: 404) reported on a "*Cynonycteris collaris*" specimen that was captured at sea off the St. John's River in Natal on 1 March 1868.

HABITS:
Jacobsen and Du Plessis (1976: 271) report that, in South Africa, radio-tracked *R. aegyptiacus* specimens travelled 24 km between their roost and

foraging sites, which took them about 1 hour and 29 minutes at an average speed of 16.2 km/h (see Jacobsen *et al.*, 1986: 207). They also found that these bats foraged on *Ficus* spp. inside the forest canopy and that seeds were dispersed while flying and consuming fruit on perches. The bats left their roosts between 20 and 40 minutes after sunset and started to return at 2 a.m., with a peak around 3.45 a.m. and most were back at 5 a.m.

In Cape Town, Barclay and Jacobs (2011: 468) report that individuals left the roost cave between 21 and 183 minutes after sunset, and that bats left their roosts later when it was raining at their usual emergence time. Furthermore, males left later than females in September - October (during early pregnancy), but not in November - January (during late pregnancy and lactation). The difference in emergence time between females and males in September - October is attributed to the males having to defend their roosting territory (Barclay and Jacobs, 2011: 471), and not to females having to reach fruit resources before males, or to travel to more distant fruit patches, because of the greater energy demands as was also suggested by Korine *et al.* (1994) for *R. aegyptiacus* in Israel. Barclay and Jacobs (2011: 469) also observed that the individuals left their roost in a consistent order. The bats returned to their roost between 217 and 21 minutes before sunrise, without any differences among the sexes. Barclay and Jacobs (2011: 469) furthermore found that native forest was prefered over residential areas (59.1 % versus 40.9 %) to forage in, but there were great individual differences.

Tsoar *et al.* (2010: 300) report that tracked fruit bats flew over relatively long distances (14.6 ± 3.7 km) at a speed of 33.0 ± 5.2 km/hr and at relatively high altitudes (108 ± 52.6 m) to commute between their roosting and feeding sites. Geva-Sagiv *et al.* (2015: 99) indicate that there are five main types of navigational strategies: beaconing, route following (or route guidance), path integration, cognitive map, map and compass. They also suggest that combinaties of these strategies can be used.

In the Dakhla Oasis in Egypt; Lucan *et al.* (2011: 36) reported that some individuals made quite long flights of about 60 km at the beginning of their night activity. They also found that spatial activities (e.g. roost changes and night exploration of foraging grounds) was strongly reduced by the end of winter, when few food resources remained available. Using an automated tracking system, Rerucha *et al.* (2014: 14) found that the feeding time showed a much larger variation in summer than in spring or winter, whereas the search time per night remained more or less stable. The oposite was true for winter, where the total feeding time remained more or less stable, but the total search time showed a large variation.

Jahelková and Vašícková (2010: 182) describe some socal calls and social behaviour (e.g. protection of mother and juvenile by a male during lactation) in a captive population. Prat *et al.* (2016: 1) examined the vocalizations of these bats and found that these contained information about identity of the emitter, the context of the call, the behavioral response to the call, and even the call's addressee. These vocalizations are composed of sequences containing 1 to 20 broad-band multi-harmonic syllables. Almost all of the communication calls were emitted during aggressive pairwise interactions.

Mann *et al.* (2011: 416) indicated that males do not form random associations with nearby conspecifics, but that they establish stable groups, in which some form of dominance hierarchy exists. They also found that *R. aegyptiacus* can make a distinction between familiar and unfamiliar conspecifics, most likely by means of olfactory and/or visual cues (Mann *et al.*, 2011: 411).

ROOST:
Type - Caves (Albayrak *et al.*, 2008); abandoned factories (Albayrak *et al.*, 2008).
Microclimate - Unknown.
Orozco (2012: 379), referring to Braack (1989), indicates that no scarab beetles were found in over 40 South African caves inhabited by *R. aegyptiacus*. Braack (1989: 77), however, does mention the presence of reduviid bugs (*Platymeris guttatipennis* (Stal)) preying on cockroaches (*Gyna caffrorum* (Stal, 1856), *Gyna* spp., *Herbardina* spp., *Symploce incuriosa* (Saussure, 1899)), parasitic evaniid and chalcidoid wasps (*Hockeria* sp.), trogid beetles (*Trox zumpti* Haaf, 1957) utilizing dead bats, tenebrionid (*Tenebrio guineensis Imhoff, 1843*) and ptinid beetles, thysanurans, as well as numerous haematophagous argasid ticks (*Ornithodoros faini* Hoogstraal, 1960) and nycteribiid flies (*Eucampsipoda africana* Theodor, 1955) using the bats as food source. Other "visitors" of cave, inhabited by *R. aegyptiacus*, were ants (*Pheidole crassinoda* Emery, 1895), spiders (*Smeringopus* sp.), troglophilic crickets,

In South Africa, Herzig-Straschil and Robinson (1978: 104) found *R. aegyptiacus* roosting together with *Miniopterus natalensis* [as *M. schreibersi*], *Rhinolophus capensis*, a few *M. fraterculus* and possibly *R. clivosus*. Similar associations were also reported from Zambia (Leopard's Hill cave) by Grafitti *et al.* (2003: 70), who reported on a colony of approximately 10,000

R. aegyptiacus, together with three colonies of *M. schreibersi* of about 50 - 300 animals, and single specimens of *R. hildebrandtii, R. simulator* and *Nycteris* sp.

DIET:
In Turkey, Albayrak *et al.* (2008) found two wild fruits were important (*Ficus elastica* (Rubber tree) and *Melia azadirachta* (Persian lilac)). In South Africa, Barclay and Jacobs (2011: 467) report that the diet includes the fruit of multiple species of figs, but also those of Cape ash (*Ekebergia capensis* Sparrm.), saffronwood (*Cassine crocea* (Thunb.) Kuntze), yellowwood (genus *Podocarpus* Persoon), *Diospyros* L., and *Syzygium* R.Br. Ex Gaertn. Herzig-Straschil and Robinson (1978: 101) also included Bushman's poison (*Acokanthera oppositifolia* (Lam.) Codd) and Mistletoe (*Viscum obscurumi* Thunb.).

Lamb *et al.* (2010: 215) reported that Cypriotic *R. aegyptiacus* specimens fed on *Agave americana* (Century plant) during mid-summer, but moved on to *Ficus carica* (figs) when these became available. During late-winter, the most important food items were *Phoenix dactylifera* (dates), *Melia azedarach* (Persian lilac), and flowers of eucalypt, *Myrtus communis* (common myrtle), mandarines and lemons. Del Vaglio *et al.* (2011: 283) identified 11 plant species in the droppings of Cypriotic specimens, including *Melia azedarach* (Perzian lilac or Chinaberry tree), *Morus* spp. (Plum tree), *Ceratonia siliqua* (Carob tree or St John's-bread), *Eryobotria japonica* (loquat, Japanese medlar or Japanese plum), *Ficus carica / F. microcarpa* (Common fig tree / Laurel fig), *Arbutus andrachne* (Eastern or Greek Strawberry Tree), *Washingtonia filifera* (Washingtonia), *Crataegus azarolus* (Mediterranean hawthorn), *Citrus sinensis* (Orange tree), and *Styrax officinalis* (Stirax). All of these plant species had limited economic importance.

Baum (1995: 339) mentioned that *R. aegyptiacus* is a frequent visitor of *Adansonia digitata* (Baobab), especially in the first two hours after dusk, where they licked nectar from the petal bases. Jacobsen and Du Plessis (1976: 271) found that in South Africa this bat fed mainly on *Ficus* spp. [*F. capensis, F. petersii, F. sansibarica*], although other fruits (e.g. *Litchis chinensis* - litchis, *Syzgium gerrardii* - water pear, *Syzgium jamba* - jamba, *Syzygium cordatum* - water berry, *Harpephyllum caffrum* - kaffll plum, *Ekebergia capensis* - Cape ash, *Prunus africana* - bitter almond/red stinkwood, and possibly *Olea capensis* and *O. africana*) were eaten in other seasons. Nader and Kock (1983c: 271) also reported that captive bats ate 8 to 9 litchis per night or 97 g of fruit (bananas). The bats were probably also feeding on the nectar of *Aloe dolomitica* as they found a number of animals covered in pollen and their faeces contained pollen too.

Seltzer *et al.* (2013: table S2) provided an overview of the plant species found beneath bat feeding roosts. For *R. aegyptiacus* these include *Ficus mucuso* Welw. ex Ficalho (Ipoh's terrible tree - Moraceae), *Ficus sur* Forssk. (Broom cluster fig - Moraceae) and *Eriobotrya japonica* (Thunb.) Lindl. (Loquat - Rosaceae).

Amitai *et al.* (2010: 2693) used stable carbon isotope ratio in exhaled CO_2 to assess the origin of metabolized substrates in 16 *R. aegyptiacus*, which were maintained on a diet of C3 plants. Amitai *et al.* (2010: 2693) found that both resting and flying individuals directly fueled their metabolism with freshly ingested exogenous substrates.

In Cape Town, Barclay *et al.* (2006: 549) observed *R. aegyptiacus* deliberately feeding on Scarabid garden fruit chaffer beetles (*Pachnoda sinuata*). Del Vaglio *et al.* (2011: 285) also reported the presence of coleopterans, lepidopterans (caterpillars), dipterans (fruit flies) and ticks in the bat's droppings, but these were most probably ingested by accident.

In his study on *R. aegyptiacus* from the Kruger Park, Braack (1989: 79) found that they were feeding on the fruits of *Ficus sycomorus* (sycamore fig or fig-mulberry), *Diospyros mespiliformis* (Jackalberry, African Ebony, jakkalsbessie), and *Xanthocercis zambesiaca* (Mashatu tree or Nyala tree).

In the Kisangani area (DRC), Gembu Tungaluna (2012: 106 - 108) followed the fruit intake by *R. aegyptiacus* during the different seasons and came up with the following list: First heavy rain season (September - November): *Carica papaya* L. (papaya) (28%), *Musanga cecropioides* R. Br. & Tedlie (African corkwood tree, umbrella tree) (14%), *Dacryoides edulis* H.J. Lam (safou, African pear, bush pear, Nsafu, bush butter tree, butterfruit) (11%), *Persea americana* Mill., 1786 (avocado) (8%), *Oncoba welwitschii* Oliv. (8%), *Myrianthus arboreus* P. Beauvois, 1805 (giant yellow mulberry, bush pineapple, corkwood) (8%), *Spondias cytherea* Sonnerat, 1782 (Ambarella, otaheite apple, great hog plum) (6%), *Annonidium mannii* (Oliv.) Engl. & Diels (Junglesop) (6%), *Ficus wildemanniana* Warb. (5%), *Ficus leprieuri* Miq., 1867 (3%), *Ficus vallis-choudae* Delile (3%). First mild rain season (December - February): *Musanga cecropioides* (36%), *Myrianthus arboreus* (22%), *Ficus vallis-choudae* (10%), *Annonidium mannii* (6%), *Spondias cytherea* (6%),

Carica papaya (6%), *Uapaca guineensis* Müll.Arg., 1864 (Sugar plum, red cedar, false mahogany, rikio) (6%), *Elaeis guineensis* Jacq. (African oil palm, macaw-fat) (2%), *Ficus wildemanniana* (2%), *Pseudospondias microcarpa* (A. Rich.) Engl. (2%), Musa sp. (2%).
Second heavy rain season (March - May): *Persea americana* (19%), *Annonidium mannii* (16%), *Carica papaya* (16%), *Dacryoides edulis* (11%), *Spondias cytherea* (10%), *Musanga cecropioides* (7%), *Oncoba welwitschii* (7%), Myrianthus cecropioides (7%), *Uapaca guineensis* (3%), *Ficus vallis-choudae* (3%), Musa sp. (3%), *Parinari excelsa* Sabine (Guinea plum) (1%), Ficus sp. (1%).
"Dry" season (June - August): *Oncoba welwitschii* (29%), *Ficus vallis-choudae* (15%), *Parinari excelsa* (14%), *Carica papaya* (14%), *Myrianthus arboreus* (14%), *Musanga cecropioides* (14%).

Izhaki *et al.* (1995: 340) report, that in Israel, *R. aegyptiacus* ingested only 2 % of the small seeds (< 4 mg), all other seeds were spat out between 25 and 400 m from the parent tree. Korine *et al.* (1998: 151) indicate that *R. aegyptiacus* feeds on two types of fruit ("syndromes"). The first one is similar to that eaten by most fruit bats: variable size (range 0.53 - 32.3 g), relatively high water content (57 - 87 %), relatively low fat content (1.3 - 4.1 %), low protein content (1.1 - 6.75 %), and relatively high sugar content (69 - 86 %). The second type is only found in eastern Mediterranean habitats and is characterized by the extremely low water content: 13 - 24 %. This type of food is generally eaten during winter, when other food sources are scarce.

A case of hemochromatosis or ISD (iron storage disease or excessive burden of iron) was reported by Clauss and Paglia (2012: S8) as the result of an accidental excessive dietary iron supplementation. Stasiak *et al.* (2014: 111) investigated whether mutations in the hepcidin gene might be the reason for the increased susceptibility to ISD, but they were unable to identify any differences in the sequence of the portion of the hepcidin gene that encodes the mature peptide. In their ISD study, Leone *et al.* (2016: 45) provided evidence of a positive correlation between hemochromatosis and HCC in any species other than humans.

In a study of *R. aegyptiacus* this was not evident as its blood plasma glucose concentrations were observed to be greater than 40 mmol/l after glucose uptake (Keegan, 1977; Michelmore *et al.*, 1998), this was not after natural feeding but during an oral glucose tolerance test (Mqokeli and Downs, 2012a: 351).

Herrera M. *et al.* (2015: 409) investigated the relationship between food and energy intakes, salt content and sugar types.

PREDATORS:
Jacobsen and Du Plessis (1976: 273) indicate that *R. aegyptiacus* has relatively few natural enemies in South Africa, but that genets (*Genetta* sp.) and Lanner falcon (*Falco biarmicus* Temminck, 1825) took them as prey.

Mikula *et al.* (2016: Supplemental data) mention the following avian predators: Black sparrowhawk (*Accipiter melanoleucus* Smith, 1830), Lanner falcon (*Falco biarmicus* Temminck, 1825), Peregrine falcon (*Falco peregrinus* Tunstall, 1771), Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850); Black-and-white-casqued hornbill (*Bycanistes subcylindricus* (Sclater, 1871)).

Mikkola (2018: 4) shows a photo of a dead bat (with sucking pup) brought to the nest by an Eagle owl (*Bubo bubo* (L., 1758)).

POPULATION:
Structure and Density - Common in parts of Africa; generally uncommon in SW Asia although locally abundant in Israel and Jordan (Z. Amr *pers. comm.,* 2005 in Benda *et al.*, 2008a in IUCN, 2009). In Africa it occurs in large colonies of up to 40,000 to 50,000 individuals. In SW Asia colonies generally number 50 to 500 individuals, although up to 3,000 individuals were recorded in a cave in Jordan. The population in Turkey is estimated at 5,000 to 10,000 individuals; the population there may be decreasing due to control measures in caves (A. Karatas *pers. comm.,* 2007 in Benda *et al.*, 2008a in IUCN, 2009). In Syria only a single locality is known of 1,000 to 2,000 animals (A. Karatas *pers. comm.,* 2007 in Benda *et al.*, 2008a in IUCN, 2009). Also see Albayrak *et al.* (2008).
Horácek *et al.* (2010: 175) indicate that there is a clear decline in the Cypriotic population, whereas the situation in other Mediterranean countries (Lebanon, Jordan, Egypt) is more or less stable. They estimate the total Mediterranean population to include at most 75,000 specimens. Lucan *et al.* (2014c: 111) report a population decline of 90 % on Cyprus between 2005 and 2013 (from 8,000 to 800 animals).

Trend - 2008 - Stable (Benda *et al.*, 2008a; IUCN, 2009). *R. aegyptiacus* populations within the Asia Minor and Levant region are predicted to have a stable population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

LIFESPAN:
Mitchell (1911: 444) mentions for 13 captive specimens (as *Cynonycteris collaris*) an average lifespan of 18 months and a maximum lifespan of 108 months (= 25 yrs). Cushing *et al.* (2013: 794) reported on a captive female of over 11 years of age that needed to be euthanised following a deterioriation of its health due to a metastatic pancreatic carcinoma. Szekely *et al.* (2015: Suppl.) report a maximum longevity of 22.9 years.

Olds *et al.* (2015: 325) found the following tumor types in a captive population of male *R. aegyptiacus*: fibrosarcoma, cutaneous lymphoma, benign focal bronchioloalveolar neoplasm, anaplastic sarcoma, and sebaceous epithelioma.

ACTIVITY AND BEHAVIOUR:
Carpenter (1986: 93) mentions that the heart beat for this species is as high as 728 beats per minute during a flight with airspeeds of 5 m/s.

During displacement experiments, Tsoar *et al.* (2011: E722) found that *R. aegyptiacus* primarily uses self-triangulation based on multiple distal visual landmarks to return to their roost cave. Ulanovsky *et al.* (2010: 302) provide evidence that the bats used a large-scale navigational map to return to their roosts after having been displaced over 44 km.

From flight corridor tests, Riskin *et al.* (2012: 2946) determined the average flight speed to be 4.41 ± 0.54 m/s.

In captive groups, Carter and Leffer (2015: 3) found that a group consisting of nine females and two castrated males spent 0.26 % of their awake time on social grooming. In a group of five males, no social grooming was observed at all.

REPRODUCTION AND ONTOGENY:
Korine and Arad (1999) [in Andrianaivoarivelo *et al.* (2011a: 77)] mention that the newborns of *R. aegyptiacus* are completely dependent on their mothers for the first 6 weeks of life. At birth, the pup weights about 18.0 % of the mother's body mass (22.7 versus 126.0 g) (Kurta and Kunz, 1987: 82). Barclay and Jacobs (2011: 467) indicate that the lactation period lasts from 9 to 12 weeks in South Africa. Davis (2007: 4) indicates that young are dependent until three months after birth in the UAE. At that time, they are able to fly, but do not leave the family colony.

In Uganda, Mutere (1968) observed a bimodal breeding pattern (pregnancies from December to March and from July to October and births in March and October), which was correlated to two rainfall peaks (April-May and October-November). Bartonicka *et al.* (2013: 17) report that in both the Levant (Turkey, Cyprus, Lebanon and Jordan) and in the Dakhla Oasis in Egypt, births take place during most of the year, except for the winter months. The births peak in April-May and in August-September.

In Sierra Leone, Weber *et al.* (2019: 20) captured one lactating female on 7 April.

Lucan *et al.* (2014a: 110; 2014b: 1036) investigated the reproductive cycle in populations from the Mediterranean region and the Egyptian desert and found that both had a bimodality in birth timing regarless of climatic differences. The differences in birth times between the two populations were linked with differences in fruiting phenology of their major dietary plants. They also hypothesize that food abundance is an important trigger of male sexual activity.

Spitzenberger and Bauer (1979: 440, 448) also found a bimodal reproduction cycle for *R. aegyptiacus* on Cyprus, but remarked that the succession of the two phases is so quick that females only take part in one cycle.

Kozhurina and Ilchenko (2016: 13) found a bimodal reproducion cycle in captive *R. aegyptiacus* with a "tropical" polyoestrous continuous reproductive pattern, but found their cycle to take 11 months rather than 12. They also found that females usually began to produce offspring at the age of 14 - 15 months up to 2 years. The gestation period was very variable and lasted from 95 to 129 days.

Mahmoud *et al.* (2018: 293) tested 3-monochloropropane-1, 2-diol (3-MCPD) to sterilize male rousettes to assess its use as pest management tool.

Stanley and Goodman (2011: 40) reported on three adult males with scrotal testes collected in the first half of August 1992 in Tanzania. Two females collected in the first halfs of August 1992 and 1993 were pregnant with a single embryo. Trentin and Rovero (2011: 49) report a lactating female captured in December 2005 in the Uzungwa Scarp Forest Reserve, Tanzania. For West Africa, Krutzsch (2000: 110) indicates that the male reproductive cycle is apparently in synchrony with the female, since they undergo biseasonal testicular hypertrophy.

In the southern Cape province of South Africa, Herzig-Straschil and Robinson (1978: 108) calculated that births took place from October to June. At Matlapitsi (RSA), Dietrich *et al.* (2018b: 4) found that 64 % of the females they sampled in

September 2015 were pregnant, indicating that there were also non-pregnant females and both scrotal and non-scrotal males. In January 2016, they found large amounts of juveniles and lactating females, whereas in April 2016, most of the bats (83 %) were flying juveniles.

In the United Arab Emirates, Davis (2007: 4) indicated that mating takes place from June to September, and that a single young (exceptionally twins) are born in October-December after a gestation period of 115 to 120 days. Szekely *et al.* (2015: Suppl.) report a gestation period of 116 days and they mention that weaning occurs after 122 days. During that period, the weight of the young has increased from 21.06 g to 73.8 g (adult: 125 g).

Laboratory tests performed by Taub *et al.* (2014: S122) provided strong evidence for vocal learning in this species.

MATING:
Jacobsen and Du Plessis (1976: 272) and Barclay and Jacobs (2011: 467) mention that in South Africa, *R. aegyptiacus* mates in spring (July to September) and, after a gestation of approximately 4 months, a single pup is born in summer (end October to December). Occasionally, Start (1969: 272) recorded the birth of twins.

In a colony in the Prague zoo, Jahelková *et al.* (2013: 76) found courtship behaviour and matings taking place throughout the year, but parturitions were strongly synchronized in a one-week period in September/October and March/April.

In a captive colony in Israel, Harten *et al.* (2019: 1895) determined the paternity of pups and found that females gave birth to young of males from which they used to scrounge food [=obtaining food from the mouth of the male], supporting the food-for-sex hypothesis in this species.

POSTNATAL DEVELOPMENT:
Prat *et al.* (2013: 123) studied *R. aegyptiacus* pups raised in small colonies and in acoustic isolation and found that the latter displayed delayed vocal development and that their calls differed from young of the same age raised in colonies. The first sounds produced by young in both groups were isolation calls (Prat *et al.*, 2015: 1). These calls are innate and appear at postnatal day 1.

PARASITES:
BACTERIA
Gram-negative bacterium - Pinus and Müller (1980) and Sara (2002: 41) reported *Citrobacter freudii*, *Enterobacter cloacae*, *Escherichia coli*, *Klebsiella pneumonia*, *Proteus morganii*, and *Proteus rettgeri*. Han *et al.* (2010) isolated a pure sample of *Kluyvera ascorbata* from blood of an individual found dead at a zoo in Seoul, Korea, which had originally been imported (possibly illegally) from Egypt. Childs-Sanford *et al.* (2009: 8) reported *Yersinia pseudotuberculosis* from a colony of bats kept in a zoo in Syracuse, New York. Two of three bats from the Republic of Congo, tested by Nowak *et al.* (2017: 6) were positive for *E. coli*.

Hughes *et al.* (2018: 867) reported the presence of *Yersinia pseudotuberculosis* in bats from a zoo colony.

Gram-positive bacterium - Three out of 55 tested *R. aegyptiacus* bats from Gabon tested positive for *Staphylococcus aureus* and two for *S. schweitzeri* (Held *et al.*, 2016: 119). The positive bats were captured at the fringe of the forest, in the vicinity of humans. None of the bats that were captured in the forest were infected by this bacterium.

Bartonellae - Bacteria
Bartonella - Kosoy *et al.* (2010: 1878) found 15 *Bartonella* spp. *gltA* sequences in *R. aegyptiacus*, and also found six unique *gltA* varients of *Bartonella* which clustered in a monophyletic genogroup. Kosoy *et al.* (2010: 1877) and Bai and Kosoy (2012: 58) reported a prelevence of *Bartonella* spp. in *R. aegyptiacus* from Kenya of 22/105 (21.0%) cultured from blood samples. See also Kosoy (2010: 719) for further information. Dietrich *et al.* (2016b: 3) found one positive testing bat (out of 7) in Mahune (RSA).
Bai *et al.* (2018: 2319) identified a new *Bartonella* species (*B. rousetti*) from bats collected in the Idanre Hills area in Nigeria, which can infect humans as they also found antibodies against this bacteria in people living in surrounding communities.

Lei and Olival (2014: Suppl.) mention *R. aegyptiacus* as host for *Leptospira* bacteria. These were further identified as *L. interrogans* and a second species as having sequences closely related to *L. borgpetersenii*.

Nakamura *et al.* (2012: 410) report on an outbreak of yersiniosis (caused by *Yersinia pseudotuberculosis*) in a colony of captive *R. aegyptiacus* in a zoological park in the Kanto region in Japan.

Kolodny *et al.* (2018: 116) examined the microbial composition of fur and gut samples of a captive and free-living colony of Egyptian fruit bats and found that the fur samples of different animals from the same colony taken at the same time were more similar than samples taken from the same animal

at different time. The gut samples, however, were more individualized and sex related.

Dietrich and Markotter (2019: 1733, Suppl.) investigated the differences between direct and indirect sampling of urine and feces in South African *R. aegyptiacus*. During this study, they found the following bacteria in the urine (in descending LDA [Linear discriminant analysis] order): direct: *Streptococcus, Bacillus, Rhizobium, Brevudimonas*, Rhizobiales, *Corynebacterium, Achromobacter, Acinetobacter, Phenylobacterium, Deinococcus, Methylobacterium, Paenibacillus, Lyninibacillus, Cellulomonas, Cellulosimicrobium*, Planococcaceae, *Nocardiodes, Serratia, Devosia, Solirubracacter, Providencia, Brucella*, Sphingomonadacea, *Stenotrophomonas*, Oxalobacteraceae, *Gp4, Terribacillus, Gemmatimonas, Ochrobactrum, Gp6, Blastococcus*, Comamonadaceae, *Microvirga*, Sphingobacteriaceae, Microbacteriaceae, *Gp3*, Solirubrobacterales, *Massilia, Arthrobacter*, Geodermatophilaceae, *Microbacterium, Leucobacter*, Beijerickiaceae, Planococcaceae, Burkholderiales, *Shinella, Rubellimicrobium, Gp16, Novosphingobium*, Alcaligenaceae, *Rubrobacter*, Betaproteobacteria, *Dyadobacter, Actinomyces, Agromyces*, Ruminococcaceae, Polyangiaceae, *Lysobacter*, Bradyrhizobiaceae, *Moraxella, Aurantimonas*, Acetobacteraceae, *Flavobacterium, Ramlibacter, Caenispirillum, Bordetella, Leifsonia*, Paenibacillaceae_1, Bacillaceae_1, Xanthobacteraceae; indirect: Planctomycetes, *Lentibacillus, Actinocatenispora*, Xanthomonadales, *Marinomonas, Ignavibacterium*, Jiangellaceae, *Methylohalomonas, Fodinicurvata, Salinicoccus, Nocardiopsis*, Deinococcales, Ectothiorhodospiraceae, *Nitrosospira, Nocardia, Saccharopolyspora*, Nocardiopsaceae, Nakamurellaceae, *Ureoplasma, Pntibaca, Phycisphaera, Nitrococcus, Actinophytocola, Nesterenkonia, Luteibacter*, Enterobacteriaceae, *Jiangella, Brevibacteriu*, Bacteroidetes, Gammaproteobacteria, *Salinisphaera*, Actinomycetales, *Gracillimonas*. In the faeces, the following bacteria were found: direct: *Actinobacillus*, Pasteurellaceae, Flavobacteriaceae, *Salinisphaera, Gp1*, Gammaproteobacteria, *Kytococcus, Mycobacterium, Gracilimonas, Chryseobacterium, Mycoplasma*, Geodermatophilaceae, Chloroflexi, *Rhizobium*, unclassified Bacteria, *Helicobacter, Rhodococcus, Blastococcus, Deinococcus*, Chitinophagaceae, *Acinetobacter, Brevundimonas*, Sphingobacteriales, Comamonadaceae, *Sphingomonas, Mosesorhizobium, Comamonas, Gemmatimonas*, Proteobacteria, *Achromobacter, Agrmyces, Nitrosococcus, Devosia, Gp10, Gp3, Flavobacterium, Roseomonas, Marmoricola, Gp6*, Ectothiorhodospiraceae, *Campylobacter*, Solirubrobacterales, *Isoptericola*, Nocardioidaceae, Deltaproteobacteria, *Gordonia*, Sphingomonadaceae, Neisseriaceae, *Luteibacter, Actinomadura*, Erythrobacteraceae, Acidimicrobiales, "3_genus_incertae_sedis", *Nocardioides, Spirosoma, Truepera*, Sphingomonadales, *Moraxella, Solirubrobacter, Tessaracoccus*, Alphaproteobacterai, Myxococcales, *Paenibacillus*, Bacteroidetes, Oxalobacteraceae, *Stenotrophomonas, Phenyobacterium*, Caulobacteraceae, *Gp7, Arthrobacter*, Polyangiaceae, *Geminicoccus, Rubellimicrobium, Gp4, Azospirillum*, Sphingobacteriaceae, Rhodospirillaceae, *Dermacoccus, Nitrospira*, Pseudomonadaceae, Acetobacteraceae, *Cellulosimicrobium, Lysobacter, Dyadobacter, Sphingopyxis*, Betaproteobacteria, *Ornithobacterium*; indirect: *Granulicatella*, Carnobacteriaceae, Streptococcaceae, *Alkalibacterium, Nesterenkonia*.

HAEMOSPORIDA

Perkins and Schaer (2016: Suppl.) mentioned the presence of *Plasmodium roussetti* van Riel, l'Hoest et l'Hoest, 1951 in bats from the DRC.

Adam (1973: 8) mention on an infection by *Trypanosoma megadermae* Wenyon, 1909. Barbosa *et al.* (2016: 215) and Espinosa-Álvarez *et al.* (2018: Suppl.) reported a specimen from Gabon being infected by "*Trypanosoma* sp. bat".

ACARI

Spinturnicidae: Hirst (1923: 979) indicates that Kolenati stated that either *R. microphyllum* or *Pteropus ægyptiacus* [=*Rousettus aegyptiacus*] is the host for *Ancystropus zelebori* Kolenati, 1856 (Acari). Another mite, he reported (p. 987) from *R. aegyptiacus* is *Ancystropus* (*Meristaspis*) *lateralis* Kolenati. Taufflieb (1962: 112) also reported *Ancystropus leleupi* Benoit, 1959.

Trombiculidae: Stekolnikov (2018a: 50) reported this species as host for *Whartonia novemsetosa* Goff, 1982 in Tanzania.

Korine *et al.* (2012: 1435) experimentally infected *R. aegyptiacus* specimens with the flea *Xenopsylla ramesis*, whose natural host is Sundevall's jird (*Meriones crassus*). They found that female fleas engorged the same amount of blood from these bats as from the jirds. Male fleas, however, sucked much less blood.

From the Lanner Gorge cave [22°27'S 31°09'E], in the Kruger National Park, Braack (1989: 81) reported argasid ticks (*Ornithodoros faini*

Hoogstraal, 1960), nycteribiid flies *Eucampsipoda africana* Theodor, 1955), spinturnicid mites (*Ancystropus zeleborii*, Kolenati, 1857), and the flea *Thaumapsylla breviceps* Rothschild, 1907 (Ischnopsyllidae).

In Jordan, Benda *et al.* (2010b: 201) found the following ectoparasites: Argasidae: *Argas vespertilionis* (Latreille, 1802), *Ornithodoros* (*Reticulinasus*) *salahi* (Hoogstraal, 1953).

Nycteridocoptes pteropodi Rodhain and Gedoelst, 1923 (Acari: Sarcoptidae) was reported by Fain (1958: 236) from "*Rousettus leachi*" specimens from Kivu, DRC. Fain (1958: 244, 245) also described *Nycteridocoptes lavoipierrei*, *Nycteridocoptes macrophallus* and *Nycteridocoptes rousetti* from the same bat species collected at Mahuysa cave, Katana-Kivu, DRC. Another species (*Nycteridocoptes rousetti* Fain,1958) was mentioned by Fain (1959a: 345) from *R. aegyptiacus* from Thysville (=Mbanza-Ngungu), DRC. Fain (1960: 83) described *Stomatodex rousetti* (Acari: Demodecidae) from "*R. leachi*" from Mahyusha cave, near Katana, DRC. Fain (1967: 367) furthermore reported on the presence of *Teinocoptes rousetti* Fain, 1959 on *R. aegyptiacus leachi* from Mahyusha cave, Kivu, DRC.

Reinhardt *et al.* (2008: 173) report that the cimicid bug *Afrocimex constrictus* Ferris and Usinger, 1957 infested *R. aegyptiacus* colonies at Makingeny and Ngwarisha (Mount Elgon region, Kenya) and that these bats were bitten between 0.5 and 1.5 times a day, and that to up to 28 µl of blood was removed each time.

Afrocimex leleupi Schouteden, 1951 was reported by Kock and Aellen (1987: 877) the Kakontwe cave (DRC).

In Iran, Benda *et al.* (2012a: 185) report the presence of *Meristaspis lateralis* (Kolenati, 1856) (Spinturnicidae). This mite was already reported by Delfinado (1963: 913) to be widely distributed on *R. aegyptiacus* in Egypt and Palestine.

DIPTERA

Streblidae: *Brachytarsina africana* (Walker, 1849) recorded in Katanga, but Haeselbarth *et al.* (1966: 100) suggests that this may be accidental and *R. aegyptiacus* is not its true host. *Brachytarsina alluaudi* (Falcoz, 1923) recorded in Katanga (Haeselbarth *et al.*, 1966: 101), Gabon (Obame-Nkoghe *et al.*, 2016: 5). *Brachytarsina bequaerti* (Jobling, 1936) collected in Tanzania and Kenya (Haeselbarth *et al.*, 1966: 101).

Nycteribiidae: *Eucampsipoda africana* (Theodor, 1955), widely distributed over the Ethiopian region and recorded from localities in Senegal to the Sudan and southwards to the Cape (Haeselbarth *et al.*, 1966: 115; Duron *et al.*, 2014: 2108; Obame-Nkoghe *et al.*, 2016: 5). This bat fly might be a carrier of *Bartonella* (Zhu *et al.*, 2014: 2160; Szentiványi *et al.*, 2019: Suppl.) and *Arsenophonus* bacteria (Szentiványi *et al.*, 2019: Suppl.), and the fungus *Anthrorhynchus eucampsipodae* Thaxter, 1901 (see Balazuc, 1971: 214; Haelewaters *et al.*, 2017: Suppl. for a record from Gabon; Haelewaters *et al.*, 2018: 794; Szentiványi *et al.*, 2019: Suppl.), as well as the blood parasite *Polychromophilus melanipherus* and Mahlapitsi and Wolkberg viruses [Szentiványi *et al.*, 2019: Suppl.). *Eucampsipoda hyrtlii* (Kolenati, 1856) has been identified with certainty only from the Middle East (Arabia, Egypt, Palestine and Syria), but probably also occurs in East Africa (Haeselbarth *et al.*, 1966: 115). Balazuc (1971: 214) reported this bat fly from a "Chiroptera" from Egypt, which was infected by the fungus *Anthrorhynchus eucampsipodae* Thaxter, 1901. However, as pointed out by Blackwell (1980: 151), *E. hyrtlii* is only known as parasiting on *R. aegyptiacus* (see also Haelewaters *et al.*, 2018: 794). *Dipseliopoda biannulate* (Oldroyd 1953) distributed over the tropical parts of Africa and recorded from localities in Nigeria, Cameroon, the Congo and the Sudan and Kenya (Haeselbarth *et al.*, 1966: 116). Morse *et al.* (2013: Suppl. 1) refer to *Eucampsipoda africana* (Diptera: Hippoboscoidea: Nycteribiidae: Cyclopodiinae) collected from a Kenyan *R. aegyptiacus*. This bat fly was also reported from Sierra Leone by Blackwell (1980: 146), where it was found to be infected by the fungus *Arthrorhynchus eucampsipodae* Thaxter, 1901. In Jordan, Benda *et al.* (2010b: 201) found *Eucampsipoda aegyptia* (Macquart, 1851). They also mention that two other Nycteribiidae were previously found in Palestine: *Nycteribia pedicularia* Latreille, 1805 and *N. schmidlii* Schiner, 1853. The latter species (as *Nycteribia schmidlii scotti* Falcoz, 1923) was also reported from Gabon by Obame-Nkoghe *et al.* (2016: 5).

Jansen van Vuren *et al.* (2016: 1) describe a new orthoreovirus, which was collected from a bat fly (*Eucampsipoda africana* (Theodor, 1955)), which in turn was captured from a *R. aegyptiacus* bat from South Africa.

SIPHONAPTERA

Ischnopsyllidae: *Thaumapsylla breviceps* Rothschild 1907, where the nominate subspecies *T. b. breviceps* Hopkins and Rothschild, 1956, was found in the Cape, Natal and Transvaal provinces

of South Africa, Kenya and DRC (Haeselbarth *et al.*, 1966: 186).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Rousettus aegyptiacus*: Adenoviruses, Astroviruses, Caliciviruses, Coronaviruses, and Rotaviruses.

Willoughby *et al.* (2017: Suppl.) mention the following viruses: Chikungunya virus, European bat 1 lyssavirus, Israel turkey meningoencephalomyelitis virus, Kasokero orthonairovirus, Lagos bat lyssavirus, Marburg marburgvirus, Rousettus bat coronavirus HKU9, Shamonda orthobunyavirus, West Nile virus, Yogue virus, Zaire ebolavirus.

In Uganda, Kading *et al.* (2018: 3) found neutralizing antibodies against Yellow fever virus (YFV), non-specific Flaviviruses, Babanki virus (BBKV), non-specific Alphaviruses, and Rift Valley fever virus (RVFV).

Adenoviridae
Mastadenovirus
Jansen van Vuren *et al.* (2018: 1) isolated a new virus (RaegAdV-3085) from an apparently healthy wild-caught Egyptian fruit bat in South Africa.

Coronaviridae - Coronaviruses
SARS - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in 29 individuals from Limpopo Province, South Africa, 11 were tested positive (11/29, 37.9 %) and 142 individuals from Oriental Province, DRC, 17 tested positive (17/142, 12 %) (28/171, 16.4 %). In Nigeria during June 2008, Quan *et al.* (2010) screened the gastrointestinal tissue for the presence of coronaviruses by PCRs, none tested positive.
Van Doremalen *et al.* (2018: 3, 10) inoculated 12 adult bats from a captive colony with WIV1-CoV (SARS-like WIV1-coronavirus) and were unable to detect efficient replication of the virus and only modest seroconversion in two of the bats.

Tong *et al.* (2009) found several alpha- and betacoronaviruses in *Rousettus aegyptiacus* collected in Kenya in 2006 based on detection of coronavirus RNA in fecal swabs. Some of the coronaviruses were highly divergent, whereas others showed similarity to *Rousettus* sp. coronaviruses identified in China.
Shehata *et al.* (2016) tested 265 Egyptian bats and found 12 infected with HKU9-like viruses.
Anthony *et al.* (2017b: Suppl.) mention beta-coronaviruses Bat_CoV_HKU9 and Kenya_CoV_BtKY56.
19 out of 397 (4.8 %) of the Kenyan bats tested by Tao *et al.* (2017: Suppl.) were positive for CoV.

Filoviridae - Filo viruses
Ebolavirus
Muyembe-Tamfum *et al.* (2012: 9) refers to Pourrut *et al.* (2005) who found ZEBOV-specific antibodies in this species.
Paweska *et al.* (2016: 1) experimentally inoculated *R. aegyptiacus* bats and were unable to find any viral RNA in oral, nasal, ocular, vaginal, penile and rectal swabs from any of the experimental groups. They concluded (p. 9) that these bats are unlikely to maintain and perpetuate EBOV in nature (see also Mandl *et al.*, 2018: 7).

Marburgvirus
Towner *et al.* (2007) tested 283 individuals from Gabon for Marburg virus [MARV] RNA by conventional and real-time RT-PCR and 242 individuals for anti-Marburg virus IgG antibodies by ELISA; 4 individuals (1.5 %) were PCR positive and 29 (12 %) were IgG positive. Peterson and Holder (2012: 1831) indicate that the Gabonese clade represents a virus form that has not been reported from human infections. Kuzmin *et al.* (2010b) detected RNA in a female *R. aegyptiacus* bat collected at Kitum cave in July 2007. Adjemian *et al.* (2011: S796 - S798) report on four cases of MHR [Marburg hemorrhagic fever] in miners, which they contracted while working in a mine tunnel at Kitaka mine in Ibanda District, Uganda, where thousands of *R. aegyptiacus* bats lived. These cases resulted in the destruction of the residing bat population. Van Paassen *et al.* (2012: 635) report on the death of a Dutch woman, who probably contracted the virus after visiting a cave in Uganda, where *R. aegyptiacus* bats were living. Amman *et al.* (2013: 6) indicate that a long-term study at this site showed that 2 to 5 % of the bat population was actively infected by the MARV virus. Amman *et al.* (2014: 1762) estimated that both the cave and the mine contained about 40,000 to 100,000 *R. aegyptiacus* bats at the time the miners and the tourist were infected. The bats were exterminated by November 2008, but in November 2012 a small colony was (1 - 5 % of the original numbers) was found in the re-opened Kitaka Mine.
Maganga *et al.* (2011: S800) indicate that MARV is enzootic in Gabon due to the fact that MARV-positive bats were captured in between 2005 and 2009.
Kuzmin *et al.* (2011a: 4) report that MARV RNA was found in bats from Gabon, Uganda, and Kenya.
Paweska *et al.* (2012: 1) inoculated captive *R. aegyptiacus* specimens - captured in northeastern South Africa - and were able to confirm the susceptibility of this species to infections with

MARV irrespective of sex and age. In a subsequent study, Paweska *et al.* (2015) recovered the virus from 15 different tissues and plasma, but only sporadically in mucal swab, urine and fecal samples. Amman *et al.* (2015b) also experimentally infected bats and found viruses in liver, spleen, blood, kidneys, salivary glands, bladder, large intestine as well as in oral and rectal swaps. The infected bats did not show any significant changes in daily food consumption, body weight, or daily body temperature, and no signs of overt morbidity or behavioral changes such as waning appetite, overly aggressive behavior, separation from cage mates, lethargy, or reduced or abandoned grooming (p. 121). Schuh *et al.* (2017c) found prove for horizontal transmission of MARV as virus RNA was found in contact bats that were kept together with MARV-inoculated bats. Schuh *et al.* (2017b), furthermore, reported that following infection of ERBs with MARV, virus-specific IgG antibodies are induced, but after 3 months the bats are seronegative again.
Amman *et al.* (2012: 1) and Albariño *et al.* (2013a: 99) link an outbreak of MARV in October 2012 in Uganda with the second annual virus pulse in *R. aegyptiacus* populations, more specifically in older juvenile bats of about six months of age. The viral genome sequences collected from infected humans were approximately 99.3 % to two MARV isolates captured in 2008 and 2009 in the Python Cave in the Queen Elisabeth National Park. Amman *et al.* (2013: 6) indicate that at the time of these pulses, the juvenile bats are about 6 months old and are 5 to 6 times more likely to be infected by the virus than the adults (see also Olival and Hayman, 2014). Storm *et al.* (2018: 1) found that maternal immunity against MARV was lost in juvenile bats by 5 months of age, and that antibodies to MARV remained present in 84 % of naturally exposed bats at least 11 months after capture.
Peterson and Holder (2012: 1832) state that *R. aegyptiacus* is now seen as central in the picture of Marburg virus maintenance, but they also are somewhat confused about the fact that two lineages of Marburg virus are maintained in the same cave or mine in Uganda.
Carroll *et al.* (2012: 2613) indicate that *Rousettus aegyptiacus* has been identified as a potential natural reservoir for Marburg and Ravn viruses (*Marburg marburgvirus*).
Jones (2015: 3420) experimentally inoculated *R. aegyptiacus* specimens with Marburg and five Ebola viruses (Sudan, Ebola, Bundibugyo, Taï Forest, and Reston). In the Ebola virus groups, viral RNA tissue distribution was limited, wheras in the Marburg virus group, the virus was widely dissimated. They concluded that this bat species is very unlikely to be a source for Ebola viruses in nature and that there is support for a single filovirus - single reservoir host relationship (here with Marburg virus).
Paweska *et al.* (2018: 1135) tested 1,431 South African bats and found 53.04 % (759) to be positive for antibodies against MARV. These percentages varied between 17.75 % in April 2013 and 82.1 % in October 2013. In adults, these numbers varied between 39.6 % in August 2013 and 100 % in February 2013 (overal 71.56 %), whereas in young bats, they varied between 1.3 % in June 2013 and 77.3 % in January 2014 (overal 30.6 %).
An extensive test by Changula *et al.* (2018: S313-S315) showed 158 out of 290 Zambian *R. aegyptiacus* bats was positive for anti-filovirus antibodies, but no viral RNA genomes were detected. They also found that the seroprevalence peaked in November-December and decreased in January-February. The seroprevalence was also lowest in animals weighing 51 - 60 g, and increased when the bats grew, suggesting that maternal antibodies might have disappeared.
Jones *et al.* (2019: 1) inoculated Egyptian fruit bats with MARV to investigated the clinical and pathologic effects. They found a mild elevation in alanine aminotransferase (ALT) at 3, 6 and 7 days after inoculation. Nine days after inoculation, Lymphocyte and monocyte counts were slightly elevated and the liver histology revealed small foci of inflammatory infiltrate, similar to lesions previously described in wild, naturally-infected bats.

The role of the argasi tick *Ornithodoros faini* as transmission vector between *R. aegyptiacus* specimens in Uganda was rejected by Schuh *et al.* (2016: 1) as none of the 3,125 ticks examined tested positive for the Marburg virus.

Flaviviridae

Flavivirus

Uganda S virus- reported in 1947 from Uganda by Butenko (1996). This virus was mentioned by Luis *et al.* (2013: suppl.). Maganga *et al.* (2014a: 5) tested 305 animals from Gabon, of which only one tested positive for a *Flavivirus*.
Malmlov *et al.* (2019: 3) referred to Simpson *et al.* (1968) who experimentally inoculated three Egyptian fruit bats with Zika virus, of which one became viremic and two seroconverted.

Pegivirus (BPgV)

Quan *et al.* (2013: Table S5) found 3 out of 26 Kenyan and 9 out of 91 Nigerian bats examined to be infected with clade K type *Pegivirus* (overal 10.3 % infection).

Herpesviridae

Jánoska *et al.* (2011: 118) reported two viruses, from captive specimens from the Budapest Zoo,

belinging to the *Betaherpesvirinae* and *Gammaherpesvirinae*.

Nairoviridae
Orthonairovirus
de Jong *et al.* (2011: 12) and Luis *et al.* (2013: suppl.) mention the presence of an unassigned Kasokero virus, as well as an unassigned Yogue virus. The latter was also reported by Kemp (1975: 617) from Senegal in June 1968.
Of the 1979 specimens from Gabon tested by Müller *et al.* (2016: 3), 48 were positive for Crimean Congo hemorrhagic fever virus (CCHFV).
Jansen van Vuren *et al.* (2017: 935) discovered an orthobynyavirus (Wolkberg virus - WBV) in a bat fly (*Eucampsipoda africana*) collected on a *R. aegyptiacus* from South Africa. WBV was detected in one serum pool from bats, and at relatively low concentration.

Orthomyxoviridae
Kandeil *et al.* (2019: 1) reported a new influenza A virus (IAV) from bats collected in the Nile delta.

Papillomaviridae
McKnight *et al.* (2006: 193) reported some carcinomas near the eye and on wing membranes of a *R. aegyptiacus* kept in captivity in the USA. These were caused by a putative novel close-to-root papillomavirus, belonging to a new genus. Tse *et al.* (2012: 7) refer to a *Rousettus aegyptiacus* papillomavirus type 1 (RaPV1), belonging to the genus *Psipapillomavirus* (GenBank: DQ366842).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) reported that three of the 213 specimens (1.4 %) they examined from Gabon and Congo tested positive for *Henipavirus*. 15 of these bats (7.0 %) were positive for *Rubulavirus*. Conrardy *et al.* (2014: 259) found one out of 10 tested animals from the Kitum cave (Kenya) and one of six from the Watamu cave to test positive for *Paramyxovirus*.
Amman *et al.* (2015a: 776) tested 1331 Ugandan *R. aegyptiacus* specimens of which 62 (4.6 %) tested positive for Sosuga virus.
Two out of 84 Kenyan *R. aegyptiacus* specimens tested by Mortlock *et al.* (2015: 1481) were found to test positive for *Paramyxovirus* sequences.
In South Africa, Mortlock *et al.* (2019b: 13) found a number of putative *Rubula*- and related virus RNA in spleen (9.54 %) and urine samples. In October, the virus observations peaked, which coincides with females aggregating in the cave during late stages of gestation. Additionally, high values were also found during December-January, when the bats were lactating. A second excretion peak was found in June-July, probably linked with the juveniles being no longer protected by maternal antibodies.

Phenuiviridae:
Phlebovirus - Balkema-Buschmann *et al.* (2018: 3) infected three bats from a captive colony with Rift Valley fever phlebovirus (RVFV) and found that viruses could be isolated from the spleens of all three animals and from the liver of one of them, proving that the virus can replicate in the bats.

Polyomaviridae:
Polyomavirus - Initially, two polyomaviruses were detected from Kenya in 2006 by Tao *et al.* (2012). Further surveillance identified four more from Kenyan caves (including Watamu cave) where three of the 11 individuals tested positive (Conrardy *et al.*, 2014: 259).

Reoviridae:
Orbivirus - Fagre *et al.* (2019: 1) described Bukakata orbivirus (BUKV) from a bat from Uganda.

Rotavirus - Sasaki *et al.* (2018: 106) isolated Group A Rotavirus (RVA) from *R. aegyptiacus* in Zambia, which was very similar to the strain they collected from *Eidolon helvum* specimens from that country, suggesting interspecies transmission and genetic reassortment between these bat species.

Rhabdoviridae
Lyssavirus - Rabies related viruses
In Nigeria during June 2008, Quan *et al.* (2010) did not detect any lyssavirus-specific antigens from the brains by use of direct fluroescent antibody testing.
European bat lyssavirus 1 is reported by Van der Poel *et al.* (2000: 1919), Wellenberg *et al.* (2002: 349), Omatsu *et al.* (2008:169), de Jong *et al.* (2011: 9), Luis *et al.* (2013: suppl.).
Lagos bat virus: Kuzmin *et al.* (2008a) found a 29 - 46% seroprevalence of Lagos bat virus neutralizing antibodies in Kenya. Kuzmin *et al.* (2011b: 1467) reported 37 seropositive Kenyan bats on a total of 79 examined (46.8 %). Picard-Meyer *et al.* (2004) isolated the virus from a *R. aegyptiacus* from an unknown location in Africa. Hayman *et al.* (2011a: 88) and Kuzmin *et al.* (2011a: 3) refer to a *R. aegyptiacus* specimen from France, which came originally from either Egypt or Togo.
Shimoni bat virus: Kuzmin *et al.* (2011b: 1467) found 26 bats to be seropositive for this virus on a total of 79 specimens examined in Kenya between 2009 and 2010.
Horton *et al.* (2014: Table S1) tested 54 Kenyan *R. aegyptiacus* specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

Togaviridae
Alphavirus: de Jong *et al.* (2011: 10) and Luis *et al.* (2013: suppl.) reported Chikungunya virus occurring on *R. aegyptiacus*.

In their overview table, Maganga *et al.* (2014a: 8) report the following viruses were already found on *R. aegyptiacus*: Lagos Bat Virus (LBV), Bat Gammaherpesvirus (1, 2, 4, 5, 6, 7), Bat Gammaherpesvirus 3, Betaherpesvirus, Marburg virus (MBGV), Coronavirus, Zaire Ebola virus (ZEBOV), Yogue virus, Kasokero virus, Chiropteran Papillomavirus, Henipavirus, Rubulavirus, Flavivirus.

In their literature review, Fagre and Kading (2019) reported that seriologic evidence was found for the following viruses: Crimean-Congo Hemorrhagic Fever Virus (CCHF), Rift Valley fever virus (RVFV) and Bunyamwera virus (BUNV). The latter virus was also isolated or molecular evidence was found, which was also the case for Kasokero (KKOV) and Yogue (YOGV) viruses.

Goldberg *et al.* (2017: 2) and Feng *et al.* (2017: 99) mention that two viruses were identified from Nycteribiid bat flies (*Eucampsipoda africana*), which were retrieved from *R. aegyptiacus*: the putative orthoreovirus Mahlapitsi virus (from South Africa) and the putative orthobunyavirus Wolkberg virus.

UTILISATION:
Vora *et al.* (2014: 334) report on an annual bat festival in Idanre, Nigeria, where males of all ages enter caves inhabited by *R. aegyptiacus* to capture these bats. Many of these animals are prepared as food and some are transported to markets in other parts of the country to be sold as bushmeat. During the Yam hunting festival in Buoyem, Ghana, fruit bats (possibly *R. aegyptiacus* were collected (Anti *et al.*, 2015: 1418).

ANTHROPOPHILOUS:
In Turkey, Albayrak *et al.* (2008) observed 11 of 15 roosts (73%) were destroyed by human efforts to exterminate the bats over a five-year period.

Centeno-Cuadros *et al.* (2017: 6234) found that, in the Mediterranean area, *R. aegyptiacus* benefits from human-mediated habitats for daily movements and foraging behaviour. On the other hand, they also found that dispersal (promotor of gene flow between colonies) is apparently not influenced by human-altered habitats.

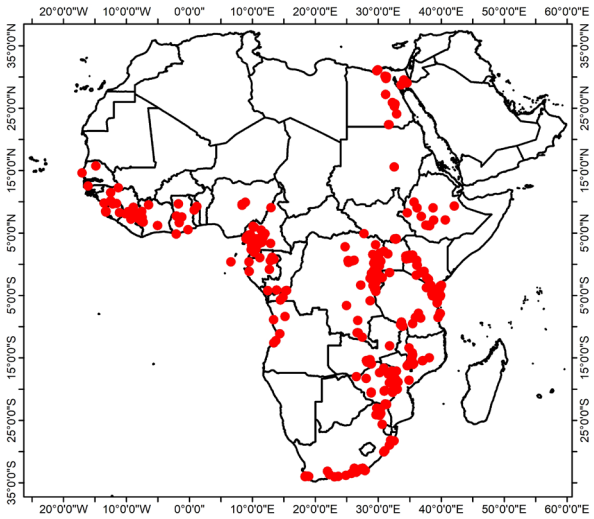


Figure 43. Distribution of *Rousettus aegyptiacus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Burundi, Cameroon, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Egypt, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Mali, Mozambique, Nigeria, Rwanda, São Tomé and Principé, Senegal, Sierra Leone, South Africa, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Rousettus madagascariensis G. Grandidier, 1929

*1929. *Rousettus madagascariensis* G. Grandidier, Bull. Acad. Malgache, (N.S.) 11: 91, pl. 4 text-figs (for 1928). Type locality: Madagascar: E Madagascar: Beforona: between Tananarive [=Antananrivo] and Andevoranto: Grand Forêt de l'Est. Holotype: MCZ 45432: ad ♂, skull and alcoholic. Collection date: 1917. Presented/Donated by: Guillaume Grandidier. Received from the "Académie Malgache" in 1917; see Bergmans (1994: 119); Peterson *et al.* (1995: 49); Helgen and McFadden (2001: 141). (Current Combination)
2016. *R[ousettus] madagascar:* Lengkong, Arisoesilaningsih, Hakim and Sudarto, Online J. Biol. Sci., 16 (2): 98. Publication date: 14 April 2016. (Lapsus)
? *Rousettus madagascariensis madagascariensis:* (Name Combination)
? *Rousettus sp. cf. R. madagascariensis*

TAXONOMY:
Considered a subspecies of *lanosus* by Hayman and Hill (1971: 12); but see Bergmans (1977a) and Simmons (2005: 348).
Bergmans (1994: 119) indicates that the year of publication is often cited as 1928, but Tome XI of the Bulletin de l'Academie Malgache, Nouvelle Série, for 1928, in which it appeared, was published in 1929. Helgen and McFadden (2001: 141) indicate that it might even be published in 1930.

COMMON NAMES:
Czech: kaloň Grandidierův. English: Madagascan Rousette, Madagascar Rousette. French: Roussette de Madagascar. German: Madagaskar-Höhlenflughund.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Samonds (2007: 57 - 58) found *Rousettus* sp. cf. *R. madagascariensis* within the deposits (NCC-1 locality) dating estimated as 69,600 to 86,800 years old within the Anjohibe cave. Samonds (2007: 60) found samples of *R. madagascariensis* in deposit (SS2) which was collected from the surface near the main cave entrance, the dating attemps revealed this sample was contaminated, therefore no date is known for Anjohibe cave, Madagascar.
Gunnell *et al.* (2014: 3) also refer to Goodman and Junkers (2013), who report on fossil material from the Andrahomana cave in Madagascar.

CONSERVATION STATUS:
Global - This species is listed as Near Threatened (NT ver 3.1 (2001)) as it is believed to have undergone a decline in the region of 20-25% over the past 15 years or so primarily as a result of chronic hunting. Almost qualifies for listing as threatened under criterion A2d. This species is not thought to be declining fast enough to place it in a category of higher threat, although a review of this assessment may be warranted in future, especially with further information on the degree to which it may be impacted by habitat loss (Andriafidison *et al.*, 2008q; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Andriafidison *et al.*, 2008q; IUCN, 2009). 2000 - LR/nt ver 2.3 (1994). 1996 - Vu ver 2.3 (1994).

MAJOR THREATS:
Andriafidison *et al.* (2008q) [in IUCN (2009)] report that the extent to which the destruction and degradation of natural forest threatens this species is poorly understood, while Andrianaivoarivelo *et al.* (2011b: 81) indicate that this is an indirect threat. Although Goodman *et al.* (2005a) suggested that *R. madagascariensis* is not dependent on relatively intact forest there are insufficient data on its annual dietary requirements to decide this matter. It is clear, however, that some of the roosting colonies are located some distance from intact forest and additional study is therefore needed on the mobility of this species. The main threats to *R. madagascariensis* are to its roosts where it is subject to hunting pressure (Jenkins *et al.*, 2007a; Rakotonandrasana and Goodman, 2007; Jenkins and Racey, 2008; Andrianaivoarivelo *et al.*, 2011b: 78, 81) in virtually all sites that are not inside protected areas (Goodman *et al.*, 2005a) or considered sacred (Rakotoarivelo and Randrianandrianina, 2007). Jenkins *et al.* (2011: 1), however, indicate that the taboo on hunting in sacred areas is rapidly eroding. It appears to be hunted exclusively for subsistence and bats are harvested using locally made traps as well as being knocked down from the cave ceiling with wooden batons (Rakotonandrasana and Goodman, 2007). *R. madagascariensis* can legally be hunted between the first of May and the first of September (Anonymus, 2007b: 6). On Ile Sainte Marie the reported offtake was between 360 and 480 bats per year (Rakotonandrasana and Goodman, 2007).

Jenkins *et al.* (2007b: 213) point out that *R. madagascariensis* is very vulnerable to hunters because it roosts in caves, which can easily be covered by a trap system. They mention that one local farmer was able to capture 170 bats in a single night.

Cardiff *et al.* (2012: 479) investigated the influence of tourist disturbance on roosting *R. madagascariensis*. They found that the bats were slightly less disturbed when ambient light was present. Directly illuminating the bats resulted in higher disturbance. Also in roosts which were previously visited by hunters, the bats were more easily disturbed. They suggest keeping a minimum visit distance of 12 m, not illuminating the bats directly, and not opening other roost sites for tourism to limit the disturbance of the bats.

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008q) [in IUCN (2009)] report that, as a game species under Malagasy law (Durbin, 2007), *R. madagascariensis* is only protected when it occurs in nature reserves. In a survey of western Madagascar, it was found in six protected areas: Réserve Spéciale d'Ankarana, Réserve Spéciale d'Analamerana, Parc National d'Ankarafantsika, Parc National de Namoroka, Parc National du Tsingy de Bemaraha and Parc National d'Isalo (Goodman *et al.*, 2005a). Roosts within existing protected areas (only three of which are known - Cardiff and Jenkins, 2016: 99) need to

receive close attention from park staff to discourage hunting. Other roosts need to be conserved and this might be best achieved through their inclusion within new protected areas and with the cooperation of local communities.

GENERAL DISTRIBUTION:
Rousettus madagascariensis is endemic to the island of Madagascar where it is widespread but rare or absent from the central highlands and the arid south-west (MacKinnon *et al.*, 2003; Goodman *et al.*, 2005a). It has also been recorded from the off-shore islands of Nosy Be, Nosy Komba, and Ile Sainte-Marie (Rakotonandrasana and Goodman, 2007: 6).

Native: Madagascar (MacKinnon *et al.*, 2003; Goodman *et al.*, 2005a; Rakotonandrasana and Goodman, 2007: 6).

BIOGEOGRAPHY:
Goodman *et al.* (2010b: 600) did not find any clear phylogeographic structure for populations of *R. madagascariensis* on Madagascar. Across the 1,600 km length of Madagascar individuals of *R. madagascariensis* from extreme ends of the island and across numerous biomes, and nearshore islands up to 13 km from the island, demonstrated complete genetic mixing.

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 55) indicate that the baculum has a rounded distal tip and a distinctly narrower proximal base; length: 2.25 ± 0.228 (1.96 - 2.57) mm, width: 0.98 ± 0.179 (0.76 - 1.19) mm.

SEXUAL DIMORPHISM:
Goodman *et al.* (2017b: 72) measured 271 adult males and 289 adult females, and found males to be significantly larger in both forearm length and body mass, although with a considerable overlap: ♂♂: Fa: 75.3 ± 2.00 (70 - 80) mm, Weight: 64.6 ± 6.85 (48.0 - 81.5) g; ♀♀: Fa: 73.0 ± 2.04 (66 - 80) mm, Weight: 56.8 ± 6.54 (31.0 - 75.5) g.

MOLECULAR BIOLOGY:
DNA - Goodman *et al.* (2010b) examined Cyt-*b* from 131 individuals from 17 sites across Madagascar.
Andrianaivoarivelo *et al.* (2008: 1025) isolated 22 nuclear microsatellite loci, which will provide valuable information for population genetic studies.

Karyotype - 2n = 36 and FN = 66, containing 7 large metacentrics, 4 medium-sized submetacentrics, 5 small metacentrics and one acrocentric pair; X: large submetacentric; Y: smallest chromosome, largely heterochromatic (see Richards *et al.*, 2016d: 187, 189).

Protein / allozyme - Unknown.

HABITAT:
Due to its small size, Andrianaivoarivelo *et al.* (2011a: 70) suggest that it is potentially an important seed disperser and pollinator inside forests, since the two other Madagascan fruit bat species are rather large and unable to fly within dense foliage. It was also found to forage in relatively intact forest and highly modified habitats close to villages (see Andrianaivoarivelo *et al.*, 2011a: 76), although this contradicts observations by Randrianandriananina *et al.* (2006), who did not find any *R. madagascariensis* specimens in relatively intact humid forest.

Dammhahn and Goodman (2013: 108) indicate that mid- to upper-canopy in forest and trees growing in open areas form the foraging habitat of this species.

HABITS:
Using radio tracking and light-tagged individuals, Andrianaivoarivelo *et al.* (2011a: 69, 73) found that these bats travelled over 8 km (up to 14.2 km for females and 14.8 km for males) from their roost sites to their feeding grounds, and that round trips might be as far as 27 km. Goodman (1999: 253) and Andrianaivoarivelo *et al.* (2011a: 73) report that they only grasp a ripe fruit in their mouths and then fly off to consume it.

ROOST:
Rousettus madagascariensis roosts in caves and although it is widespread, relatively few roosts are known (MacKinnon *et al.*, 2003). Even though some roosts are protected from hunters because they occur in protected areas (Kofoky *et al.*, 2007) or sacred sites (Rakotoarivelo and Randrianandrianina, 2007), there are many reports of hunting in and around caves (Rakotonandrasana and Goodman, 2007; Jenkins *et al.*, 2007b).

DIET:
Goodman (1999: 253), Andrianaivoarivelo *et al.* (2007: 3) and Andrianaivoarivelo *et al.* (2011a: 69) reported that this species extensively feeds on the fruits of banana (*Musa paradisiaca*, family Musaceae), litchi (*Litchi chinensis*, family Sapindaceae), and *Dimocarpus longan* (Sapindaceae). Jenkins *et al.* (2007b: 213) [referring to Rakotonirainy, 2001] mention these bats visiting *Ficus soroceoides, F. pyrifolia*, and *F. guatteriifolia*. However, Andrianaivoarivelo *et al.* (2012: 19) indicate that in flight cage experiments, *R. madagascariensis* preferred native or

introduced fruit of no commercial value (*Ficus polita, Syzygium jambos* and *S. malaccense* (Myrtaceae)) to commercially important fruits (*Litchi chinensis* and *Diospyros kaki*).

Faecal analysis performed by Nogales *et al.* (2006: 69) indicated that small amounts of seeds were present, which suggests that these bats either feed on nectar, flowers and leaves or on fruits with seeds too large to swallow. They did find *Ficus* seeds in the faeces during the months of March and April.

Jenkins (2007: 17) reported the following plant species being found in faecal samples: *Ficus soroceoides, Ficus botryoïdes, Ficus pyrifolia, Ficus brachyclada* and *Rubus mollucanus*. Seeds less than 2.5 mm in length were swallowed. The seeds that passed through the bat's gut germinated faster than non-ingested seeds.

Andrianaivoarivelo *et al.* (2011a: 75) also indicate that seeds of *Ficus rubra*, which have passed through the digestive tract of *R. madagascariensis* germinate faster than those not passing through it.

Ramanantsalama *et al.* (2018: 6) reported that adult *R. madagascariensis* consumed 37 ± 16 (range 2 - 67) ectoparasites (Streblidae and Nycteribiidae) per day while grooming, whereas juveniles did not ingest any parasites. However, they do admit that this number is an overestimation as they refer to Rajemison *et al.* (2017b), who reported an average of 6.6 bat flies per adult.

PREDATORS:
In one locality on Madagascar (near Antonibe), Goodman and Griffiths (2006: 555) found that 81.3% of the total biomass predated by the barn owl (*Tyto alba*) consisted of *R. madagascariensis*.

POPULATION:
Structure and Density - It roosts in aggregations of up over a thousand individuals (MacKinnon *et al.*, 2003; Rakotoarivelo and Randrianandrianina, 2007), but smaller colonies of a few hundred are also known (Jenkins *et al.*, 2007a; Kofoky *et al.*, 2007; Andrianaivoarivelo *et al.*, 2011b: 80). It can be locally abundant and is often the most commonly trapped species in mist-netting surveys in the west of Madagascar (Kofoky *et al.*, 2007; Rakotoarivelo and Randrianandrianina, 2007).

For the "Grotte des Chauves-souris, Ankarana", Lalarivoniaina Noroalintseheno *et al.* (2017: 72) estimated the population size to be between 675 and 4000 (IC 95 %, between September 2014 and September 2015). For the same population, Noroalintseheno Lalarivoniaina *et al.* (2018: 26-27) found that in adults there was a male bias during the dry season and a female bias during the wet season, whereas this was the inverse for juvenile bats. Adults were also present in higher numbers during the dry season than during the wet season.

Trend - 2008 - Decreasing (Andriafidison *et al.*, 2008q; IUCN, 2009; Andrianaivoarivelo *et al.*, 2011b: 80).

LIFESPAN:
Lalarivoniaina Noroalintseheno *et al.* (2017: 73) found that the survival rate of males tended to exceed that of females.

REPRODUCTION AND ONTOGENY:
Andrianaivoarivelo *et al.* (2011a: 69, 73) report that most juveniles were captured between March and July, and they suspect that young are weaned before 8 weeks of age. Pregnancy (October-December), lactation (December-January) and weaning occurs in the austral summer, when food is readily available.
Lalarivoniaina Noroalintseheno *et al.* (2017: 69) indicate that mating occurs in the dry season and births follow in the wet season. This was also confirmed by Noroalintseheno Lalarivoniaina *et al.* (2018: 26), who only found neonates during the wet season, with an unbiased sex ratio.

MATING:
Goodman *et al.* (2017b: 74) indicate that this species probably has a diffused polygamous mating system, with male-male competition for access to females.

POSTNATAL DEVELOPMENT:
Andrianaivoarivelo *et al.* (2011a: 69) were unable to distinguish juveniles from adults in December, and therefore assume that *R. madagascariensis* reaches somatic maturity within one year.

PARASITES:
Gomard *et al.* (2016: 5) found 15 out of the 49 bats they tested to be positive for *Leptospira* bacteria.

DIPTERA
Tortosa *et al.* (2013: 3), Wilkinson *et al.* (2016), Rajemison *et al.* (2017a; 2017c: 805) and Ramasindrazana *et al.* (2017: Suppl.) report the presence of the Nycteribiid bat fly *Eucampsipoda madagascarensis* Theodor, 1955. Rajemison *et al.* (2017b: 72; Rajemison *et al.* (2017c: 805) reported a second bat fly: *Megastrebla wenzeli* (Jobling, 1952), belonging to the Streblidae. They found that the number of *E. madagascariensis* flies per bat (up to 27) varied by season and was lowest during the rainy season, and that the sex ratio for this fly was biased towards males (especially during the dry season). As for the bats, adult

males were more infected by *E. madagascariensis* than females, subadults and neonates. No such variation was observed for *M. wenzeli*.
Szentiványi *et al.* (2019: Suppl.) indicated that the *E. madagascariensis* bat flies were found to carry Enterobacteriales and *Rickettsia* bacteria.

SIPHONAPTERA
Hastriter (2016: 15) reported the collection of a male flea (*Araeopsylla martialis* (Rotschild, 1903)) from a *Rousettus madagascariensis*, but believes this to be an accidental association.

VIRUSES:
Astroviridae
Two out of 41 by Lebarbenchon *et al.* (2017: Suppl.) tested bats were positive for Astroviruses.

Paramyxoviridae
Henipavirus
Nipah (NiV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) could not detect the virus. Kuzmin *et al.* (2011a: 5) suggest that their exposure to NiV might be the result of contact with infected *Pteropus rufus* specimens.
Hendra (HeV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) were unable to detect the virus.
Tioman (TiV) - In Madagascar during 2003 - 2004, Iehlé *et al.* (2007) found an overall contamination of 20.0 %.

Rhabdoviridae
Lyssavirus
Lagos bat virus (LBV) - A sero reaction was found by Mélade *et al.* (2016a: 6) in seven out of 35 bats tested.
Duvenhage lyssavirus (DUVV) - Four out of 33 bats tested positive in the same study.

UTILISATION:
Golden (2005) reported large annual harvests in the Makira forest and Maroantsetra were unsustainable.
See Jenkins *et al.* (2007b) and Goodman *et al.* (2008d).

Golden and Comaroff (2015: 5) indicate that flying foxes and other fruit bats (including *R. madagascariensis*) are frequently the subject of food taboos, which they link to the fact that these bats are carriers of virulent zoonotic diseases.

ANTHROPOPHILOUS:
Cardiff *et al.* (2012) suggests that a minimum visit distance of 12 m should be maintained and not illuminating the bats directly at tourist caves, as well as not opening other roost sites to tourism, is likely to help to limit disturbance of *R. madagascariensis* by tourists at Ankarana.

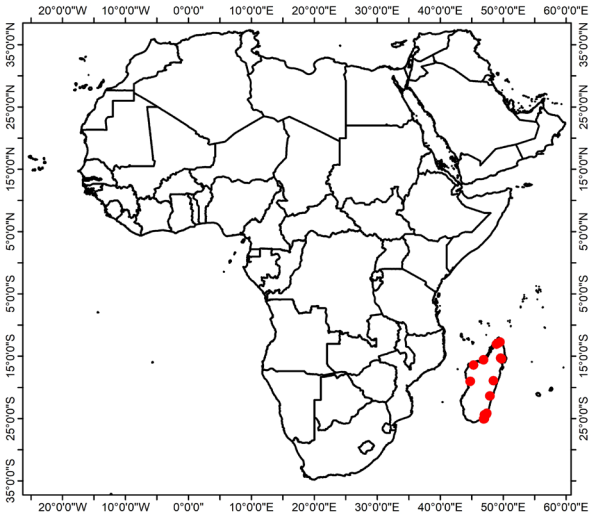


Figure 44. Distribution of *Rousettus madagascariensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar.

Rousettus obliviosus Kock, 1978

*1978. *Rousettus (Rousettus) obliviosus* Kock, in: Olembo, Castelino, and Mutere, Proceedings of the 4th International Bat Research Conference Nairobi, 208. Type locality: Comoros: Grand Comoro: Boboni, cave near [ca. 11 35 S 43 20 E, 640 m]. Holotype: ZFMK 1958.0207:. Presented/Donated by: ?: Collector Unknown. Holotype: ZMB 58207: ad ♂. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 3 August 1903; original number: 60. See Turni and Kock (2008: 21). Paratype: SMF 47973: ad ♂, skull and alcoholic. Formerly ZMB 58201; see Turni and Kock (2008: 21). Paratype: ZMA MAM.20903: sad ♀, skull and alcoholic. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 10-11 October 1903; original number: 94. From Anjouan [= Nzwani, Comoro Ids.]. Formerly ZMB 58196, exchanged in 1979, see Turni and Kock (2008: 21), Bergmans (2011: 842). Paratype: ZMA MAM.20906: imm ♀, skull and alcoholic. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 11 October 1903. Presented/Donated by: ?: Collector Unknown. Paratype: ZMB 4908: skull only. Collected by: Dr. Johann Maria Hildebrandt; collection date: 3 August 1903. From Anjouan [Nzwami, Comoro Isls.]; see Turni and Kock (2008: 21). Paratype: ZMB 58189: skull and alcoholic. Collected by: Prof. Dr. Alfred

Voeltzkow; collection date: 10-11 October 1903; original number: 91. From Cercle de Bambao, Anjouan [= Nzwani, Comoro Ids.]; see Turni and Kock (2008: 21). Paratype: ZMB 58197: sad ♀. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 10-11 October 1903; original number: 88 ?. From Anjouan [= Nzwani, Comoro Ids.]; see Turni and Kock (2008: 21). Paratype: ZMB 58198: skin and skull. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 10-11 October 1903. From Cercle de Bambao, Anjouan [= Nzwani, Comoro Ids.]; see Turni and Kock (2008: 21). Paratype: ZMB 58199: sad ♀. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 10-11 October 1903; original number: 88 ?. From Anjouan [= Nzwani, Comoro Ids.]; see Turni and Kock (2008: 21). Paratype: ZMB 58200: skull and alcoholic. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 10-11 October 1903; original number: 97. From Cercle de Bambao, Anjouan [= Nzwani, Comoro Ids.]; see Turni and Kock (2008: 21). Paratype: ZMB 58202: ad ♀, alcoholic (skull not removed). Collected by: Prof. Dr. Alfred Voeltzkow. From Boboni cave, Grand Comoro; see Turni and Kock (2008: 21). Paratype: ZMB 58203: skull and alcoholic. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 21 December 1903. From Grand Comoro; see Turni and Kock (2008: 21). Paratype: ZMB 58204: skull and alcoholic. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 21 December 1903. From Grand Comoro; see Turni and Kock (2008: 21). Paratype: ZMB 58205: skull and alcoholic. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 21 December 1903. From Grand Comoro; see Turni and Kock (2008: 21). Paratype: ZMB 58206: skull and alcoholic. Collected by: Prof. Dr. Alfred Voeltzkow; collection date: 21 December 1903. From Grand Comoro; see Turni and Kock (2008: 21).

? *Rousettus obliviosus:* (Name Combination, Current Combination)

TAXONOMY:
Considered a valid species by Meirte (1987), Koopman (1993a: 153), Bergmans (1994: 79), Wilson and Cole (2000: 40), and Simmons (2005: 348), but as a subspecies of *madagascariensis* by Peterson *et al.* (1995: 48).

Goodman *et al.*, 2010b: 599) shows that *R. obliviosus* is a sister taxa to *R. madagascariensis* with a 6.2-8.7 % sequence divergence, and clearly form a reciprocally monophyletic clades.

COMMON NAMES:
Czech: kaloň Kockův. English: Comoro Rousette. French: Roussette des Comores, la petite roussette des Comores. German: Komoren-Höhlenflughund.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU B1ab(iii)+2ab(iii) ver 3.1 (2001)) in view of its extent of occurrence of and area of occupancy being a maximum of 1,659 km^2), with all individuals in fewer than ten locations (six roosting caves known), and a continuing decline in the extent and quality of its habitat. If the roosting locality of Bandakalala has been abandoned, and no additional roosting sites located, then the species will qualify as Endangered B1ab(iii)+2ab(iii) in view of its restricted range and being limited to five or fewer localities (roosting caves) (Mickleburgh *et al.*, 2008v; IUCN, 2009).

Assessment History - 2008 - VU B1ab(iii)+2ab(iii) ver 3.1 (2001) (Mickleburgh *et al.*, 2008v; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004cr; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
Mickleburgh *et al.* (2008v) [in IUCN (2009)] report that the species is sensitive to disturbance at roost sites and this appears to be the major threat to this restricted range bat. During the early 1990s, deforestation on the Comoros averaged 5.8% per year, with human population growth at 2.5%. While the species is regularly recorded from agricultural areas, and it seems that deforestation is possibly not a major threat, this bat also uses areas of both natural and underplanted forests which are expected to help the species cope with seasonal and year to year environmental variation, including droughts and cyclones (Sewall *et al.*, 2003: 350). Anonymus (2000: 31) also points out that the fact that rivers become dried out, forms a major threat for this species.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008v) [in IUCN (2009)] report that there are currently no direct conservation actions in place for this species. The National Conservation Action Plan for *Pteropus livingstoni* (Sewall *et al.*, 2003) includes an appendix for the conservation of *R. obliviosus*. While the few known roosting sites are in remote areas, there is a need to ensure that these caves are not disturbed. Sewall *et al.* (2003) note that the roosting site at Bandakalala on Moheli might have

been abandoned. Additional field surveys are needed to confirm this, as are attempts to locate any additional roost sites for this species. Anonymus (2000: 31) indicates that an action plan for the conservation of the Comoran fruit bats needs to be worked out and implemented. Also a local and national education and sensibilisation (Projet Biodiversité, …) needs to be put in place to make people aware of the importance of fruit bats and their role in the forests.

GENERAL DISTRIBUTION:
Rousettus obliviosus is restricted to the lower elevations of the islands of Grande Comores, Moheli and Ajouan in the Comoros, western Indian Ocean. The species has not been reported on Mayotte Island (Louette, 1999; Sewall *et al.*, 2003; Goodman *et al.*, 2010c: 124); Goodman *et al.* (2010c: 125) suggest that the reason for the absence from Mayotte island is that it is geologically the oldest (Emerick and Duncan, 1982) and the former lava tubes - important day roost sites for this species elsewhere in the archipelago - have collapsed (Goodman *et al.*, 2010c: 125). On Grande Comore it has an elevational range from near 30 to 1,750 m, on Anjouan from 200 to 1,350 m, and on Moheli from 10 to 700 m (Sewall *et al.*, 2003; Goodman *et al.*, 2010c: 125).

Native: Comoros (Mickleburgh *et al.*, 1992; Carroll and Feistner, 1996; Sewall *et al.*, 2003; Goodman *et al.*, 2010c: 124).

BIOGEOGRAPHY:
Goodman *et al.* (2010b: 600) did not find any clear phylogeographic structure for populations of *R. obliviosus* on Grand Comore, Anjouan and Moheli, with open-water distances separating these islands between 40 and 80 km.

ECHOLOCATION:
Although Reason *et al.* (1994: 402) did not see flying *R. obliviosus* before dusk, it is unknown whether this species is able to echolocate.

MOLECULAR BIOLOGY:
DNA - Goodman *et al.* (2010b) examined Cyt-*b* from 44 individuals from three islands in the Comoro island (Grande Comore, Anjouan, and Moheli).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
R. obliviosus has been found roosting in forest caves near waterfalls (Anonymus, 2000: 30) and it feeds in the Comoron rain forests. Forages in agricultural zones, degraded or largely intact-forested areas, and understory plantations (Goodman *et al.*, 2010c: 125). A number of cave roost sites are at considerable distances from native forests (Goodman *et al.*, 2010c: 125).

HABITS:
R. obliviosus is strictly nocturnal, as Goodman *et al.* (2010c: 125) recorded exit times commenced on the 16 November 2006 at 18h45, after complete darkness at a cave roost at Nyamaoui Panga (Grand Comore).

ROOST:
Roosts in lava tube caves or difficult to access rock crevices (Goodman *et al.*, 2010c: 125). Reason *et al.* (1994) suggested that it uses tree hollows for day roost sites. However, there is no evidence for this (Goodman *et al.*, 2010c: 125). Wilkinson *et al.* (2012: 160) indicate that caves are typical roosting sites for this species on the Comoros.

Middleton and Hume (2010: 137) found a colony of a few thousand animals in a large overhang 12.4 m high, 15 m deep and about 35 m long, beside a waterfall on Anjouan Island.

DIET:
Young *et al.* (1993) [in Carroll and Feistner (1996: 330)] indicate that *R. obliviosus* and *P. livingstonii* were captured at the same kapok and fig feeding sites on Anjouan, which would suggest that their feeding niches might overlap. However, they also indicate that there might be a vertical separation between the two species.

Based on direct observations and food plants recovered from ejecta, *R. obliviosus* commonly feeds on several species of introduced fruiting plants (Mickleburgh *et al.*, 1992; Sewall *et al.*, 2003). Goodman *et al.* (2010c: 125) list *Ceiba pentandra* [= Kapok tree] (Malvaceae), *Musa* spp. [= Banana] (Musaceae), *Artocarpus integrifolia* [= Jackfruit] (Moraceae), and *Carica papaya* [= Papaya] (Caricaceae). Most of these are introduced plants which are abundant in agricultural areas with degraded forest. Ratrimomanarivo (2007) characterized *R. obliviosus* as a forest dependent species, which is not supported by Goodman *et al.* (2010c: 125).

POPULATION:
Structure and Density - The species is fairly common, with colony roost size ranging from around 100 to several thousand animals (Sewall *et al.*, 2003; Goodman *et al.*, 2010c: 125). Hume and Middleton (2011: 35) report that over 2,000 animals were hanging from the ceiling of a cave called "Rousettus Overhang" on Anjouan. The total estimated population is between 7,100 and 17,100 bats (Sewall *et al.*, 2003).

Reason *et al.* (1994: 399) reported a female sex ratio bias on Anjouan, which was not statistically significant.

Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008v; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Reason *et al.* (1994: 125) noted that during the months of July and August 1992 on Anjouan, non-reproductive subadults were captured, estimated to be between 3 and 12 months old. Similarly, Carroll and Thorpe (1991) on Anjouan late July 1990 captured four parous adult females and two non-parous adult females; not one showed signs of reproductive activity. On the 16 November, Goodman *et al.* (2010c: 125) visited Nyamaoui Panga on Grande Comore, where among the 14 free-flying adults captured, seven were male, one of which had scrotal testes measuring 8 x 4 mm with partially convoluted epididymes, and the remaining six were not in reproductive condition. Amongst the seven females, two were pregnant, with single embryos measuring 2 - 31 mm in crown rump length, four lactating, and one non-reproductive. Goodman *et al.* (2010c: 125) revisited the site on the 6 December 2006 and amongst the six individuals caught, one male had abdominal testes, one was a female that had previously reproduced and showed no sign of active reproduction, and the balance were lactating females with single placental scars. This indicates that individuals at different reproductive stages during the same period, and there also appears to be notable inter-island synchronization in the reproductive season (Goodman *et al.*, 2010c: 125). The birthing period would seem to coincide with the wet season, October to April.

Reason *et al.* (1994: 401) suggest that females can reach sexual maturity in their first year (earlier than males).

PARASITES:
R. obliviosus from the Comoros tested positive for *Leptospira* bacteria (Lagadec *et al.*, 2012: 1696). Dietrich *et al.* (2018a: 3) identified these further as *L. interrogans* and *L. borgpetersenii*. Lei and Olival (2014: Suppl.) mention that the species is also a host for *Bartonella* bacteria.

Tortosa *et al.* (2013: 3) and Wilkinson *et al.* (2016) report the presence of the Nycteribiid bat fly *Eucampsipoda theodori*. These bat files were found to carry Enterobacteriales and *Bartonella* bacteria (Szentiványi *et al.*, 2019: Suppl.).

Reason *et al.* (1994: 399) collected *Brachytarsia* sp. (possibly *B. wenzeli* [=?*Megastrebla wenzeli*]).

VIRUSES:
Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 26 individuals from the Comoros using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids.

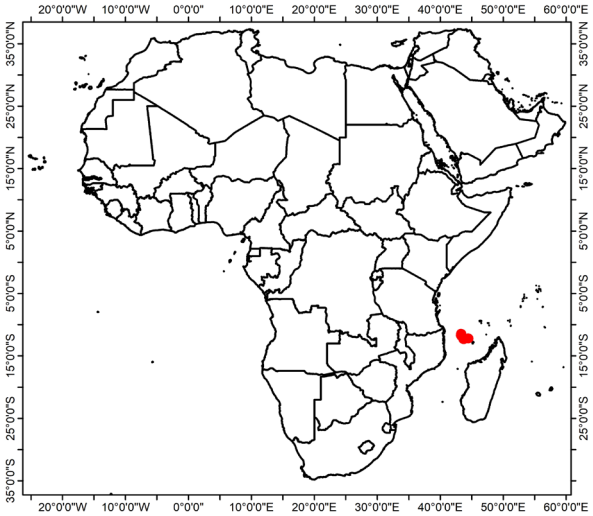


Figure 45. Distribution of *Rousettus obliviosus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Comoros, South Africa.

Genus ***Scotonycteris*** Matschie, 1894

*1894. *Scotonycteris* Matschie, Sber. Ges. naturf. Freunde Berlin, 200. - Comments: Type species: *Scotonycteris zenkeri* Matschie, 1894. - Etymology: From the Greek "*σκόοτος*", meaning darkness and "*νυκτερίς*", meaning bat (see Palmer, 1904: 627). (Current Combination)

TAXONOMY:
Reviewed by Bergmans (1991). See also Simmons (2005: 349), Hassanin *et al.* (2015). Based on cyt *b* analyses, Hassanin (2014: 141) transferred *ophiodon* Pohle, 1943 from *Scotonycteris* to *Casinycteris*. Further analyses on cyt *b* and nuclear DNA data led Hassanin *et al.*

(2015: 206) to split up *S. zenkeri* in four clades of which they recognized three as full species.

Included in the Scotonycterini tribe by Bergmans (1997: 69) and Almeida *et al.* (2016: 83), which was considered part of the Epomophorinae by the former and of the Rousettinae by the latter.

Known species of *Scotonycteris*: ***bergmansi*** Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, 2015, ***occidentalis*** Hayman, 1947, ***zenkeri*** Matschie, 1894.

COMMON NAMES:
Czech: hadozubí kaloni. English: Harlequin Fruit-bats, Tear-drop Fruit-bats, West African fruit bats. French: Scotonyctères. German: Harlekin-Flughunde.

MOLECULAR BIOLOGY:
Based on analyses of mitochondrial cyt *b* and nuclear DNA sequences, Hassanin *et al.* (2015: 205) found support for four clades: Upper Guinea (Liberia and Côte d'Ivoire), Cameroon, western Equatorial Africa (EG, Gabon, RC, and southwestern CAR), and eastern DRC. The mtDNA distances calculated between these four geographic clades are slightly higher than those found between the three species of the genus *Casinycteris*, which suggest that *S. zenkeri* might contain four cryptic species. These results are confirmed nuclear DNA data, except for the eastern DRC clade. Hassanin *et al.* (2015) suggest that females from eastern DRC and western Equatorial Africa have remained isolated since the end of the Pliocene (2.7 Mya), whereas males were able to disperse, at least occasionally during interglacial periods, resulting in male-mediated nuclear gene flow between these distant populations, apparently from western Equatorial Africa to eastern DRC.

Scotonycteris bergmansi Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, 2015

*2015. *Scotonycteris bergmansi* Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, C. R. Biologies, 338 (3): 206. Publication date: 27 January 2015. Type locality: Central African Republic: Mabaéré-Bodingué National Park: Case of Kpoka [3.90 N 17.16 E, 430 m] [Goto Description]. Holotype: MNHN ZM-2011-713: ad ♀, alcoholic (skull not removed). Collected by: Alexandre Hassanin, Emmanuel Nakouné, Nicolas Nesi and Carine Ngoagouni; collection date: 16 November 2008; original number: R08-119. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of Dr. Wim Bergmans, a Dutch zoologist, for his outstanding contributions in the fields of taxonomy and biogeography of African fruit bats (see Hassanin *et al.* (2015: 206).

COMMON NAMES:
English: Bergmans's fruit bat. French: Scotonyctère de Bergmans. German: Bergmans Harlekin-Flughund.

GENERAL DISTRIBUTION:
Scotonycteris bergmansi occurs in Equatorial Africa, where it is known from the rainforests of Gabon, Equatorial Guinea, Republic of Congo, southern Central African Republic, and eastern Democratic Republic of the Congo Hassanin *et al.* (2015: 207).

Native: Gabon, Equatorial Guinea, Congo, Central African Republic, Democratic Republic of the Congo.

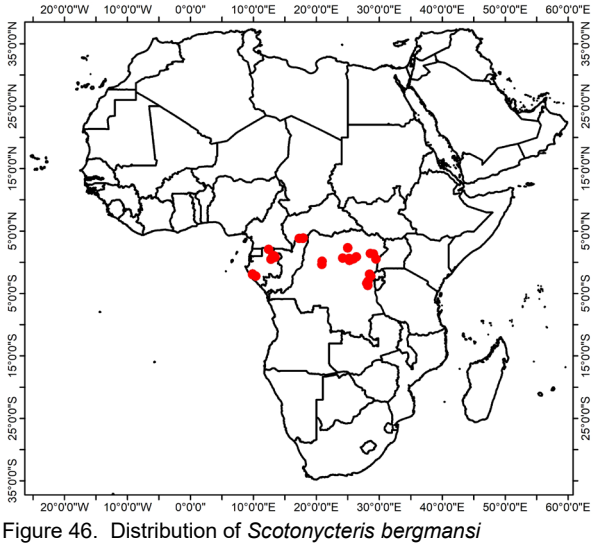


Figure 46. Distribution of *Scotonycteris bergmansi*

Scotonycteris bergmansi bergmansi Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, 2015

*2015. *Scotonycteris bergmansi bergmansi* Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, C. R. Biologies, 338 (3): 206. Publication date: 27 January 2015. Type locality: Central African Republic: Mabaéré-Bodingué National Park: Case of Kpoka [3.90 N 17.16 E, 430 m] [Goto Description]. - Etymology: In honour of Dr. Wim Bergmans, a Dutch zoologist, for his outstanding contributions in the fields of taxonomy and biogeography of African fruit bats (see Hassanin *et al.* (2015: 206).

GENERAL DISTRIBUTION:
Scotonycteris bergmansi bergmansi is found in the rainforests of western Equatorial Africa in the following countries: Central African Republic (South), Republic of Congo, Gabon, and Equatorial Guinea.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Primus *et al.* (2006) reported a male "*S. zenkeri*" from Gabon with a 2*n* = 32.
Protein / allozyme - Unknown.

Scotonycteris bergmansi congoensis Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, 2015

*2015. *Scotonycteris bergmansi congoensis* Hassanin, Khouider, Gembu, Goodman, Kadjo, Nesi, Pourrut, Nakouné, and Bonillo, C. R. Biologies, 338 (3): 207. Publication date: 27 January 2015. Type locality: Congo (Democratic Republic of the): Sukisa [2.31 N 24.98 E, 470 m] [Goto Description]. Holotype: MNHN ZM-2014-564: ad ♀, alcoholic (skull not removed). Collected by: ?: Collector Unknown; original number: K13-48. Presented/Donated by: ?: Collector Unknown.

GENERAL DISTRIBUTION:
Scotonycteris bergmansi congoensis is found in the rainforests of eastern DRC.

Native: Congo (Democratic Republic of the).

DIET:
Gembu Tungaluna (2012: 110 - 112) reported the following fruits being eaten by "*Scotonycteris zenkeri*" in the Kisangani area (DRC) during the various seasons: First heavy rain season (September - November): *Ficus leprieuri* Miq., 1867 (29%), *Ficus wildemanniana* Warb. (22%), *Uapaca guineensis* Müll.Arg., 1864 (Sugar plum, red cedar, false mahogany, rikio) (14%), *Musanga cecropioides* R.Br. & Tedlie (African corkwood tree, umbrella tree) (14%), *Spondias cytherea* Sonnerat, 1782 (Ambarella, otaheite apple, great hog plum) (7%), *Annonidium mannii* (Oliv.) Engl. & Diels (Junglesop) (7%), *Pseudospondias microcarpa* (A. Rich.) Engl. (7%).
First mild rain season (December - February): *Ficus wildemanniana* (33%), *Ficus leprieuri* (27%), *Myrianthus arboreus* P. Beauvois, 1805 (giant yellow mulberry, bush pineapple, corkwood) (20%), *Musanga cecropioides* (20%).
Second heavy rain season (March - May): *Annonidium mannii* (17%), *Musanga cecropioides* (17%), *Oncoba welwitschii* Oliv. (11%), *Ficus leprieuri* (11%), *Ficus vallis-choudae* Delile (11%), *Ficus* sp1 (11%), *Parinari excelsa* Sabine (Guinea plum) (6%), *Carica papaya* L. (papaya) (6%), *Uapaca guineensis* (5%), *Spondias cytherea* (5%).
"Dry" season (June - August): *Parinari excelsa* (50%), *Ficus leprieuri* (25%), *Musanga cecropioides* (25%).

Scotonycteris occidentalis Hayman, 1947

1947. *Scotonycteris zenkeri occidentalis* Hayman, Ann. Mag. nat. Hist., ser. 11, 13 (104): 547 (for 1946). Publication date: 25 June 1947. Type locality: Ghana: Central province: Oda [05 55 N 00 56 W] [Goto Description]. Holotype: BMNH 1946.898: ad ♀, skin and skull. Collected by: George Soper Cansdale; collection date: 1946. - Etymology: *occidentalis* refers to the western Africa.

COMMON NAMES:
English: Hayman's tear-drop fruit bat. French: Scotonyctère de Hayman. German: Haymans Harlekin-Flughund.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bm) [in IUCN (2009)] report that although there appear to be no direct conservation measures in place [for "*S. zenkeri*"], it has been recorded from a number of protected areas (e.g. Tai National Park, Côte d'Ivoire). There is a need to investigate whether this species can adapt to secondary forest habitats. Further studies are needed to fully determine if the species is present in forested areas between known localities.

GENERAL DISTRIBUTION:
Scotonycteris occidentalis is distributed in West Africa, where it ranges from Liberia and Guinea, into Côte d'Ivoire, Ghana and possibly Nigeria.

Native: Côte d'Ivoire (Heim de Balsac, 1934b: 24 - as "*S. zenkeri*); Ghana; Guinea; Liberia; Nigeria [Hassanin *et al.* (2015: 206) indicate that some Nigerian populations might belong to *S. zenkeri*, leaving the possibility that some others might belong to *S. occidentalis*].

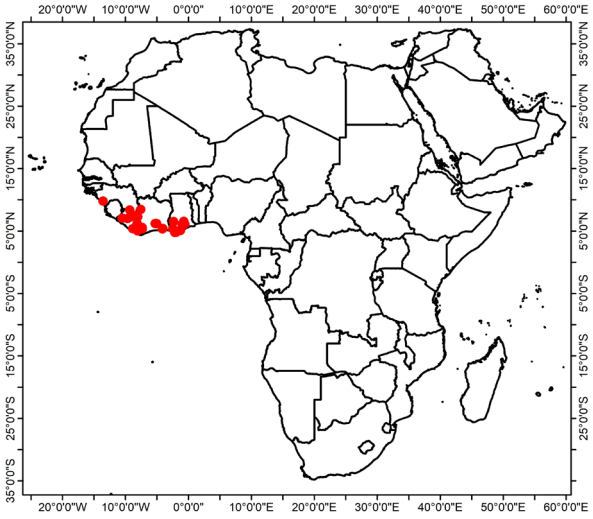


Figure 47. Distribution of *Scotonycteris occidentalis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Côte d'Ivoire, Ghana, Guinea, Liberia.

Scotonycteris zenkeri Matschie, 1894

*1894. *Scotonycteris zenkeri* Matschie, Sber. Ges. naturf. Freunde Berlin, 202. Type locality: Cameroon: Yaunde [03 52 N 11 31 E]. Holotype: ZMB 66533: ad ♀, skull and alcoholic. Collected by: Georg August Zenker. See Turni and Kock (2008: 21). (Current Combination)

1904. *Scotonycteris bedfordi* Thomas, Abstr. Proc. Zool. Soc. Lond., 4: 14. Publication date: 8 March 1904. Type locality: Equatorial Guinea: Bioko: Fish Town [10 m] [Goto Description]. Holotype: BMNH 1904.7.1.28: ad ♀, skin and skull. Collected by: E. Seimund; collection date: 2 January 1904; original number: 31. Presented by Fernando Poo Committee: see Andersen (1912b: 568).

? *Scotonycteris zenkeri zenkeri:* (Name Combination)

TAXONOMY:
See Simmons (2005: 349).

See also Hassanin *et al.* (2015: 206), who split-off *occidentalis* and *bergmansi*.

COMMON NAMES:
Czech: kaloň Zenkerův. English: Zenker's Harlequin Fruit-bat, Zenker's Tear-drop Fruit-bat, Zenker's Fruit Bat. French: Scontonyctère de Zenker, Roussette de Zenker. German: Zenkers Harlekin-Flughund, Zenker's Traenenflughund. Spanish (Castillian): Zorra Voladora de Zenker.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in some protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bm; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bm; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004bk; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

This status is for *S. zenkeri* as perceived prior to the publication of Hassanin *et al.* (2015) and will need to be re-evaluated in view of the split-up of this species.

MAJOR THREATS:
The species is threatened by habitat loss, presumably largely through logging and mining operations and the conversion of land to agricultural use (Mickleburgh *et al.*, 2008bm; IUCN, 2009).

GENERAL DISTRIBUTION:
Hassanin *et al.* (2015: 206) restricted the distribution of *S. zenkeri* to Cameroon, with the remark that additional data are needed to assess the taxonomic status of some populations from Nigeria. Tentatively, we assigned the Nigerian specimens to this species.

Native: Cameroon; Nigeria(?).

DETAILED MORPHOLOGY:
Chawana *et al.* (2013: 160) mention that the average brain mass for 2 specimens was 0.64 g.

FUNCTIONAL MORPHOLOGY:
Sagot and Chaverri (2015: 191) indicated that the retinal area in the eye of *S. zenkeri* covers about 40 - 50 mm^2 and contains about 90,000 retinal ganglion cells. The minimum angle of resolution was about 0.227° (ca. 8 mm at 1 m distance).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Primus *et al.* (2006) reported a male from Gabon with a 2*n* = 32, but the specimen on which this is based, would currently be assigned to *S. bergmansi*, so the karyotype for *S. zenkeri* is still to be confirmed.
Protein / allozyme - Unknown.

HABITAT:
Juste B. and Perez del Val (1995: 144) reported that *S. zenkeri* was only netted below 400 m, and was found more frequently in cultivated clearings than in rainforests.

POPULATION:
Structure and Density - It appears to be a rare, or at least rarely recorded, species (Mickleburgh *et al.*, 2008bm; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bm; IUCN, 2009).

The above statements pertain to *S. zenkeri* s.l. and need to be re-evaluated in view of the split-up proposed by Hassanin *et al.* (2015: 206).

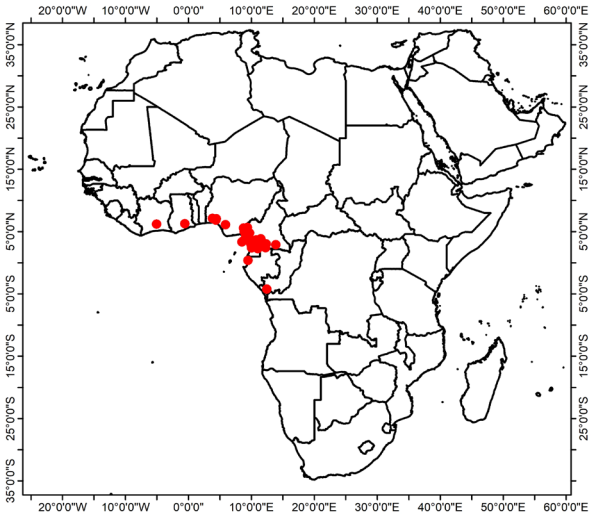


Figure 48. Distribution of *Scotonycteris zenkeri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Nigeria.

Genus ***Stenonycteris*** Gray, 1870

1870. *Stenonycteris* Gray, Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London, 127. - Comments: Considered a valid genus by Giannini and Simmons (2003: 504), Lavrenchenko *et al.* (2004b: 130), but only a synonym according to Bergmans (1994: 79). Sometimes considered a valid subgenus containing *lanosus*. Allen (1939a: 62), Meester *et al.* (1986: 28), Bergmans (1994: 80), and Kwiecinski and Griffiths (1999: 1) assigned this name to K. Andersen, Cat. Chiroptera Brit. Mus., 1: 23, 1912. - Etymology: From the Greek *stenos* meaning narrow and *nycteris* meaning bat (see Andersen, 1912b: 23).

TAXONOMY:
Included in the Stenonycterini tribe (Almeida *et al.*, 2016: 83).

Known species of *Stenonycteris*: ***lanosus*** (Thomas, 1906).

Stenonycteris lanosus (Thomas, 1906)

*1906. *Rousettus lanosus* Thomas, Ann. Mag. nat. Hist., ser. 7, 18 (104): 137. Publication date: 1 August 1906. Type locality: Uganda: Ruwenzori East: Mubuku Valley [00 15 N 30 10 E, 13 000 ft] [Goto Description]. Holotype: BMNH 1906.7.1.2: ad ♂, skull and alcoholic. Collected by: Mr. R.B. Woosnam. Presented by Ruwenzori Exploration Committee: see

Andersen (1912b). - Comments: Type locality originally "Ruwenzori East at 13,000 ft", but restricted to Mubuku Valley by Hayman *et al.* (1966: 30) (see Bergmans, 1994: 109). - Etymology: From the Greek/Latin? "*lanosus*" for woolly. (Current Combination)

1909. *Rousettus kempi* Thomas, Ann. Mag. nat. Hist., ser. 8, 4 (24): 543. Publication date: 1 December 1909. Type locality: Kenya: Southern slopes Mount Elgon, Kirui's: Twere [ca. 00 46 N 34 37 E, 6 000 ft] [Goto Description]. Holotype: BMNH 1910.4.1.6: sad ♂, skin and skull. Collected by: Robin Kemp; collection date: 16 September 1909; original number: 269. Presented/Donated by: C.D. Rudd Esq. Formerly in Rudd collection.

2012. *Stenonycteris lanosus:* Nesi, Kadjo, Pourrut, Leroy, Pongombo Shongo, Cruaud and Hassanin, Mol. Phylog. Evol., 66 (1): 135 (for 2013). Publication date: 10 October 2012. (Name Combination, Current Combination)

? *Rousettus (Stenonycteris) lanosus:* (Name Combination)

? *Rousettus lanosus kempi:* (Name Combination)

? *Rousettus lanosus lanosus:* (Name Combination)

TAXONOMY:
Revised by Bergmans (1994), but see Simmons (2005: 348).

Included in the genus *Stenonycteris* by Almeida *et al.* (2011a: 5, 7, 9, 10) and Patterson and Webala (2012: 10) since it consistently recovered in another clade allied to *Myonycteris, Lissonycteris*, and *Megaloglossus*.

Nesi *et al.* (2012: 126) confirm that *Stenonycteris* should be considered a separate genus and should even be placed in its own tribe (Stenonycterini), within the subfamily Epomophorinae.

COMMON NAMES:
Chinese: 狭齿果蝠. Czech: kaloň vlnatý. English: Mountain Rousette, Long-haired Rousette, Woolly Rousette, Ruwenzori Long-haired Rousette. French: Roussette du Ruwenzori, Roussette à longs poils. German: Gebirgs-Höhlenflughund. Kinande (DRC): Karakonube

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) [as *Rousettus lanosus*] in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because the global population is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008dg; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008dg; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cx; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The major threats to this species include ongoing deforestation in montane regions, likely disturbance of cave roosting sites (possibly from tourists in parts of its range), and possible overhunting of bats at roost sites for subsistence food by local people (Mickleburgh *et al.*, 2008dg; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dg) [in IUCN (2009)] report that although there appear to be no direct conservation measures in place, it has been recorded from a number of protected areas (e.g. Mount Elgon National Park, Kenya). There is a need to maintain remaining areas of suitable montane forest and to protect major roosting colonies from disturbance. In areas where this species is identified as being overhunted, there is a need to encourage the sustainable use of susceptible populations.

GENERAL DISTRIBUTION:
Stenonycteris lanosus is distributed in East Africa and marginally in Central Africa. It ranges from Ethiopia and southern Sudan in the north of its range, into Kenya, Uganda, eastern Democratic Republic of the Congo and Rwanda, to Tanzania and northern Malawi. It is largely, but not strictly, a montane species being found between 500 and 4,000 m asl (with most records above 1,000 m, e.g. at 13,000 ft in the Mubuku Valley, E. Ruwenzori [Thomas, 1910b: 486]).

Native: Congo (The Democratic Republic of the); Ethiopia (Bergmans, 1994: 79); Kenya; Malawi (Bergmans, 1994; Bergmans, 1994: 79; Monadjem *et al.*, 2010d: 555); Rwanda (Bergmans, 1994: 79); Sudan; Tanzania (Stanley and Goodman, 2011: 41); Uganda (Kityo and Kerbis, 1996: 60).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data: Fa: 94.5 mm, mass: 121 g, wing loading: 21.8 N/m^2, aspect ratio: 5.6.

POPULATION:
Structure and Density - This appears to be a little recorded, but locally abundant species (Mickleburgh *et al.*, 1992). It forms colonies of up to a few hundred bats (Mickleburgh *et al.*, 2008dg; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008dg; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 18.7 years.

REPRODUCTION AND ONTOGENY:
Stanley and Goodman (2011: 40) reported on five pregnant females collected between 19 and 24 July 1993 in the South Pare Mountains (Tanzania).

Kingdon (1974) [in Krutzsch (2000: 111)] showed that *S. lanosus* is one of the species in which pregnant or lactating females are present in the population in all months of the year, and where most adult males have enlarged spermatogenic testes and hypertrophied, secretion-filled accessory glands. This would indicate that while males are fecund population-wide, they enter periods of inactivity individually.

PARASITES:
HAEMATOSPORIDA
The two South Sudanese "*Rousettus lanosus*" specimens tested by Schaer *et al.* (2017: 2) were infected by *Hepatocystis* parasites.

DIPTERA
Nycteribiidae: *Dipseliopoda setosa* Theodor, 1955 from Kenya and Tanzania (Haeselbarth *et al.*, 1966: 116).
The fly *Stylidia scissa* Speiser, 1901 was collected on a bat from South Sudan (the same bat where also *T. dina* was collected from, see below), although Bergmans (1982: 161) indicates that this fly is generally found on Microchiropterans and its find might "be due to straggling between spirit specimens".

SIPHONAPTERA
Ischnopsyllidae: *Thaumapsylla breviceps* Rothschild 1907, where the nominate subspecies *T. b. breviceps* Hopkins and Rothschild, 1956 is occurring in Kenya and the DRC (Haeselbarth *et al.*, 1966: 186). *Thaumapsylla dina* Jordan, 1937 in the mountains of the Ruwenzori, Congo and Kenya (Haeselbarth *et al.*, 1966: 186). (Bergmans (1982: 161) reported that this flea was also collected from a "*Rousettus lanosus*" from South Sudan.

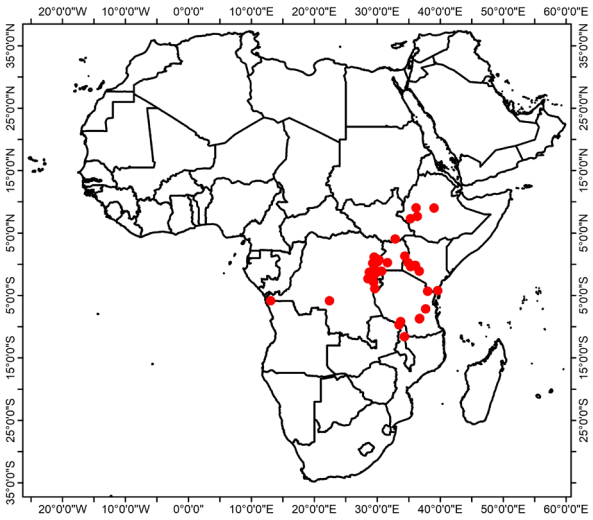


Figure 49. Distribution of *Stenonycteris lanosus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Burundi, Congo (Democratic Republic of the), Egypt, Ethiopia, Kenya, Malawi, Rwanda, South Sudan, Tanzania, Uganda.

INFRAORDER RHINOLOPHIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007

1866. *Histiorrhina* Haeckel, Generelle Morphologie der Organismen., 2: clx. - Comments: Proposed as family, including the genera *Rhinolophus* Lacépède, 1799; *Megaderma* É. Geoffroy, 1810; and *Phyllostoma* G. Cuvier, 1800 [= *Phyllostomus* Lacépède, 1799] (see Jackson and Groves, 2015: 229).
1998. *Megachiropteramorpha* Simmons and Geisler, Bull. Am. Mus. Nat. Hist., 235: 135, 136. - Comments: Originally included the fossil *Archaeopteropus* Meschinelli, 1903 and the suborder Megachiroptera (Dobson, 1875) (see Jackson and Groves (2015: 229).
*2007. *RHINOLOPHIFORMACEI* Van Cakenberghe, Kearney and Seamark, African Chiroptera Report. Publication date: July 2007. - Comments: The name of the Infraorder is based on *Rhinolophus* Lacépède, 1799 (type of RHINOLOPHIDAE Gray, 1825). (Current Combination)

Superfamily RHINOLOPHOIDEA J. E. Gray, 1825

1825. *Rhinolophina* Gray, Ann. Philos., 10 (5): 338. - Comments: Proposed as tribe and originally containing the genera *Megaderma* É. Geoffroy, 1810; *Rhinolophus* Lacépède, 1799; *Nycteris* É. Geoffroy & G. Cuvier, 1795; *Mormoops* Leach, 1821 and *Nyctophilus* Leach, 1821. Jackson and Groves (2015: 241, 242) placed this name in the synonymy of both Rhinolophoidea and Rhinolophidae.

*1825. *Rhinolophoidea* Gray. - Comments: The name of the Superfamily is based on *Rhinolophus* Lacépède, 1799 (type of RHINOLOPHIDAE Gray, 1825).

Some publications assigned the name to Bell (1836). (Current Combination)

COMMON NAMES:
Czech: vrápencovci, vrápenci.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Shi and Rabosky (2015: 1532) [based on Teeling *et al.* (2005)] mention 55 milion years ago as approximate fossil date for the Rhinolophoidea, and Patterson and Webala (2012: 12) indicate that the separation between the Rhinolophidae and the Hipposideridae took place some 28.7 mya, although Shi and Rabosky (2015: 1532) set this about 8 million years earlier (at 37 mya). Foley *et al.* (2014: 320) provide another estimate for the African divergence between the Rhinolophidae and the Hipposideridae from their common ancestor: 42 mya. Based on transcriptome RNA-seq data, Lei and Dong (2016: 2) placed the split at about 40 mya.

Ravel *et al.* (2016: 358) indicate that the oldest occurrence of the Hipposideridae in northern Africa and the oldest occurrence of the Rhinolophidae in eastern Asia suggest that a common ancestor for these two families might have occurred in Central Asia. Unfortunately, there are no fossil records to substantiate this.

BIOGEOGRAPHY:
Foley *et al.* (2014: 320) indicate that the Rhinolophoidea and Pteropodidae diverged approximately 59 Mya. While within the Rhinolophoidae, the families Rhinolophidae and Hipposideridae diverged in Africa from their common ancestor approximately 42 May during the Eocene. The family Rhinonycteridae separated from the other Hipposideridae approximately 39 Mya, also in Africa (Foley *et al.*, 2014: 320).

Family HIPPOSIDERIDAE Lydekker, 1891

1860. *Phyllorhina* Koch, Bericht der Oberhessischen Gesellschaft für Natur- und Heilkunde, 8 (4): 26. - Comments: Type genus: *Phyllorrhina* Bonaparte, 1837 [1832–1841] [= *Hipposideros* J. Gray, 1831]. Jackson and Groves (2015: 245) indicate the name is unavailable.

1860. *Phyllorrhina* Koch. - Comments: Pavlinov *et al.* (1995: 75) mention *Phyllorrhina* with a question mark as synonym of Hipposideridae. Lanza *et al.* (2015: 121) mention "*Phyllorhina*" Koch as a synonym of the genus *Asellia*.

*1891. *Hipposideridae* Lydekker, in: Flower and Lydekker, Mammals Living and Extinct, 657. (Current Combination)

*1891. *Hipposiderinae* Lydekker, in: Flower and Lydekker, Mammals Living and Extinct, 657. - Comments: Type genus: *Hipposideros* Gray, 1831. Originally included the genera *Hipposiderus* [sic] J. Gray, 1834 [= *Hipposideros* J. Gray, 1831]; *Anthops* Thomas, 1888; *Rhinonicteris* J. Gray, 1847; *Triaenops* Dobson, 1871; and *Coelops* Blyth, 1848 (see Jackson and Groves, 2015: 244). (Current Combination)

1907. *Hipposideridae* Miller, Bull. U.S. natl. Mus., 57: viii, 109. Publication date: 29 June 1907. - Comments: Type genus: *Hipposideros* J. Gray, 1831. Originally included the genera *Hipposideros* J. Gray, 1831; *Asellia* J. Gray, 1838; *Anthops* Thomas, 1888; *Coelops* Blyth, 1848; *Cloeotis* Thomas, 1901; *Rhinonicteris* J. Gray, 1847; and *Triaenops* Dobson, 1871 (see Jackson and Groves, 2015: 245).

1941. *Coelopinae* Tate, Am. Mus. Novit., 1140: 11. Publication date: 20 August 1941. - Comments: Type genus: *Coelops* Blyth, 1848.

1970. *Hipposiderini* Koopman and J.K. Jones Jr., in: Slaughter, Classification of bats, 25. - Comments: Type genus: *Hipposideros* J. Gray, 1831. Proposed as tribe and originally

included the genera *Hipposideros* J. Gray, 1831; *Aselliscus* Tate, 1941; *Cloeotis* Thomas, 1901; *Rhinonicteris* J. Gray, 1847 and *Triaenops* Dobson, 1871 (see Jackson and Groves, 2015: 245).

1994. *Hipposiderina* Koopman, in: Niethammer et al., Chiroptera: Systematics, 60. - Comments: Type genus: *Hipposideros* J. Gray, 1831. Proposed as subtribe and originally included the genera *Hipposideros* J. Gray, 1831; *Anthops* Thomas, 1888 and *Asellia* J. Gray, 1838 (see Jackson and Groves, 2015: 245).

1995. *Coelopsinae:* Pavlinov, Borissenko, Kruskop and Jahonton, Archives of the Zoological Museum, Moscow State University,, 133: 84. - Comments: Mentioned as a synonym of the Hipposideridae by Pavlinov *et al.* (1995: 84). (Lapsus)

2014. *Hippossideridae:* Ndara R., IJISR, 12 (1): 253. Publication date: November 2014. (Lapsus)

2014. *Hippossyderidae:* Ndara R., IJISR, 12 (1): 252. Publication date: November 2014. (Lapsus)

2015. *Hypposideridae:* Lanza, Funaioli and Riccucci, The bats of Somalia and neighbouring areas, 118. (Lapsus)

2018. *Hipossidaridae:* Malekani, Musaba, Gembu, Bugentho, Toengaho, Badjedjea, Ngabu, Mutombo, Laudisoit, Ewango, Van Cakenberghe, Verheyen, Asimonyo, Masudi, Bongo and Ngbolua, Nat. Conserv. Res., 3 (1): 68. Publication date: January 2018. (Lapsus)

Taxonomy:

Considered a subfamily of the Rhinolophidae by Koopman (1993a: 169), Schutt and Simmons (1998: 28), but see Harrison and Bates (1991: 51), Corbet and Hill (1992: 104), Peterson *et al.* (1995: 66), Hutson *et al.* (2001), Simmons (2005: 365), who consider this to be a valid family. Hoofer and Van Den Bussche (2003: 10 - 12) suggest that the Hipposideridae might not be monophyletic, with *Triaenops* being different, although they state this might be the result of inadequate sampling.

McKenna and Bell (1997) used the name Rhinonycterinae Gray, 1866 for this group, but this has not been accepted by other authors (Simmons, 2005: 365). Although Rhinonycteridae (= Rhinonycterina Gray, 1866) has priority over Hipposideridae as a family-group name, nobody other than Gray (1866b) used the former name until it was resurrected by McKenna and Bell (1997). Miller (1907) used the name Hipposideridae for this group because *Hipposideros* Gray, 1831 has priority over *Rhinonycteris* Gray, 1866 (= *Rhinonicteris* Gray, 1847). Subsequent authors have followed Miller (1907) usage of Hipposideridae/inae, and Simmons (2005: 365) believes that there is little to be gained by replacing it with an unknown name. Simmons (2005: 365) therefore retains Hipposideridae for this group pending action by the International Commission on Zoological Nomenclature.

Due to the recent split off of *Cloetis, Paratriaenops, Rhinonicteris* and *Triaenops* into a separate family, the above naming issue has resolved itself.

McKenna and Bell (1997) proposed a tribal classification for hipposiderids (which they treated as a subfamily), but many of the groups they defined have subsequently been shown to be paraphyletic (Bogdanowicz and Owen, 1998, Hand and Kirsch, 1998); accordingly, Simmons (2005: 365) did not recognize subfamilies or tribes within Hipposideridae.

Known genera of Hipposideridae: *Anthops* Thomas, 1888, ***Asellia*** Gray, 1838, *Aselliscus* Tate, 1941, *Coelops* Blyth, 1848, ***Doryrhina*** Peters, 1871, ***Hipposideros*** Gray, 1831, ***Macronycteris*** Gray, 1866, †*Miophyllorhina* Hand, 1997, †*Palaeophyllophora* Revilliod, 1917, *Paracoelops* Dorst, 1947, †*Riversleigha* Hand, 1998, †*Vaylatsia* Sigé, 1990.

Common Names:

Czech: pavrápencovití, listonosovití. Dutch: Bladneusvleermuizen. English: Old-World leaf-nosed bat, Trident bats, Leaf-nosed bats. French: Hipposidéridés. German: Rundblattnasen. Italian: Ipposidèridi. Norwegian: Rundbladneser, falske hesteskoneser. Russian: Листоносы, Подковогубы, Ложные подковоносы. Vietnamese: Họ dơi mũi.

Similar Species:

Key characters for the genera:

Anthops - Head and body is about 50 mm, the tail is very short (less than half as long as the femur), and the forearm length is about 48 - 51 mm. The horseshoe-shape part of the nose leaf has two lateral leaflets, the inner one being quite small and the outer one large. Traces of a small frontal sac are present (Nowak, 1994: 115).

Asellia - Head and body length is about 46 - 62 mm, tail length is 18 - 27 mm (tail protruding up to 7 mm beyond interfemoral membrane), and forearm length is 45 - 52 mm. Posterior

component of noseleaf with three short, triangular projections. Only one upper premolar on each side, M^3 greatly reduced (two ridges) (Nowak, 1994: 114, Happold, 2013al: 357).
Aselliscus - Head and body length is about 38 - 45 mm, tail length is 20 - 40 mm (tail extends beyond the membrane, as in *Asellia*), and forearm length is 35 - 45 mm. The upper margin of the transverse noseleaf is divided into three points, and two lateral leaflets margin the horseshoe (Nowak, 1994: 116).
Coelops - Head and body length is 28 - 50 mm, the tail is extremely short or absent, and forearm length is 33 - 47 mm. Lateral leaflets are lacking on the noseleaf, or they are obscured by dense, stiff hairs (Nowak, 1994: 119).
Hipposideros - Head and body is about 35 - 100 mm, tail length is 18 - 70 mm, and forearm length is about 33 - 105 mm. Posterior component of noseleaf roughly elliptical in outline (although the outline of upper margin varies from almost flat to low-arched or even subtriangular), without three projections (Nowak, 1994: 111, Happold, 2013al: 357).
Paracoelops - Head and body length, 45 mm; tail absent, forearm length is about 42 mm. The nose leaf is horseshoe-shaped and surmounted by a round leaf with radial striations (Nowak, 1994: 119).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The Hipposideridae have been found from the Miocene of Songhor (Butler, 1969) and from the Mio-Pliocene of Morocco (Lavocat, 1961). The family goes back to the middle Eocene in Europe (Butler, 1978), where the genus *Palaeophyllophora* is considered to be the oldest representative (Ravel *et al.*, 2016: 412). Early Oligocene to recent in Arabia, early Miocene to recent in Africa, Pleistocene to recent in Asia, late Oligocene to recent in Australia (Hand and Kirsch, 1998). Because they are predominantly cave-dwelling bats, their remains are frequently preserved in Cenozoic limestone sediments (Happold, 2013al: 357). The earliest known *Hipposideros* is from the early Miocene, and the subgenus *Syndesmotis* (into which *H. megalotis* is sometimes placed) appears to have separated from *Hipposideros* in the middle Miocene (Happold, 2013al: 357). The fossils of Hipposideridae from the late Eocene and early Oligocene of France were already distinct from the Rhinolophidae that occurred in the same deposits (Lekagul and McNeely, 1977).

Based on phylogenetic analyses, Bogdanowicz and Owen (1998) suggest that the Hipposideridae probably originated somewhere in the Oriental region. In contrast, based on evidence from fossils, Hand and Kirsch (1998) suggest that the family originated in Australia.

Shi and Rabosky (2015: 1537) calculated the family-level stem and crown ages to be respectively 49.9 and 49.3 Mya.

BIOGEOGRAPHY:
The Hipposideridae diverged from the Rhinolophidae from a common ancestor in Africa approximately 42 Mya during the Eocene (Foley *et al.*, 2014: 320). While the family Rhinonycteridae separated from the other Hipposideridae approximately 39 Mya, also in Africa (Foley *et al.*, 2014: 320). The monophyletic *Hipposideros* clade diverged from other Hipposideridae approximately 31 Mya during the Oligocene in Africa (Foley *et al.*, 2014: 320). During the Miocene at about 15 Mya, *Hipposideros* diversified into distinct clades based on geography: these being the African, India and South East Asia clades (Foley *et al.*, 2014: 320).

DENTAL FORMULA:
$^{1123}/_{2123}$ = 30.
Except in *Asellia* and *Hipposideros megalotis*, which have a dental formula of $^{1113}/_{2123}$ = 28.

DETAILED MORPHOLOGY:
In their comparative study on bat brains, Bhatnagar *et al.* (2016) found that Hipposiderids stand apart from all other examined bats due to their relatively large adenohypophysis

HABITS:
Hipposiderids are often fly-catchers and gleaners but they also forage by slow-hawking, some to a greater extent than others (Happold, 2013al: 358). Unlike most rhinolophids, many hipposiderids forage in small groups (Happold, 2013al: 358).
Hipposiderids are unable to scuttle over the ground, and apparently cannot climb (Happold, 2013al: 358).

DIET:
Hipposiderids are insectivorous: the taxa and size of prey varies according to the size of the bat and the robustness of its teeth (Happold, 2013al: 358).

PARASITES:
Fain (1994: 1280) reports that the Hipposideridae are hosts for four genera of Myobiidae (Acari): *Hipposiderobia* with 12 species (parasiting on five genera of bats), *Metabinuncus* also with 12 species (occurring only on the genus *Hipposideros*), *Binunculoides* with one species on *Hipposideros*, and *Triaenomyobia*, with one species on *Triaenops*.

Genus ***Asellia*** Gray, 1838

*1838. *Asellia* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 493. Publication date: 1 February 1838. - Comments: Type species: *Rhinolophus tridens* E. Geoffroy Saint-Hilaire, 1813. - Etymology: From the Greek "*α*-" "alpha privative" and the Greek feminine substantive "*σέλλα*" (sélla), meaning "saddle", referring to the absence of a sella in the noseleaf (see Lanza *et al.*, 2015: 121). Palmer (1904: 124), however, mentions that *Asellia* is an adjective used as a noun, from the Latin "*asellus*", a little ass - probably in allusion to the long, pointed ears. (Current Combination)
1957. *Aseltia:* Harrison, Mammalia, 21 (1): 8. Publication date: March 1957. (Lapsus)
2008. *Ascidia:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 253. (Lapsus)

TAXONOMY:
Allen (1939a: 78) mentioned that *Asellia* was originally described as subgenus of *Hipposideros*.

Known species of the genus *Asellia*: †*vetus* Lavocat, 1961; ***arabica*** Benda, Vallo and Reiter, 2011; ***italosomalica*** de Beaux, 1931; ***patrizii*** de Beaux, 1931; ***tridens*** (E. Geoffroy St.-Hilaire, 1813).

COMMON NAMES:
Czech: trojzubcoví pavrápenci. English: Lesser Trident Bats, Trident Bats, Trident Leaf-nosed Bats. French: Tridents, Asellia, Chauve-souris à 3 endentures. German: Dreizackblattnasen. Italian: Asèllie.

Asellia italosomalica de Beaux, 1931

*1931. *Asellia tridens italo-somalica* de Beaux, Ann. Mus. civ. Stor. nat. Genova, 55: 190. Publication date: 6 June 1931. Type locality: Somalia: Oddur. Holotype: MSNG 30942: ♀, skin and skull. Collected by: N. Mosconi Brozzi; collection date: 1929. Presented/Donated by: ?: Collector Unknown. See Benda *et al.* (2011f: 266). - Etymology: From the feminine scientific Latin adjective *italosomalica*, meaning "inhabiting Italian Somalia, referring to country where the type specimens were collected (see Lanza *et al.*, 2015: 123)..
? *Asellia italosomalica:* (Current Combination)
? *Asellia tridens italosomalica:* (Alternate Spelling)

TAXONOMY:
Based on morphometric analyses and a K2P genetic distance of 12.3 to 13.7 % with other *Asellia* populations, Benda *et al.* (2011f: 262) distinguish *italosomalica* specimens from Socotra and Somalia as a different, well-defined taxon, which is best considered to be a separate species.

COMMON NAMES:
English: De Beaux's Trident Bat. German: Somalische Dreizackblattnase. Italian: Asèllia italosòmala.

GENERAL DISTRIBUTION:
Socotra, Somalia

Asellia patrizii de Beaux, 1931

*1931. *Asellia patrizii* de Beaux, Ann. Mus. civ. Stor. nat. Genova, 55: 186. Publication date: 6 June 1931. Type locality: Eritrea: Dancalia: Gaare [13 13 N 42 07 E]. Holotype: MSNG 13313: ♂, skull and alcoholic. Collected by: Marquis Saverio Patrizi Montoro; collection date: December 1912. Presented/Donated by: ?: Collector Unknown. See Benda *et al.* (2011f: 267). Paratype: MSNG 13314: ♀, skull and alcoholic. Collected by: Marquis Saverio Patrizi Montoro; collection date: December 1929. Presented/Donated by: ?: Collector Unknown. See Benda *et al.* (2011f: 267), who mention this specimen along with the holotype, but not explicity as "paratype". They do mention three further paratypes from the series: MSNG 33203, 33204 [S+B], 31315a, 31315b, collected at Attab (Eritrea), in July 1893 by G. Pestalozza and October 1906 by P. Felter. - Etymology: In honour of the Marquis Saverio Patrizi Nero Montoro (1902 - 1978), eminent Italian entomologist, biospeleologist and explorer, collector of zoological material especially in central and

eastern Africa, Sardinia and eastern Mediterranean countries (see Lanza *et al.*, 2015: 128). (Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: pavrápenec eritrejský. English: Patrizi's Lesser Trident Bat, Patrizi's Trident Leaf-nosed Bat. French: Trident de Patrizi, Asellia de Patrizi. German: Patrizis Dreizackblattnase. Italian: Asèllia di Patrìzi.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008a; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Mickleburgh *et al.*, 2004ad; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
There is very little information, but roost disturbance is a possible threat. However, the species is associated with habitats that are not under significant threat, and has been found in buildings, and so can adapt to human presence (Mickleburgh *et al.*, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008a) suggest surveys are needed to determine the distribution of this species, both in northeastern Africa and in the Arabian Peninsula.
Has been recorded from Awash National Park (Hill and Morris, 1971).

GENERAL DISTRIBUTION:
This species has a restricted known range in northeastern Africa, from central Ethiopia north to Eritrea (Yalden *et al.*, 1996), and also from islands in the Red Sea including Farasan Island and Segid Island (=As-Saqid) of southwestern Saudi Arabia (Moeschler *et al.*, 1990; Harrison and Bates, 1991: 316; Horácek *et al.*, 2000). It probably occurs more widely in this poorly explored region (Mickleburgh *et al.*, 2008a).

Native: Eritrea (Yalden *et al.*, 1996); Ethiopia (Yalden *et al.*, 1996); Saudi Arabia (Moeschler *et al.*, 1990; Harrison and Bates, 1991: 316; Horácek *et al.*, 2000).

HABITAT:
Dry open terrain such as the semi-desert grassland of the Awash National Park (Hill and Morris, 1971).

ROOST:
It roosts in caves and buildings and in dry open terrain such as the semi-desert grassland of the Awash National Park (Hill and Morris, 1971).

POPULATION:
Structure and Density - Appears to be rare with small roosts. There is a possibility that it will be found in larger roosts, but to date none have been found (Mickleburgh *et al.*, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008a; IUCN, 2009). 2004 - Decreasing (Mickleburgh *et al.*, 2004ad; IIUCN, 2004).

ACTIVITY AND BEHAVIOUR:
It flies close to the ground catching insects (Mickleburgh *et al.*, 2008a; IUCN, 2009).

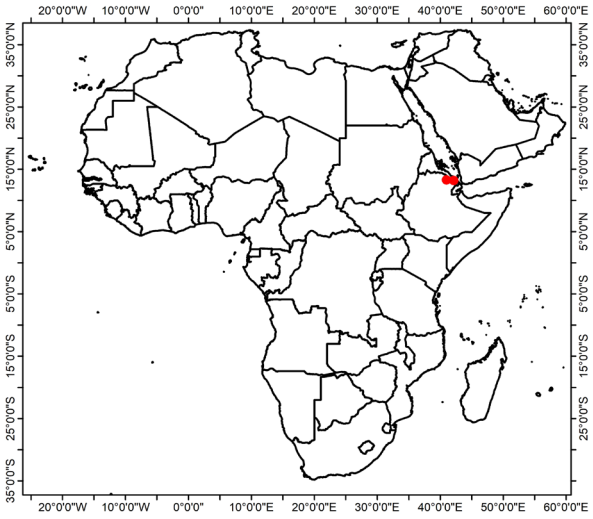


Figure 50. Distribution of *Asellia patrizii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Eritrea, Ethiopia.

Asellia tridens (E. Geoffroy St.-Hilaire, 1813)

*1813. *Rhinolophus tridens* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 20: 260, pl. 5. Publication date: 1813. Type locality: Egypt: Qena province: Luxor, near [ca. 25 41 N 32

39 E] [Goto Description]. Syntype: MNHN A.235: ad ♂, alcoholic (skull not removed). Number 187 in Rode (1941: 240), who mentions this specimen as holotype. Furthermore, he remarks that the skull is not removed, so the skull in the atlas, pl. IV, fig. 2, 2', 2" does not correspond to any of the skins in the collection. See also Qumsiyeh (1985: 41). Benda *et al.* (2011f: 267) mention MNHN 1986-1068 as lectotype and indicate this is collected by E. Geoffroy Saint-Hilaire. Syntype: MNHN A.237: ad ♀, alcoholic (skull not removed). Number 187a in Rode (1941: 240), who considers this to be an allotype. - Comments: Grubb *et al.* (1998: 82) mention p. 265. Kock (1969a: 122), Corbet and Hill (1992: 116) and Horácek *et al.* (2000: 98) only mention "Egypt" as type locality. Kock (1969a: 122) also indicates that E. Geoffroy Saint-Hilaire (1818: 127) restricted the type locality to "Grab der Könige (=Theben, Luxor)".

1855. *Ph[yllorhina] tridens:* Giebel, Die Säugethiere., 987. (Name Combination)

1881. *Phyllorhina tridens murraiana* Anderson, Catalogue of the Mammals in the Indian Museum, vol. I: 113. Type locality: Pakistan: Sind: Karachi [24 51 N 67 02 E].

1918. *Asellia tridens diluta* K. Andersen, Ann. Mag. nat. Hist., ser. 9, 2 (10): 375. Publication date: 1 October 1918. Type locality: Algeria: Algerian Sahara: El Golea [30 35 N 02 53 E] [Goto Description]. Holotype: BMNH 1912.11.14.2: ♀. Collected by: Dr. Ernst Johnann Otto Hartert; collection date: 16 May 1912; original number: 42. Presented/Donated by: Nathanial Charles Rothschild. See Andersen (1918: 379).

1937. *Asellia tridens pallida* Laurent, Mammalia, 1: 111, fig. 8. Type locality: Morocco: Anti Atlas: Oued Tata [=Tata] [29 44 N 07 56 W] [Goto Description].

2008. *Ascidia tridens:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 253. (Name Combination, Lapsus)

? *Asellia tridens murraiana:* (Name Combination)

? *Asellia tridens tridens:* (Name Combination)

? *Asellia tridens:* (Current Combination)

TAXONOMY:
Simmons (2005: 366) recognises three subspecies *A. t. diluta* Andersen, 1918 [see discussion below]; *A. t. italosomalica* De Beaux, 1931; and *A. t. murraiana* Anderson, 1881.
Simmons (2005: 366) assigned *A. tridens diluta* to J. Anderson (1881), which would make this form Asian. However, no description is found in J. Anderson's publication, but a description is found in Andersen (1918: 379) as is confirmed by Owen and Qumsiyeh (1987 334), who mention "Andersen, 1918" as author.

Owen and Qumsiyeh (1987: 335) did not examine any specimens from *A. t. italosomalica* De Beaux, 1931, but Benda *et al.* (2011f: 261) consider *italosomalica* to be a separate species, a view that is followed here.

COMMON NAMES:
Arabian: Khaffash. Czech: pavrápenec trojzubcový, wrápenec trojzeykowý, listonos trojzubcový. Dutch: Drietandbladneusvleermuis. English: Geoffroy's Lesser Tident Bat, Trident Leaf-nosed Bat, Trident bat, Trident Rhinolophe. French: Trident du désert, Asellia à trois endentures, Chauve-souris trident, Trident, Rhinolophe trident. German: Dreizackblattnase, Geoffroys Dreizackblattnase, Dreyzahnige Kammnase. Hebrew: pasafon, Parsafon.

ETYMOLOGY OF COMMON NAME:
So named because of the three-pronged process at the top of the nose-leaves and noticeably short ears (Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Kock *et al.*, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Kock *et al.*, 2008b; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004l; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The main threat is the widespread use of pesticides against locusts, while human disturbance in caves and old buildings is affecting some populations (Kock *et al.*, 2008b; IUCN, 2009).

Besides water stress and their aerial hawking feeding style, roosting in caves and trees is an important risk factor linked with climatic change (Sherwin *et al.*, 2012: 174).

CONSERVATION ACTIONS:
Kock *et al.* (2008b) [in IUCN (2009)] suggest underground roost management is needed in some places and a study on the impacts of pesticides is required, especially ways in which the impact might be minimised.

It presumably occurs in several protected areas (Kock *et al.*, 2008b; IUCN, 2009).

GENERAL DISTRIBUTION:
Asellia tridens ranges widely in the Sahara, through the Arabian Peninsula and the Middle East, to Afghanistan, Pakistan, and India. It is absent from the northern parts of Morocco and Algeria, and Tunisia, and occurs south to Ethiopia and Somalia.

Native: Afghanistan; Algeria (Kowalski and Rzebik-Kowalska, 1991: 64); Burkina Faso (Kangoyé *et al.*, 2015a: 607); Chad; Djibouti; Egypt; Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 147); Gambia (Kock *et al.*, 2002: 86); India (Senacha and Dookia, 2013: 21); Iran, Islamic Republic of; Israel; Libyan Arab Jamahiriya; Mali; Mauritania (Brito *et al.*, 2010: 453, Allegrini *et al.*, 2011: 2); Morocco (Aulagnier and Thevenot, 1986: 38; Benda *et al.*, 2010a: 157; El Ibrahimi and Rguibi Idrissi, 2015: 360); Niger; Oman; Pakistan; Saudi Arabia; Senegal; Sudan; Syrian Arab Republic; Tunisia (Horácek *et al.*, 2000: 99); Western Sahara.

Presence uncertain: Iraq; Kuwait; Lebanon; Qatar; United Arab Emirates.

A record from Zanzibar (Peters, 1871) has never been confirmed (though often repeated) and may be a MNHN mislabelled specimen. Records from Socotra and Somalia are now considered to belong to *A. italosomalica* (see Benda *et al.*, 2011f).

DETAILED MORPHOLOGY:
Brain:
Adult hippocampal neurogenesis was studied by Chawana R. *et al.* (2016: 1551).

ECHOLOCATION:
Search-phase call-shape: CF/FM. CF component is sometimes of very low amplitude, but is always present (Pye, 1972). For 11 Egyptian bats, the CF-frequency varied from 115 - 120 kHz; each individual emitted a narrow range of frequencies, and different individuals emitted different ranges of frequencies (ibid.). For 18 Tunisian bats, resting, CF-frequency: 111 - 124 kHz (the CF-frequency varied from bat to bat, individuals kept the frequency constant); band-width of terminal FM component: 19-21 kHz; call-duration 7 - 10 ms; minimum intercall interval 27 - 215 ms (depending on degree of alertness) (Gustafson and Schnitzler, 1979). Flying bats lowered their emission frequency to compensate for Doppler shifts caused by the flight movement; call-duration: 9 - 11 ms; minimum intercall interval: 26 ms. For bats in a roost in Gambia containing thousands of individuals, CF-frequency: 108 - 122 kHz (frequency found to be negatively correlated with FA length within sexes); lowest frequency of the terminal FM sweep: 97 kHz: call-duration: 7.5 - 9 ms, inter-call interval: 10 - 20 ms (Jones *et al.*, 1993). In the UAE, Davis (2007: 5) reports a CF-frequency with an FM-ending (117 - 124 kHz).

Benda *et al.* (2012a: 182) provide two sets of data for Iranian *A. tridens*: **1**: F_{start}: 118.4 ± 0.6 (117.5 - 119.0) kHz, F_{end}: 117.1 ± 0.6 (116.3 - 118.0) kHz, F_{peak}: 117.9 ± 0.6 (117.0 - 118.5) kHz, duration: 10.3 ± 2.1 (6.8 - 13.1) msec, and interpulse interval: 32.3 ± 15.7 (13.4 - 55.9) msec; **2** (with bat in resting position): F_{start}: 122.3 ± 0.4 (121.7 - 122.8) kHz, F_{end}: 119.7 ± 4.1 (112.5 - 123.0) kHz, F_{peak}: 122.0 ± 0.4 (121.3 - 122.6) kHz, duration: 9.0 ± 0.4 (8.4 - 9.3) msec, and interpulse interval: 28.0 ± 7.7 (19.3 - 38.4) msec.

From Israel, the following values were reported by Hackett *et al.* (2016: 223) for 56 calls: Pulse duration: 7.97 ± 0.29 msec, F_{start}: 117.74 ± 12.58 (114.2 - 121) kHz, F_{end}: 106.96 ± 10.44 (96.6 - 101.91) kHz, F_{peak}: 116.60 ± 10.69 (107.4 - 120.1) kHz.

Jones and Siemers (2010: 449 - 450) indicate that females emit pulses with a higher frequency than males, and also that juveniles emit lower frequencies than adults (see also Jones *et al.*, 1993; Kunz and Hood, 2000: 420).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Baker *et al.* (1974) reported 2*n* = 50, FN = 62, a submetacentric X chromosome and an acrocentric Y chromosome. Baker et al. (1975) reported BA = 14.
Protein / allozyme - Unknown.

Bray and Benda (2016: 283) studied concatenated fragments of Cytochrome-*b*, NADH Dehydrogenase 2, and Cytochrome Oxidase 1 genes of primarily Saudi-Arabian bats, but also covered African representatives.

HABITAT:
Arid and semi-desert habitats.

HABITS:
This is a gregarious and colonial species (Kock *et al.*, 2008b).

ROOST:
It roosts in temples, caves, mines, open-wells, underground irrigation tunnels and old tombs and buildings and in the desert and semi desert vegetation zones it occurs in crevices or in cliffs (Kock *et al.*, 2008b). From Israel, Amichai *et al.* (2012: 96 - 97) report they use abandoned man-made structures (such as military bunkers), where the sexes are initially roosting separately. Later on (October), when their young become independent, this sexual segregation weakens.

MIGRATION:
In the Dakhla Oasis in Egypt, Benda *et al.* (2014b: 55) found *A. tridens* to be the most common bat during the summer months until the beginning of October, with at least 5,000 individuals divided over several roosts. However, from November to the beginning of April, these roosts were empty (except for a few single animals). In that period, only small colonies were found (70 - 120 ind.), and no animals were observed during the night. Benda *et al.* (2014b) were unable to determine whether the bats disappeared to the Nile Valley (long-distance migration) or whether they moved over short distances to other roosts in the neighbourhood, although there is some evidence that the latter is the case.

DIET:
Amichai *et al.* (2012: 101) report its diet in Israel to consist primarily of Coleoptera and Heteroptera, whereas Lepidoptera, Hymenoptera, Diptera were important additions in different parts of the country. In Iran, Benda *et al.* (2012a: 265) report that Coleoptera - mostly Scarabaeidae, but also Cerambycidae and Curculionidae were dominatingly present, but another faecal sample was dominated by Blattodea. The most frequent representatives of Heteroptera in the diet samples collected on both occasions were bugs of the family Tingidae.

In Libya, Benda *et al.* (2014c: 37) examined the digestive tract of one bat and found it contain 80 % (by volume) Coleoptera (Scarabeidae) and 20 % of Hymenoptera (Formicoidea).

Benarbia and Fentrouci (2017: 44) found the following items in droppings of *A. tridens* in Algeria: Arachnida: Aranea: Araneidae: *Aranea* sp. Ind1; Insecta: Coleoptera: Carabidae: *Megacephala australis*; Chrisomilidae: *Chrisomelida* sp.; Curculionidae: *Curculionida* sp., *Phyllognatnus* sp.; Anthicidae: *Anthicidae* sp. / *Anthicus* sp.; Carabidae: *Cicindella* sp.; Tenebrionidae: *Akis* sp.; Aphodiidae: *Aphodius* sp.; Blatidae: *Blatida* sp.; Hymenoptera: Formicidae: *Messor* sp., *Cataglyphis* sp., *Myrmecina* sp., *Formica* sp.; Vespoidae sp.; Orthoptera: Gryllidae: *Gryllus* sp.; *Ensiphera* sp.; Orthoptera sp.; Odonatoptera; Diptera: Tabanidae sp; Ephemeroptera sp., and Plantea: Planta: Arecaceae: *Phoenix dactilifera*.

POPULATION:
Structure - Unknown.
Density - It is a very common species, found in colonies of up to several hundred in North Africa, and in its Asian distribution it has been found in groups up to 5,000 animals (Kock *et al.*, 2008b; IUCN, 2009).
Trend - 2008 - Stable (Kock *et al.*, 2008b; IUCN, 2009). 2004 - Unknown (Mickleburgh *et al.*, 2004l; IUCN, 2004). *A. tridens* populations within the Asia Minor and Levant region are predicted to have a stable population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

ACTIVITY AND BEHAVIOUR:
Forages over desert and semi-desert vegetation zones, mainly in oases (Kock *et al.*, 2008b). Forages by slow hawking, has been observed foraging around palm trees and buildings, and over water (Kock *et al.*, 2008b).

REPRODUCTION AND ONTOGENY:
Amichai *et al.* (2012: 96) report that almost all females arrive in their summer roosts in Israel at an advanced stage of pregnancy, and that births take place between the end of June and mid July. There is one young, which is born hairless, with closed eyes and weighting up to 30 % (2.5 - 3 g) of its mother's weight. In the United Arab Emirates, Davis (2007: 5) found females to be pregnant in April-May, and giving birth in June after a gestation period of about 9 to 10 weeks. The lactation period lasts for 40 days.

Intrauterine ultrasonography of pregnant females performed by Amichai *et al.* (2019: 1) showed that the development of the horseshoe is completed (100%) *in-utero*, whereas skull (70%) and forearm (40%) development continues after birth. Neonates already begin emitting precursor echolocation calls two days after birth, and they are able to fly three weeks after birth.

PARASITES:
ACARI:
Trombiculidae: *Neoschoengastia elegans* (Vercammen-Grandjean, Rohde and Mesghali, 1970) from Iran. *Myotrombicula aselliae* Vercammen-Grandjean, 1963, *Riedlinia platypygia* Vercammen-Grandjean, 1963, and *R. afghanensis* Vercammen-Grandjean, 1963, all three from Afghanistan (Benda *et al.*, 2012a: 266-267).
Myobiidae: *Ugandobia euthrix* Fain, 1972 from Saudi Arabia (Fain 1972 [in Benda *et al.*, 2012a:

267]) and *Hipposiderobia heteronycha* (Berlese et Trouessart, 1889) from Saudi Arabia and various parts of Africa (Radford 1949, Fain 1972, 1978 [in Benda *et al.*, 2012a: 267]).
Argasidae: *Argas boueti* Roubaud et Colas-Belcour, 1933 from various countries in Africa (Roubaud & Colas-Belcour 1933, Hoogstraal 1955 [in Benda *et al.*, 2012a: 267]).

DIPTERA:
Streblidae: *Raymondia huberi* Frauenfeld, 1856 from Tanzania (Haeselbarth *et al.*, 1966: 102), and Iran (Benda *et al.*, 2012a: 266) (see also Shapiro *et al.*, 2016: 254). *Raymondia setosa* Jobling, 1930 from Israel (Haeselbarth *et al.*, 1966: 104).
Nycteriibidae: *Nycteribia schmidlii* Schiner, 1853 from the Levant (Benda *et al.*, 2012a: 266). *Nycteribia (Listropoda) schmidlii schmidlii* Schiner, 1853 and *Penicillidia (Penicillidia) dufourii* Westwood, 1835 were reported by Bendjeddou *et al.* (2017: 15) from Algeria.
Hippoboscidae: *Penicillidia dufourii* Westwood, 1834 from the Levant (Benda *et al.*, 2012a: 266). *Brachytarsina flavipennis* Macquart, 1851 from the Levant (Benda *et al.*, 2012a: 266).

SIPHONAPTERA:
Ischnopsyllidae: *Chiropteropsylla brockmani* Rothschild, 1915 from Iran and Iraq (Benda *et al.*, 2012a: 266). *Rhinolophopsylla unipectinata* (Taschenberg, 1880) from Iraq (Benda *et al.*, 2012a: 266).

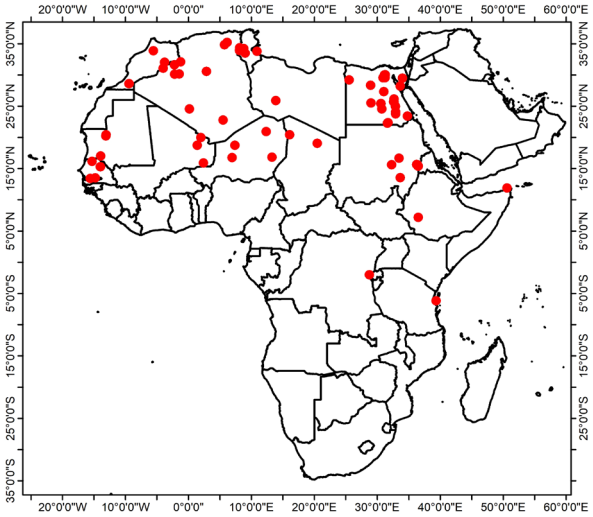


Figure 51. Distribution of *Asellia tridens*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Burkina Faso, Chad, Congo (Democratic Republic of the), Egypt, Ethiopia, Libya, Mali, Mauritania, Morocco, Niger, Saudi Arabia, Senegal, Somalia, Sudan, Tanzania, The Gambia, Tunisia.

Genus ***Doryrhina*** Peters, 1871

*1871. *Doryrhina* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 314. Publication date: 1871 [Goto Description]. - Comments: Grubb *et al.* (1998: 79) mention p. 324. Type species: *Phyllorrhina cyclops* Temminck, 1853, by monotypy (see Decher and Fahr, 2005: 1; Jackson and Groves, 2015: 246).. - Etymology: From the Greek "*δόρυ*", meaning spear and "*ρινός*", meaning nose, referring to the club-shaped process which is directed forward from the base of the sella, or to the slender and somewhat longer vertical process which projects upward from the margin of the transverse erect nose leaf (see Palmer, 1904: 244).

TAXONOMY:
Generally considered a synonym of the genus *Hipposideros*, but based on Cyt-*b* analyses, Foley *et al.* (2017: 12) considered *cyclops* to be that different from the other members of this genus to be placed in a separate genus.

Due to the generally recognized close relation between *cyclops* and *camerunensis*, Musila *et al.* (2018a: 21) provisionally placed the latter in the genus *Doryrhina*, but they also indicated that this still needs to be confirmed.

MOLECULAR BIOLOGY:
Karyology -
The genus *Hipposideros* s.l. shows an extreme conservatism concerning the 2*n* complement. Almost all species have 32 chromosomes. The only exceptions are the species transferred by Foley *et al.* (2017) to the genus *Macronycteris*, which have 52, and *cyclops*, which has 2*n* = 36.

Doryrhina cyclops (Temminck, 1853)

*1853. *Phyllorrhina cyclops* Temminck, Esquisses zoologiques sur la Côte de Guiné. 1e partie, les Mammifères, 75. Publication date: 1853. Type locality: Ghana: Boutry River [=Butre river] [ca. 04 49 N 01 55 W] [Goto Description]. - Comments: Type locality originally: "sur la rivière Boutry, côte de Guiné". - Etymology: Refers to the one-eyed giants of Greek

mythology and alludes to the orifice in the center of the forehead of these bats (see Rosevear, 1965 in Decher and Fahr, 2005: 4).

1897. *Rhinolophus micaceus* de Winton, Ann. Mag. nat. Hist., ser. 6, 20 (120): 524. Publication date: 1 December 1897. Type locality: Gabon: 75 mi (112.5 km) from Gaboon: Como River [Goto Description]. Holotype: BMNH 1897.12.1.7: ♀. Collected by: George Latimer Bates Esq. Collection date: 6 July 1897; original number: GLB 230. Note: Smoked out of hollow tree.

1899. *Hipposideros cyclops:* de Winton, Ann. Mag. nat. Hist., ser. 7, 4 (23): 354. Publication date: 1 November 1899. (Name Combination)

1917. *Hipposideros langi* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 434, text-fig. 4 - 6. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Avakubi [01 18 N 27 32 E] [Goto Description]. Holotype: AMNH 49098: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 24 January 1914; original number: 2481.

1922. *H[ipposideros]. cyclops micaceus:* J.A. Allen, Bull. Am. Mus. Nat. Hist., 47: 2, footnote. (Name Combination)

1922. *Hipposideros cyclops langi:* J.A. Allen, Bull. Am. Mus. Nat. Hist., 47: 2, footnote. (Name Combination)

2017. *Doryrhina cyclops:* Foley, Goodman, Whelan, Puechmaille and Teeling, Acta Chiropt., 19 (1): 12. Publication date: June 2017. (Current Combination)

TAXONOMY:
Simmons (2005: 370) includes this taxon in the *Hipposideros cyclops* species group. See Decher and Fahr (2005, Mammalian Species, 763), but see also Foley *et al.* (2017: 12), who transferred it to the genus *Doryrhina*.

COMMON NAMES:
Chinese: 大眼蹄蝠. Czech: pavrápenec Kyklop. English: Cyclops Leaf-nosed Bat, Cyclops Roundleaf Bat, Cyclops Bat. Fang: angon. French: Phyllorine des Cyclopes, Phyllorine cyclope. German: Zyklopen-Rundblattnase, Zyklossen-Blattnase.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bw; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bw; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cn; IUCN, 2004). 1994 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
Although not threatened throughout its range, the species may disappear from many areas that are threatened by deforestation, especially on the extreme limits of its distribution (Decher and Fahr, 2005).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bw) [in IUCN (2009)] report that the roosting habits of this bat requires very large hollow trees, so conservation of these must be a priority. It is found in some protected areas, for example Kwamgumi Forest Reserve in Tanzania, and the Udzungwa Mountains National Park of Tanzania.

GENERAL DISTRIBUTION:
Doryrhina cyclops has been recorded widely over much of West Africa and Central Africa, with a few scattered records from East Africa. It ranges from Senegal and The Gambia in the west, through most countries in West Africa, to Cameroon, Equatorial Guinea (Rio Muni and Bioko), Gabon, Congo (The Democratic Republic of the) Congo, Central African Republic and Rwanda, being recorded from East Africa in southern Sudan, Uganda and western Kenya, with an isolated population in southeastern Kenya and northeastern Tanzania in coastal forests and Eastern Arc Mountains (Decher and Fahr, 2005: 3). It has been collected at Tongwe Forest near Tanga and Kwamgumi Forest Reserve in Tanzania (K. Howell *pers. comm.* 2004). There is a dubious record from the border area of Chad and the Central African Republic. It occurs from sea-level up to at least 1,000 m.

Native: Benin; Burkina Faso (Kangoyé *et al.*, 2012: 6024; 2015a: 608); Cameroon (Hill, 1968; Eisentraut, 1973); Central African Republic (Lunde *et al.*, 2001); Congo (Bates *et al.*, 2013: 335); Congo (The Democratic Republic of the); Côte d'Ivoire; Equatorial Guinea (Bioko); Gabon; Gambia; Ghana (Decher and Fahr, 2007: 17); Guinea; Guinea-Bissau (Veiga-Ferreira, 1949;

Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 52); Kenya (Aggundey and Schlitter, 1984); Liberia; Nigeria (Happold, 1987); Rwanda; Senegal; Sierra Leone; Sudan; Tanzania (Decher and Fahr, 2005: 3; Stanley *et al.*, 2005b), United Republic of; Togo; Uganda.
Presence uncertain: Burundi; Chad.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data for 6 specimens: Fa: 70.63 ± 1.942 mm, mass: 37.3 ± 3.27 g, wing loading: 11.5 ± 0.53 N/m^2, aspect ratio: 5.5 ± 0.46.

DETAILED MORPHOLOGY:
Baculum - Unknown
Brain - Amrein *et al.* (2007) reported from specimens collected in Bénin that proliferating cells, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus were found to be absent. They also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. No NeuroD was detected in the hippocampal granule cells (Amrein *et al.*, 2007).

SEXUAL DIMORPHISM:
Decher and Fahr (2005) [in Kangoyé *et al.* (2015a: 608)] indicate that a pronounced sexual dimorphism exists, with females being larger than males.

ECHOLOCATION:
Monadjem *et al.* (2013b: 351) report a F_{max} of 55.5 (55 - 56) kHz for two specimens from Mount Nimba.

From western Uganda, Monadjem *et al.* (2011: 32) report the following values for 6 calls: F_{min}: 51.24 ± 0.670 kHz, F_{max}: 51.54 ± 0.387 kHz, F_{char}: 51.37 ± 0.459 kHz, F_{knee}: 51.51 ± 0.395 kHz, duration: 14.5 ± 2.02 msec.

In Sierra Leone, Weber *et al.* (2019: 21) reported on two females calling at 54.5 (54.0 - 55.0) kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Koubínová *et al.* (2010b) report for one female from Senegal, 2*n*= 36, Fna= 62 (as "*Hipposideros cyclops*") , while the chromosomal complement comprised 15 metacentric or submetacentric, and three small acrocentric pairs.
Protein / allozyme - Unknown.

HABITAT:
Monadjem *et al.* (2016y: 365) recorded it from two forested sites in the Mount Nimba area, between 480 and 730 m.

ROOST:
Killick-Kendrick (1973: 641) reported on pygmy flying squirrels (*Idiurus macrotis* Miller, 1898) collected from hollow trees, which were associated with "*Hipposideros cyclops*".

POPULATION:
Structure and Density - It is a reasonably common species in some areas (Mickleburgh *et al.*, 2008bw; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bw; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
One female, carrying a furred female infant, was captured in December 2005 at Uzungwa Scarp Forest Reserve, Tanzania (Trentin and Rovero, 2011: 50).

Two lactating females were reported on 26 and 28 May from Sierra Leone by Weber *et al.* (2019: 24).

PARASITES:
HAEMOSPORIDA:
Schaer *et al.* (2013a: 17416) report the presence of the hemosporidian parasite *Plasmodium cyclopsi* Landau and Chabaud, 1978 in three out of four investigated bats. Up until now, *Macronycteris cyclops* is the only known host species for this parasite. Lutz *et al.* (2016: 9) examined three *M. cyclops* specimens from East Africa and found all of them infected with *Nycteria* sp.
Perkins and Schaer (2016: Suppl.) also mention *Dionisia bunoi* Landau, Chabaud, Miltgen and Baccam, 1980 from bats from Gabon, *Nycteria* sp. from Uganda, *Plasmodium cyclopsi* from Gabon and Liberia.
Landau *et al.* (1980a: 272), furthermore, mentioned a third atypical hematozoon: *Trypanosoma lizae* Miltgen and Landau, 1979.

DIPTERA:
Streblidae: *Raymondia brachyphysa* Jobling, 1956 from Abidjan, Côte d'Ivoire (Haeselbarth *et al.*, 1966: 102; Shapiro *et al.*, 2016: 254). *Raymondia intermedia* Jobling, 1936 in Côte d'Ivoire (Haeselbarth *et al.*, 1966: 102).

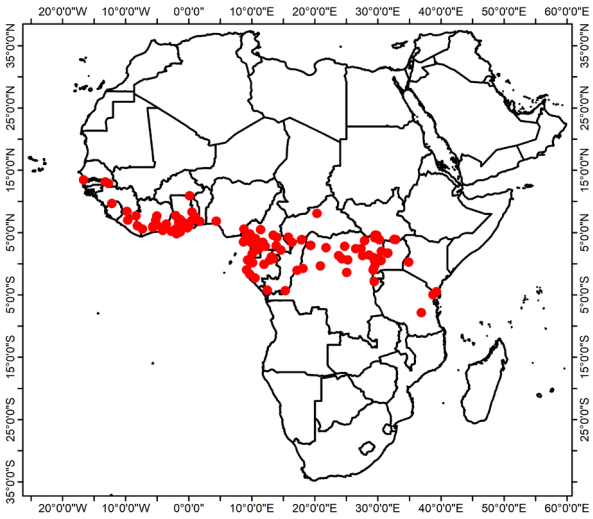


Figure 52. Distribution of *Doryrhina cyclops*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: "Africa", Benin, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Kenya, Liberia, Nigeria, Senegal, Sierra Leone, South Sudan, Tanzania, The Gambia, Togo, Uganda.

Genus ***Hipposideros*** Gray, 1831

*1831. *Hipposideros* Gray, Zool. Misc., 1: 37. Publication date: 1831. - Comments: Type species: *Vespertilio speoris* Schneider, 1800, by subsequent designation by Sclater (1901: 166) (see Meester *et al.*, 1986: 41; Jackson and Groves, 2015: 245). - Etymology: From the Greek "*ἵππος*", meaning horse and "*σίδηρος*", meaning iron (=horse-iron, horseshoe), an allusion to the shape of the noseleaf (see Palmer, 1904: 327). (Current Combination)

1831. *Phyllorrhina* Bonaparte, Icon. Fauna Ital.. - Comments: *Nomen nudum* (see Palmer, 1904: 535).

1834. *Hipposiderus* Gray, Proc. zool. Soc. Lond., 1834, II (xviii): 53. Publication date: 26 September 1834. - Comments: Unjustified emendation (see Meester *et al.*, 1986: 41; Pavlinov *et al.*, 1995: 84; Decher and Fahr, 2005: 1; Jackson and Groves (2015: 245). Blanford (1888: 638) claims the name *Hipposiderus* was published by Gray (1831: 37), but this is in error. (Emendation)

1837. *Phyllorhina:* Bonaparte, Iconografia Fauna italiana, 1, fasc. 21: 3. Publication date: 1837. - Comments: Type species: *Rhinolophus diadema* E. Geoffroy Saint Hillaire, 1813. Preoccupied by *Phyllorhina* Leach, 1816 (see Pavlinov *et al.*, 1995: 84; although they do not explicitly mention its preoccupation), although also see Fenton and Rautenbach (1998: 535), who refers to Bonaparte (1837) to refute this. Fenton and Rautenbach (1998: 535) and Allen (1939a: 79) indicated that it was described as a subgenus of *Rhinolophus*. - Etymology: From the Greek "*φύλλον*", meaning leaf and "*ρίς*" or "*ρινος*", meaning nose, referring to the nose-leaf (see Palmer, 1904: 535).

1837. *Phyllorrhina* Bonaparte, Icon. Fauna Ital., 1, fasc. 21: 3. - Comments: Type species: *Rhinolophus diadema* É. Geoffroy, 1813, by subsequent designation by Sclater (1901: 116) (see Decher and Fahr, 2005: 1; Jackson and Groves, 2015: 245).

1866. *Chrysonycteris* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 82. Publication date: May 1866. - Comments: Type species: *Hipposideros fulvus* Gray, 1838, by monotypy (see Decher and Fahr, 2005: 1; Jackson and Groves, 2015: 246). - Etymology: From the Greek "*χρυδός*", meaning gold and "*νυκτερις*", meaning bat, referring to the briljant golden yellow fur (see Palmer, 1904: 189).

1866. *Gloionycteris* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 82. Publication date: May 1866. - Comments: Type species: *Rhinolophus armiger* Hodgson, 1835, by monotypy (see Decher and Fahr, 2005: 1; Jackson and Groves, 2015: 246). - Etymology: From the Greek "*γλοιός*", meaning gum and "*νυκτερις*", meaning bat, referring to the large glandular elevations on the sides of the forehead (see Palmer, 1904: 297).

1866. *Rhinophylla* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 82. Publication date: May 1866. - Comments: Type species: *Phyllorrhina labuanensis* Tomes, 1859, by monotypy (see Jackson and Groves, 2015: 246). Preoccupied by *Rhinophylla* Peters, 1865 (Chiroptera, Phyllostomidae) (see Pavlinov *et al.*, 1995: 84).

1866. *Speorifera* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 82. Publication date: May 1866. - Comments: Type species: *Rhinolophus vulgaris* Horsfield, 1823 (=*Rhinolophus larvatus* Horsfield).

1871. *Cyclorhina* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 326. Publication date: 1871. - Comments: Type species: *Phyllorrhina obscura* Peters, 1861 and *Phyllorrhina doriae* Peters, 1871. Meester *et al.* (1986: 42) retain only *Phyllorhina obscura* Peters as type species, by subsequent designation by Moreau *et al.* (1946: 208), Tate (1941a: 354), Corbet and Hill (1992: 105) (see Jackson and Groves, 2015: 246). Not *Cyclorhina* J. Hall and Clarke, 1894 (Brachiopoda, Rhynchonellata, Rhynchonellida, Machaerariidae) (see Jackson and Groves, 2015: 246). - Etymology: From the Greek "*κύκλος*", meaning circle, and "*ρις*" or "*ρινός*", meaning nose (see Palmer, 1904: 208).

1871. *Ptychorhina* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 325. Publication date: 1871. - Comments: Type species: *Rhinolophus caffer* Sundevall, 1846, by monotypy (according to Decher and Fahr, 2005: 1) or by subsequent designation by Palmer (1904: 597) (according to Jackson and Groves, 2015: 246).

1871. *Sideroderma* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 324. Publication date: 1871. - Comments: Type species: *Phyllorrhina fuliginosa* Temminck, 1853, by monotypy (see Decher and Fahr, 2005: 1; Jackson and Groves, 2015: 246). - Etymology: From the Greek "*σίδηρος*", meaning iron and "*δέρμα*", meaning skin, referring to the dark brown or reddish colour of the fur (see Palmer, 1904: 630).

1871. *Sybdesmotus* Peters.

1871. *Syndesmotis* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 329. Publication date: 1871. - Comments: Type species: *Phyllorhina megalotis* Heuglin, 1862, by monotypy (see Jackson and Groves, 2015: 247).

1871. *Thyreorhina* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 327. Publication date: 1871. - Comments: Type species: *Phyllorrhina coronata* Peters, 1871, by monotypy (see Decher and Fahr, 2005: 1; Jackson and Groves, 2015: 246). - Etymology: From the Greek "*θυρεός*", meaning a large, oblong shield and "*ρις*" or "*ρινός*", meaning nose, referring to the upper noseleaf with thickened edge (see Palmer, 1904: 678).

1902. *Syndesmotus* C.O. Waterhouse, Index Zoologicus. - Comments: Objective synonym of *Syndesmotis* Peters, 1871 (see Simmons, 2005) or incorrect subsequent spelling of *Syndesmotis* Peters, 1871 (see Jackson and Groves, 2015: 247). - Etymology: From the Greek "*σύνδεσμος*", meaning bond or fastening and "*ούς*" or "*ώτός*", meaning ear (see Palmer, 1904: 656).

2015. *Hypposideros:* Sylla, Pourrut, Diatta, Diop, Ndiaye and Gonzalez, Afr. J. Microbio. Res., 9 (22): 1460. Publication date: 3 June 2015. (Lapsus)

2016. *Hipposieros:* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 42. Publication date: 9 May 2016. (Lapsus)

2017. *Hipposidereos:* Hammond, Tan and Johnson, Protein Sci., 26: 1727. Publication date: 5 June 2017. (Lapsus)

? *Hipposideros sp.:*

TAXONOMY:

For review of the genus see Hill (1963a), on which the above synonymy and the treatment that follows are largely based, followed by Meester *et al.* (1986); Koopman (1993a: 170). Hill (1963a) recognizes seven species groups, five are recognized in Africa *speoris*, *bicolor*, *cyclops*, *commersoni*, and *megalotis* (Simmons, 2005: 367 - 379). However, see also Bogdanowicz and Owen (1998: 38), who indicate that recent species are not expressed accurately by current systematic arrangements based on the supraspecific groupings proposed by Hill (1963a), and that the genus *Hippoderos* might be a paraphyletic taxon. This is confirmed by Foley *et al.* (2014: 324), who indicate that *H. commersoni* and *H. vittatus* pose a problem here. Without these species, the monophyly of the remaining *Hipposideros* species is supported by all of their analyses. Foley *et al.* (2017: 2) furthermore indicate that the species groups, currently recognized in the genus, have yet to be thoroughly evaluated using molecular data.

One of the most controversial groups in the African *Hipposideros* representatives is the *caffer/ruber* complex. Vallo *et al.* (2009: 196) subdivided this in four main groups, of which three are again subdivided in two lineages, and which were tentatively called: A1, A2, B1, B2, C1, C2, and D. These lineages would represent at least five species. Monadjem *et al.* (2013b: 345) separated two further lineages in southern African *H. caffer*: A1a and A2b, and two in Senegalese *H.* cf. *ruber*: D1 and D2; and one in Ghanian (E2) and Liberian and Côte d'Ivorian *H.* cf. *ruber*: (E1).

Known species to the genus *Hipposideros*: †***besaoka*** Samonds 2007; †***kaumbului*** Wesselman 1984; ***abae*** J.A. Allen, 1917; *armiger* (Hodgson,

1835) – Northern India, Nepal, Burma, south and southeastern China, Vietnam, Laos, Cambodia, Thailand, Malay Peninsula, Taiwan (Simmons, 2005: 367); *ater* Templeton, 1848 – Sri Lanka; India to western Malaysia, through Philippines, Indonesia, and New Guinea to northern Queensland, north Northern Territory, and north Western Australia (Australia) (Simmons, 2005: 367); ***beatus*** (K. Andersen, 1906); *bicolor* (Temminck, 1834) – Laos, Vietnam, southern Thailand and Malaysia to Borneo and the Philippines, Java, Sumbawa, Seralu, Sumba, Savu, Roti and Timor Isls (Indonesia) and adjacent small islands (Simmons, 2005: 368); *breviceps* Tate, 1941 – Mentawai Isls (Indonesia) (Simmons, 2005: 368); ***caffer*** (Sundevall, 1846); *calcaratus* (Dobson, 1877) – central New Guinea (Simmons, 2005: 368); ***cameruensis*** Eisentraut, 1956; *cervinus* (Gould, 1854) – western Malaysia, Sumatra, and Mindanao (Philippines) to the Mollucca Isls, Vanuatu, and northeastern Australia (Simmons, 2005: 369); *cineraceus* Blyth, 1853 – Pakistan and India to Burma, Thailand, Laos, Vietnam, Sumatra and Borneo, adjacent small islands including Kangean Isls (Indonesia) (Simmons, 2005: 369); *coronatus* (Peters, 1871) – northeastern Mindanao (Philippines) (Simmons, 2005: 369); *corynophyllus* Hill, 1985 – central New Guinea (Simmons, 2005: 370); *coxi* Shelford, 1901 – Sarawak (Borneo, Malaysian part) (Simmons, 2005: 370); *crumeniferus* (Lesueur and Petit, 1807) – Timor (Indonesia) (Simmons, 2005: 370); ***curtus*** G.M. Allen, 1921; *demissus* K. Andersen, 1909 – San Cristobal Isl (Solomon Isls) (Simmons, 2005: 370); *diadema* (E. Geoffroy, 1813) – Burma and Vietnam through Thailand, Laos, western Malaysia and Indonesia (including Sumatra, Borneo and Bali) to New Guinea, Bismarck Arch., Solomon Isls and northeastern Australia, Philippines, Nicobar Isls (Simmons, 2005: 370); *dinops* K. Andersen, 1905 – Solomon Isls; Bougainville Isl (Paua New Guinea) (Simmons, 2005: 370); *doriae* (Peters, 1871) – western Malaysia, Sarawak and Sabah (Malaysia), Borneo and Sumatra (Indonesia) (Simmons, 2005: 371); *durgadasi* Khajuria, 1970 – central India (Simmons, 2005: 371); *dyacorum* Thomas, 1902 – Borneo (including Sarawak, Malaysia), Peninsular Thailand (Simmons, 2005: 371); *edwardshilli* Flannery and Colgan, 1993 – northwestern Papua New Guinea (Simmons, 2005: 371); ***fuliginosus*** (Temminck, 1853); *fulvus* Gray, 1838 – Afganistan, India, Sri Lanka, Pakistan to Vietnam (Simmons, 2005: 371); *galeritus* Cantor, 1846 – Sri Lanka and India through southeast Asia (including Burma, Thailand and Peninsular Malaysia) to Java and Borneo, Sanana Isl (Sula Group, Moluccas Isls) (Simmons, 2005: 372); *grandis* G.M. Allen, 1936 – Burma, Thailand and Vietnam (Simmons, 2005: 372); *halophyllus* Hill and Yenbutra, 1984 – Thailand (Simmons, 2005: 372); *hypophyllus* Kock and Bhat, 1994 – southern India (Simmons, 2005: 372); *inexpectus* Laurie and Hill, 1954 – northern Sulawesi (Indonesia) (Simmons, 2005: 372); *inornatus* McKean, 1970 – Northern Territory (Australia) (Simmons, 2005: 373); ***jonesi*** Hayman, 1947; ***lamottei*** Brosset, 1985; *lankadiva* Kelaart, 1850 – Sri Lanka, southern and central India (Simmons, 2005: 373); *larvatus* (Horsefield, 1823) – northern and eastern India and Bangladesh; Yunnan, Kwangsi and Hainan (China), Burma, Thailand, Cambodia, Laos and Vietnam, western Malaysia to Sumatra, Java, Borneo and adjacent small islands including Kangean Isls (Indonesia) (Simmons, 2005: 373); *lekaguli* Thonglongya and Hill, 1974 – Thailand, peninsular Malaysia, Luzon (Philippines) (Simmons, 2005: 373); *lylei* Thomas, 1913 – Burma, Vietnam, Thailand, western Malaysia (Simmons, 2005: 374); *macrobullatus* Tate, 1941 – Sulawesi, Seram (Molucca Isls) and Kangean Isls (Indonesia) (Simmons, 2005: 374); *madurae* Kitchener and Maryanto, 1993 – Madura Isl, central Java (Indonesia) (Simmons, 2005: 374); *maggietaylorae* Smith and Hill, 1981 – New Guinea, Bismarck Arch (Simmons, 2005: 374); ***marisae*** Aellen, 1954; ***megalotis*** (Heuglin, 1861); *muscinus* (Thomas and Doria, 1886) – New Guinea (Simmons, 2005: 374); *nequam* K. Andersen, 1918 – Malaysia (Simmons, 2005: 375); *obscurus* (Peters, 1861) – Philippines except Palawan region (Simmons, 2005: 375); *orbiculus* Francis, Kock, and Habersetzer, 1999 – Sumatra (Indonesia), Peninsular Malaysia (Simmons, 2005: 375); *papua* (Thomas and Doria, 1886) – Biak and Numfoor Isls, western New Guinea and northern Molucca Isls (Simmons, 2005: 375); *pelingensis* Shamel, 1940 – Peleng Isl and Sulawesi (Indonesia) (Simmons, 2005: 375); *pomona* K. Andersen, 1918 – Bangladesh and India to Burma, Thailand, Laos, Cambodia, Vietnam, southern China and western Malaysia (Simmons, 2005: 375); *pratti* Thomas, 1891 – southern China, Burma, Thailand, Vietnam, western Malaysia (Simmons, 2005: 375); *pygmaeus* (Waterhouse, 1843) – Philippines except Palawan region (Simmons, 2005: 376); *ridleyi* Robinson and Kloss, 1911 – Penninsular Malaysia, Singapore, northern Borneo (Simmons, 2005: 376); *rotalis* Francis, Kock, and Habersetzer, 1999 – Laos (Simmons, 2005: 376); ***ruber*** (Noack, 1893); *scutinares* Robinson, Jenkins, Francis, and Fulford, 2003 – Loas, Vietnam (Simmons, 2005: 376); *semoni* Matschie, 1903 – northern Queensland (Australia), eastern New Guinea (Simmons, 2005: 376); *sorenseni* Kitchener and Maryanto, 1993 – central and western Java (Indonesia) (Simmons, 2005: 376); *speoris* (Schneider, 1800) – India, Sri Lanka (Simmons, 2005: 377); *stenotis* Thomas, 1913 – Northern Territory, north Western Australia and northern Queensland (Australia) (Simmons, 2005:

377); *sumbae* Oei, 1960 – Sumba, Roti, Sumbawa, Flores, Semau and Savu Isls (Indonesia) (Simmons, 2005: 377); ***tephrus*** (Cabrera, 1906); ***thomensis*** (Bocage, 1891); *turpis* Bangs, 1901 – Peninsular Thailand and Vietnam; Ryukyu Isls (Japan) (Simmons, 2005: 377); *wollastoni* Thomas, 1913 – western and central New Guinea (Simmons, 2005: 378).

COMMON NAMES:
Czech: praví pavrápenci. English: Leaf-nosed Bats, Leafnosed Bats, Roundleaf Bats. French: Phyllorhines. German: Altwelt-Rundblattnasen. Italian: Ipposidèri.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The approximate fossil date for crown *Hipposideros* is set by Shi and Rabosky (2015: 1532) to 40.4 Mya.

At Songhor, Butler (1969, 1978) found *Hipposideros* sp. from Early Miocene deposits.

BIOGEOGRAPHY:
During the Miocene at about 15 Mya, *Hipposideros* diversified into distinct clades based on geography: these being the African, Indian and South East Asian clades (Foley *et al.*, 2014: 320).

PARASITES:
HAEMATOSPORIDA
Schaer *et al.* (2017: 2) examined 23 *Hipposideros* specimens from South Sudan, of which 1 (4 %) was infected by *Hepatocystis*.

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - During Febuary 2008 in Ghana, Pfefferle *et al.* (2009) tested fecal samples of various *Hipposideros* species of the *caffer*/*ruber* complex, where the specific identification needs to be confirmed, and therefore is presented here - Pfefferle *et al.* (2009) as *Hipposideros caffer ruber* tested 40 fecal samples, 10 tested positive for coronavirus (CoV) RNA, while 4 were positive for group 1 CoV and 6 for group 2 CoV. Pfefferle *et al.* (2009) as *Hipposideros* cf. *ruber* tested 8 fecal samples which tested negative for coronavirus (CoV) RNA, from Booyem A cave. While from Booyem B cave [identified as *H* cf. *ruber* two morphotypes], in Ghana 11 fecal samples, 2 samples tested positive for coronavirus (CoV) RNA, while the one was positive for group 1 CoV and the other for group 2 CoV (Pfefferle *et al.*, 2009).

Drexler *et al.* (2013a: 50) and Hu *et al.* (2015: 5) indicate that *Hipposideros* betacoronaviruses detected in Africa (Ghana, Kenya, and Nigeria) and Asia are clearly distinct from SARS-related coronaviruses.

27.6 % (?; 16 out of 68) of the Kenyan *Hipposideros* specimens tested by Tao *et al.* (2017: 3, Suppl.) were positive for CoV.

Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that one out of eight examined Kenyan *Hipposideros* sp. specimens tested positive for *Paramyxovirus* sequences. This was also the case for one out of 39 specimens from Cameroon, and one out of three Nigerian specimens.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Horton *et al.* (2014: Table S1) tested 16 Tanzanian *Hipposideros* sp. specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

†***Hipposideros africanum*** Ravel, 2016

*2016. *Hipposideros (Pseudorhinolophus) africanum* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 372, figs 8 - 10. Publication date: 30 September 2016. Type locality: Tunisia: Kassérine province: Djebel Chambi National Park: Chambi [35 14 03 N 08 45 29 E, 630 m] [Goto Description]. - Etymology: The name refers to the African continent and underlines the geographic importance as the genus was herethereto only reported from Europe (see Ravel et al., 372).

GENERAL COMMENTS:
This fossil species is generally assigned to the subgenus *Pseudorhinolophus* Schlosser, 1887.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe:
Late lower Eocene to early middle Eocene.

†***Hipposideros amenhotepos*** Gunnell, Winkler, Miller, Head, El-Barkooky, Gawad, Sanders, and Gingerich, 2015

*2015. *Hipposideros (Pseudorhinolophus) amenhotepos* Gunnell, Winkler, Miller, Head, El-Barkooky, Gawad, Sanders, and Gingerich, Hist. Bio., 28 (1-2): 162, figs 4, 5, 6 (for 2016). Publication date: 1 October 2015. Type locality: Egypt: Eastern Desert: Khasm El-Raqaba [28.451 N 31.834 E] [Goto Description]. Holotype: CGM 83763: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Right M1. - Comments: The paper was published online on 1 October 2015, and in print on 17 February 2016. - Etymology: Named after Amenhotep IV (= Akhenaten), an Egyptian 18th Dynasty pharaoh, whose capital city of Amarna was located in the Eastern Desert not far from the type locality of this species (see Gunnell *et al.*, 2015b: 162).

†***Hipposideros kaumbului*** Wesselman, 1984

*1984. *Hipposideros kaumbului* Wesselman, Contributions to vertebrate evolution, 7: 59. Type locality: Ethiopia: Locality 28, lower Member S, Shungura Formation. - Etymology: This taxon is named in honour of John Kaumbulu Kimau, a Wakamba tribesman from Kikoko, Kenya, who worked with H.B. Wesselman as his field assistant following the 1972 and 1973 field seasons and helped with the task of handpicking almost 20 tons of screenwashed residues (Wesselman, 1984: 59). (Current Combination)

TAXONOMY:
Wesselman (1984: 59) suggests that this taxon may be ancestral to "*Hipposideros commersoni*" (=*Macronycteris commersoni*. Rakotoarivelo *et al.* (2019: 14), however, indicate that many different taxa included in the *commersoni*) group are morphologically very similar to each other, yet genetically quite distinct

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Late Pliocene (2.08 Mya) (Wesselman, 1984: 59).

†***Hipposideros vetus*** (Lavocat, 1961)

*1961. *Asellia vetus* Lavocat, Notes Mém. Serv. Mines Carte geol. Maroc, 155: ?. - Comments: Marandat (1994: 61) mentions that the holotype consists of a left maxillary fragment with P^4-M^3.
1982. *Hipposideros (Syndesmotis) vetus:* Legendre, J. Vert. Paleont., 2 (3): 379. Publication date: December 1982. (Name Combination)
2013. *Asellia/Hipposideros vetus:* Stoetzel, Palaeog., Palaeoclim., Palaeoecol., 392: 363. Publication date: 29 September 2013. (Name Combination)
? *Hipposideros vetus:* (Current Combination)

TAXONOMY:
Originally described in the genus *Asellia*, the generic assignment of this taxon was unclear. Some authors (e.g. Legendre, 1982: 372; Gunnell *et al.*, 2011: 71; Hugueney *et al.*, 2015) assign it to the genus *Hipposideros*, whereas others (e.g. Aulagnier, 2013a: 360) assign it to the genus *Asellia*. Stoetzel, 2013: 363) furthermore mentions it as *Asellia/Hipposideros vetus*.

Legendre (1982: 382) examined the teeth and dental characters and found that although the absence of a P^2 and the degree of reduction of M^2 as well als M^3 are similar to those of other fossil *Asellia*, there are characters that are incompatible with this genus: upper canines with a separate secondary cusp on the distal edge, mandible with a long and slender horizontal ramus; low coronoid process; long and outward deflected angular process. These characters are much more similar to those of *Hipposideros*. Legendre (1982: 383) assigned *vetus* to the subgenus *Syndesmotis*, together with *H. megalotis*.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Miocene - Pliocene.

Hipposideros abae J.A. Allen, 1917

*1917. *Hipposideros abæ* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 432. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Aba [03 53 N 30 17 E] [Goto Description]. Holotype: AMNH 49123: ad ♂,

skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 13 December 1911; original number: 1715. - Etymology: Referring to the locality where the type specimen was collected (Aba). (Current Combination)

? *Hipposideros abae:* (Current Spelling)

TAXONOMY:
Simmons (2005: 367) places it in the *speoris* species group.

COMMON NAMES:
Czech: pavrápenec abánský. English: Aba Roundleaf Bat, Aba Leaf-nosed Bat. French: Phyllorhine d'Aba. German: Aba-Rundblattnase.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008at; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008at; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004bq; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There are no known major threats to this species. It appears to have taken advantage of forest clearance by moving into formerly forested land (Mickleburgh *et al.*, 2008at; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008at) [in IUCN (2009)] report that no specific conservation measures are in place, but it occurs in Comoe National Park in Côte d'Ivoire, and presumably also in other protected areas across its wide range.

GENERAL DISTRIBUTION:
Hipposideros abae is patchily distributed in a range which extends from Guinea-Bissau in West Africa (also the most northerly record) to northern Uganda (also the most eastern and southerly record) (Simmons, 2005: 367). It is a lowland species found below 1,000 m.

Native: Burkina Faso (Koopman *et al.*, 1978: 4; Kangoyé *et al.*, 2015a: 608); Cameroon; Central African Republic; Congo (The Democratic Republic of the); Côte d'Ivoire; Ethiopia (Kruskop *et al.*, 2016: 57); Ghana; Guinea (Weber and Fahr, 2007); Guinea-Bissau (Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 56); Liberia; Nigeria; Sierra Leone; Sudan; Togo; Uganda (Kityo and Kerbis, 1996: 61).
Presence uncertain: Benin; Chad; Mali.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Young (1975: 76) indicates that two distinct colour phases can be found: rufous (orange) and grey.

ECHOLOCATION:
In Sierra Leone, Weber *et al.* (2019: 21) recorded the call of one female with CF at 103.0 kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Unknown.
Protein / allozyme - Unknown.

ROOST:
It roosts in caves and rocky crevices or on the undersides of boulders, but apparently not in houses (Happold, 1987). For Guinea, Weber and Fahr (2006: 4) indicate that *H. abae* largely or exclusively depends on the availability of caves as day roosts.

POPULATION:
Structure and Density - Is thought to be sparsely distributed throughout its range, and to roost in small colonies (approximate group size in the dozens, not hundreds) (Mickleburgh *et al.*, 2008at; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008at; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
One female captured on 24 May in Sierra Leone was lactating (Weber *et al.*, 2019: 23).

PARASITES:
ACARI
Fain (1959c: 239) described *Psorergates (Psorergatoides) hipposideros* (Acari: Psoridatidae) from a *H. abae* captured near Bunia, Ituri, DRC.

DIPTERA
Streblidae: *Ascodipteron jonesi* Jobling 1952 from the wing at Njala, Sierra Leone (Haeselbarth *et al.*, 1966: 106).

VIRUSES:
Coronaviridae

SARS-CoV - During Febuary 2008 in Ghana, 16 fecal samples for coronavirus (CoV) RNA from two localities tested negative Pfefferle *et al.*, 2009). Corman *et al.* (2015: 11859) tested 242 Ghanese bats and found 19 (7.8 %) to test positive for 229E-related coronaviruses.

Hepeviridae
Drexler *et al.* (2012b: 9137) reported two positive feacal samples out of a total of 57 examined (3.51 %) from Ghana. Johne *et al.* (2014: 223, 224) suggested to place the Bat hepatitis E virus found in *H. abae*, as well as Hepevirus-species occuring in other bat families into a separate genus: *Chiropteranhepevirus*.

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) reported that none of the 80 specimens they examined from Ghana tested positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

Phenuiviridae
Phlebovirus
de Jong *et al.* (2011: 11), Luis *et al.* (2013: Suppl.), and Willoughby *et al.* (2017: Suppl.) report the occurrence of Rift Valley fever virus.

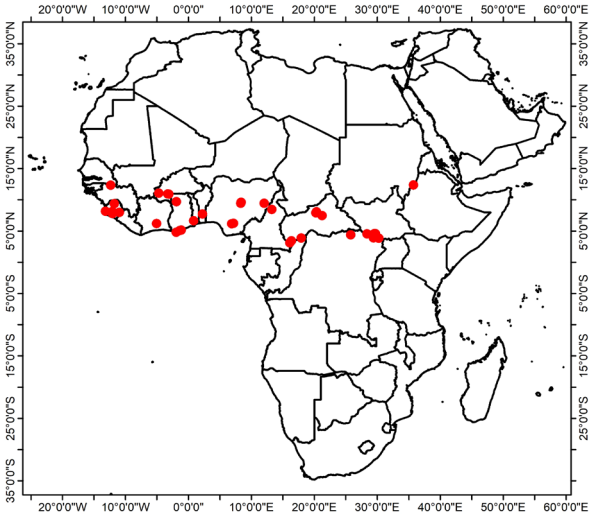


Figure 53. Distribution of *Hipposideros abae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Ghana, Nigeria, Senegal, Sierra Leone, South Sudan, Togo.

Hipposideros beatus (K. Andersen, 1906)

*1906. *Hipposiderus beatus* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 17 (99): 275, 279. Publication date: 1 March 1906. Type locality: Equatorial Guinea: Rio Muni: Benito River, 15 mi (24 km) from [01 31 N 09 52 E] [Goto Description]. Holotype: BMNH 1900.2.5.45: ad ♀, alcoholic (skull not removed). Collected by: George Latimer Bates Esq. Collection date: February 1899. (Current Combination)

1957. *Hipposideros beatus maximus* Verschuren, Exploration du Parc national du Garamba, 7: 365. Type locality: Congo (Democratic Republic of the): Garamba National Park: Pidigala-Nord, Source area of [04 38 N 29 42 E]. Holotype: RBINS 13768: ad ♂. Collected by: Jacques Verschuren; collection date: 23 April 1952; original number: 4565. Presented/Donated by: ?: Collector Unknown. Holotype: RBINS 4037: ad ♂. Collected by: Gaston-François de Witte *et al.*; collection date: 23 April 1952; original number: 4565. Presented/Donated by: ?: Collector Unknown.

? *Hipposideros beatus beatus:* (Name Combination)

? *Hipposideros beatus:* (Current Spelling)

TAXONOMY:
Simmons (2005: 368) places it in the *bicolor* species group.

COMMON NAMES:
Czech: pavrápenec guinejský. English: Benito Roundleaf Bat, Benito Leaf-nosed Bat, Dwarf Leaf-nosed Bat. French: Phyllorine naine, Phyllorhine de Benito. German: Benito-Rundblattnase, Benito-Blattnase. Spanish (Castillian): Murciélago de Nariz de Hoja.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bz; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bz; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004ck; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
Habitat loss is the major threat to this species (Mickleburgh *et al.*, 2008bz; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bz) [in IUCN (2009)] report that it occurs in the Mount Allen National Park (Equatorial Guinea), and Garamba National Park (Democratic Republic of Congo), and presumably in several other protected areas.

GENERAL DISTRIBUTION:
Hipposideros beatus has been recorded from Sierra Leone eastwards across the forest zone west and central Africa, as far east as the Sudan/Democratic Republic of Congo border. There are records from Sierra Leone, Guinea, Liberia, Côte d'Ivoire, Ghana, Togo, Nigeria, Cameroon, Equatorial Guinea, Congo, Democratic Republic of Congo and Sudan. A previous report of this species in Central African Republic is in error, though it might occur in the south of that country.

Native: Cameroon (Eisentraut, 1973); Congo (The Democratic Republic of the); Côte d'Ivoire; Equatorial Guinea; Gabon; Ghana (Decher and Fahr, 2007: 16); Guinea; Guinea-Bissau (Rainho and Ranco, 2001: 59); Kenya (Webala *et al.*, 2019: 13); Liberia; Nigeria (Happold, 1987); Sierra Leone; Sudan; Togo.
Presence uncertain: Central African Republic.

Bates *et al.* (2013: 338) reject the presence of *H. beatus* in the Republic of Congo, because previous authors (e.g. Malbrant and Maclatchy, 1949; Dowsett *et al.*, 1991) indicated it would be 'likely' to occur in that country.

ECHOLOCATION:
Monadjem *et al.* (2013b: 351) report the F_{max} to be 129.0 kHz at Mount Nimba.

Heller and Volleth (2016: 4) report different bandwidths for *H. beatus* specimens from various parts of Africa: Côte d'Ivoire: 139 - 147 kHz (Happold, 2013ap), Mount Nimba: 129 kHz (Monadjem *et al.*, 2013b), Lake Tumba, DRC: 108 and 129 kHz (2 specimens; see Novick, 1958), and Irangi, DRC: 109.2 kHz (their study). This 20 kHz difference makes them suggest that two cryptic species might be present.

In Kenya, Webala *et al.* (2019: 15) report F_{max}: 114.8 - 123.7 kHz, duration: 7.0 - 9.1 msec for three females and F_{max}: 124.0 kHz, duration: 8.0 - 8.4 msec for two males.

HABITAT:
In Nigeria, it is widely distributed in the rainforest zone (Happold, 1987). Monadjem *et al.* (2016y: 365) also report its wide distribution in forested habitats in the Mount Nimba area, on altitudes between 420 and 700 m.

POPULATION:
Structure and Density - It has a patchy distribution, typically found in small familial groups, but can be found in groups of up to 20 individuals. There is no information on overall abundance (Mickleburgh *et al.*, 2008bz; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bz; IUCN, 2009).

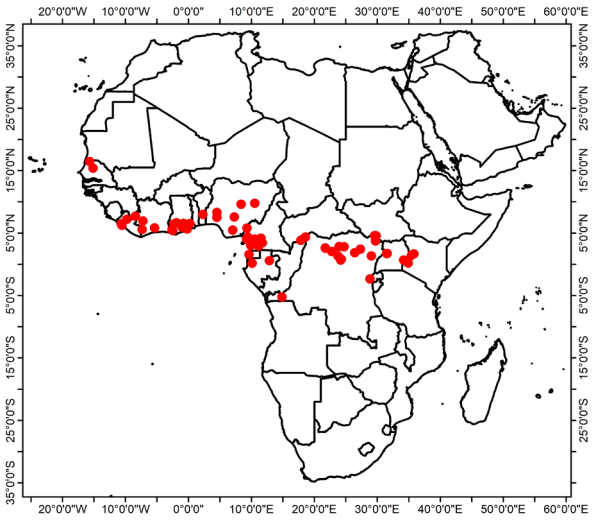


Figure 54. Distribution of *Hipposideros beatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Kenya, Liberia, Nigeria, Senegal, Uganda.

Hipposideros caffer (Sundevall, 1846)

*1846. *Rhinolophus caffer* Sundevall, Öfvers. kongl. Sv. Vet.-Akad. Förhandl., 3 (4): 118. Publication date: 1846. Type locality: South Africa: KwaZulu-Natal: Port Natal [=Durban], near [ca. 29 52 S 31 00 E] [Goto Description]. Syntype: BMNH 1848.6.2.16: skull only. "Cotype" from Stockholm Museum, labeled "*Hipposideros caffer typicus*" locality Natal. Syntype: BMNH 1849.11.22.11: skin only. - Comments: Type locality originally mentioned as "Circa Port-Natal inventus". - Etymology: From the masculine scientific Latin adjective *càffer* "Kafir", referring to the southern African locality where the type specimen was collected (see Lanza *et al.*, 2015: 139).

1852. *Phyllorhina caffra* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 39, pl. 8. Publication date: 1852. Type locality: Mozambique: Ibo island. (Name Combination)

1852. *Phyllorrhina gracilis* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 36, pl. 7, fig. 1 - 4; pl. 13, fig. 14 - 15. Publication date: 1852. Type locality: Mozambique: Lower Zambesi River: Tete [16 10 S 33 35 E, 230 m] [Goto Description]. Holotype: ZMB 364/85624: ♂. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847; original number: An 16311. See Turni and Kock (2008: 38) [skin & skull: ZMB 364 + skeleton: ZMB 85624].

1852. *Phyllorrhina patellifera* Peters, Naturw. Reise Mossamb., Säugethiere, p. 39. Type locality: Mozambique: Ibo island. - Comments: Manuscript name, cited by Peters (1852: 39, 40).

1898. *Phyllorhina angolensis* Seabra, J. Sci. mat. phys. nat., ser. 2, 5: 256. Publication date: December 1898. Type locality: Angola: Rio Coroca [=Curoca river] [15 43 S 11 55 E]. Syntype: BMNH 1906.1.3.2:. - Comments: Meester *et al.* (1986: 43) indicate "Benguela, Angola, restricted by Hill and Carter (1941: 40), who point out that the name is based on four specimens from Benguela, housed in the Museu Bocage, Lisbon, and one from Rio Coroca, Angola, in the British Museum (Natural History). Koopman (in litt.) points out that, as the Museu Bocage had been destroyed by fire, the Rio Coroca specimen may be the only remaining of the type series.".

1917. *Hipposideros nanus* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 434. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Faradje [03 44 N 29 43 E] [Goto Description]. Holotype: AMNH 49426: ad ♀, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 24 September 1912; original number: 1689. Allen (1917: 434) erroneously mentioned 24 October 1912 as collection date, see Goodwin (1953: 245).

1924. *Hipposideros caffer aurantiaca* de Beaux, Atti Soc. Lig. Sci. Nat. Geogr, 3: 155. Type locality: Somalia: Basso Giuba [=Lower Juba river]: Belet Mamu. - Comments: Lanza *et al.* (2015: 139) indicate that the correct spelling shoud actually be "*aurantiacus*" as the generic name ("*Hipposideros*") is a masculine name.

2015. *H[ipposideros] cafer:* Gunnell, Winkler, Miller, Head, El-Barkooky, Gawad, Sanders, and Gingerich, Hist. Bio., 28 (1 - 2): 163. Publication date: 1 October 2015. (Lapsus)

? *Hipposideros caffer angolensis:* (Name Combination)

? *Hipposideros caffer caffer:*

? *Hipposideros caffer centralis:*

? *Hipposideros caffer nanus:* (Name Combination)

? *Hipposideros caffer:* (Name Combination, Current Combination)

TAXONOMY:

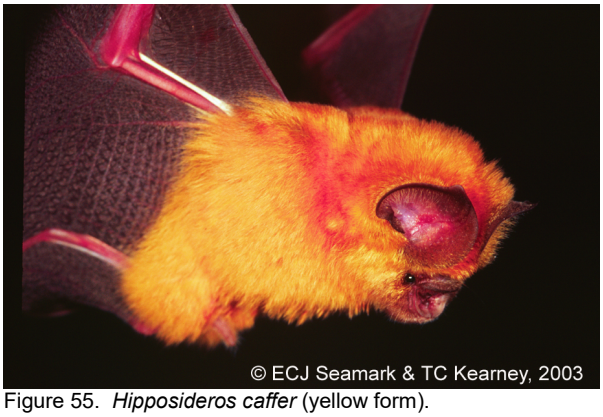


Figure 55. *Hipposideros caffer* (yellow form).

Meester *et al.* (1986) state that further extralimital [to Southern Africa] subspecies may include *centralis* Andersen, 1906, *tephrus* Cabrera, 1906, *nanus* J.A. Allen, 1917 (Koopman, 1975), and also *guineensis* Andersen, 1906, and *niapu* J.A. Allen, 1917 (Hill, 1963a). Most recent authors appear to regard *ruber* Noack, 1893, as a separate species (Kock, 1969a; Hayman and Hill, 1971; Ansell, 1978; Corbet and Hill, 1980, Koopman, 1982). Although Hill (1963a) and Koopman (1975 regard *ruber* as only subspecifically distinct from *caffer*. Simmons (2005: 368) places *H. caffer* within the *bicolor* species group. Vallo *et al.* (2007: 257) consider *tephrus* to be a separate species, based on cytochrome *b* analysis. Reviewed by Vallo *et al.* (2009).

COMMON NAMES:

Afrikaans: Sundevall se bladneusvlermuis, Sundevall-bladneusvlermuis, Sundevallse blaarneusvlermuis, Kaapse Blaarneusvlermuis. Azande (DRC): Nkulo. Chinese: 松氏蹄蝠. Czech: pavrápenec natalský, listonos africký, pavrápenec africký. English: Sundevall's Leaf-nosed Bat, Common African Leaf-nosed Bat, Lesser Leaf-nosed bat, Sundevall's Roundleaf Bat, Cape Leaf-nosed bat, Sundevall's African

Leaf-nosed Bat, South African Lesser Leaf-nosed Bat. French: Phyllorhine de Cafrerie, Phyllorhine de Sundevall, Rhinolophe de Cafrerie. German: Sundevalls Rundblattnase, Sundevall's Blattnase. Italian: Ipposìdero càfro. Kiluba (DRC): Kasusu. Nyungwe: Kalemawalema (Malawi; not specific). Portuguese: Morcego de nariz enfolhado da cafraria.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining at nearly the rate required to qualify for listing in a threatened category (Kock *et al.*, 2008c; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Kock *et al.*, 2008c; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004ae; IUCN, 2004). 1994 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016t). 2004 - DD ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
Human disturbance to roosting sites (caves) could have a negative effect (Kock *et al.*, 2008c; IUCN, 2009).

Sherwin *et al.* (2012: 174) consider aerial hawking and water stress to be the major risk factors linked to climatic change.

CONSERVATION ACTIONS:
Kock *et al.* (2008c) [in IUCN (2009)] report that no specific conservation measures are in place. Occurs in protected areas throughout its range.

GENERAL DISTRIBUTION:
Hipposideros caffer is a very wide ranging species, occurring from the south-western Arabian Peninsula (including Yemen) and across most of sub-Saharan Africa (except for central forested regions) (Simmons, 2005: 368). This species has also been recorded in southern Algeria, central Niger, eastern Chad, the Senegal/Mauritania border. Elevation ranges from sea level to 2,500 m in this area.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,581,888 km^2. In South Africa, its distribution is stongly associated with the mean temperature of the coldest quarter (Babiker Salata, 2012: 49).

Specimens from Morocco need verification as these may be attributed to *H. tephrus* (Cabrera, 1906). A supposed record from southern Algeria requires confirmation.

Specimens identified by Fahr *et al.* (2006a) as *H. caffer* from Mount Nimba might need to be reassigned, as this species is restricted to southern Africa (Monadjem *et al.*, 2016y: 365).

Native: Angola (Crawford-Cabral, 1989; Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 536); Benin; Botswana (Monadjem *et al.*, 2010d: 536); Burkina Faso; Burundi; Cameroon; Chad; Congo (Bates *et al.*, 2013: 335); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 536); Côte d'Ivoire; Equatorial Guinea; Eritrea; Ethiopia; Gabon (Brosset, 1966c); Gambia; Ghana; Guinea; Guinea-Bissau (Seabra, 1900c; Monard, 1939;; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 50); Kenya; Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d:536); Mali; Mauritania; Morocco (El Ibrahimi and Rguibi Idrissi, 2015: 360); Mozambique (Lopes and Crawford-Cabral, 1992; Monadjem *et al.*, 2010d: 536; Monadjem *et al.*, 2010c: 380); Namibia (Monadjem *et al.*, 2010d: 536); Niger; Nigeria (Menzies, 1973); Rwanda; Saudi Arabia; Senegal; Sierra Leone; Somalia; South Africa (Taylor, 2000: 140; Monadjem *et al.*, 2010d: 537); Sudan; Swaziland (Monadjem *et al.*, 2010d: 537); Tanzania (including the islands of Pemba, Unguja, and Mafia [see O'Brien, 2011: 287]); Togo; Uganda (Kityo and Kerbis, 1996: 61); Yemen; Zambia (Ansell, 1969; Ansell, 1978; Ansell, 1986; Cotterill, 2002b: 5; Monadjem *et al.*, 2010d: 537); Zimbabwe (Monadjem *et al.*, 2010d: 537).
Presence uncertain: Algeria; Liberia.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Menzies (1973) [in Young (1975: 76) indicates that, in some colonies in northern Nigeria, rufous bats get a grey fur during the molting season, and subsequently change back to rufous. Young (1975: 76) also mentions that the majority of *H. caffer* specimens in Angola and south-west Africa (Namibia) is grey, whereas in eastern Africa, the rufous phase is more common.

From western Uganda, Monadjem *et al.* (2011: 30) reported the following data for 5 *H.* cf. *caffer* specimens: Fa: 51.50 ± 1.398 mm, mass: 10.2 ± 1.10 g, wing loading: 5.2 ± 0.27 N/m^2, aspect ratio: 5.8 ± 0.10.

DETAILED MORPHOLOGY:
Baculum - Unknown
Brain - Amrein *et al.* (2007), from specimens collected from Bénin, reported moderate

proliferating cell activity, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus, with doublecortin (DCX) they detected highest levels of young migrating neuron in the subgrannular layer of the hippocampus. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. No NeuroD was detected in the hippocampal granule cells (Amrein *et al.* (2007).

ECHOLOCATION:
At Irangi (Kivu province, DRC), Heller (1992: 77) was able to distinguish *H. caffer* from *H. ruber* as the prior emitted calls at a much higher frequency: 137 - 160 kHz (versus 130 - 140 kHz in *ruber*).

In Guinea, Fahr and Ebigbo (2003) reported a constant frequency component of 160.2 - 164.1 kHz (these may not represent *H. caffer* see Vallo *et al.*, 2009). In Kenya, Taylor *et al.* (2005) reported a maximum frequency of 157 (± 0.2) kHz, using a Pettersson D980 detector. From the same country, Eisenring *et al.* (2016: SI 2.) reported the following values: PF: 144.0, HF: 149.4, LF: 110.9, DT: 0.1, DF: 38.5, and IPI: 0.0. At Sengwa in Zimbabwe, Fenton (1986a) reported a maximum frequency of 141.5 (± 2.7) kHz, whereas previously Jacobs (1996) and Fenton and Bell (1981) had reported a maximum frequency of 138 kHz from the same locality. In South Africa, Fenton (1986a) reported a maximum frequency of 145.4 (± 2.5) kHz from Levuvhu, while Taylor (1999b) using a Pettersson D980 detector reported a similar maximum frequency 145 (± 0.2) kHz from Jozini Dam. Monadjem *et al.* (2007a), using an Anabat detector, reported a maximum frequency of 143.0 (± 1.43) kHz from various localities in Swaziland. See also Pye (1972, O'Shea and Vaughan, 1980). Monadjem *et al.* (2010c: 381) reported from Mozambique that the peak echolocation frequencies of two individuals were recorded at 145 kHz (ANABAT).

Monadjem *et al.* (2007a) also reported sexual dimorphism in the call with males emitting a higher call than females (males 145.0 (± 0.76) kHz, females 142.9 (± 1.39) kHz).

For 13 calls from Swaziland, Taylor *et al.* (2013b: 19) reported the following parameters: F_{max}: 142.9 ± 0.96 (140.4 - 144.1) kHz, F_{min}: 123.2 ± 6.40 (108.9 - 130.3) kHz, F_{knee}: 141.5 ± 0.95 (139.3 - 142.9) kHz, F_{char}: 142.0 ± 1.00 (139.8 - 143.5) kHz, duration: 4.2 ± 0.28 (3.7 - 4.7) msec. Monadjem *et al.* (2017c: 180) indicated that calls from this species could not be detected at a distance of more than 0.5 m, using an Anabat detector. They also reported the following values: F_{min}: 121.2 ± 5.88 (109.1 - 127.3) kHz, F_{knee}: 141.4 ± 1.97 (138.7 - 144.3) kHz, F_c: 141.7 ± 1.69 (139.5 - 144.0) kHz, duration: 4.8 ± 1.08 (3.7 - 6.7) msec.

Monadjem *et al.* (2011: 32) reported on 3 calls from *Hipposideros* cf. *caffer* from western Uganda: F_{min}: 144.11 ± 6.373 kHz, F_{max}: 151.73 ± 1.661 kHz, F_{char}: 146.88 ± 3.909 kHz, F_{knee}: 151.13 ± 1.650 kHz, duration: 2.8 ± 1.18 msec.

In the Mapungubwe National Park (RSA), Parker and Bernard (2018: 57) recorded the following parameters: F_{char}: 143.00 ± 1.64 kHz, F_{max}: 143.28 ± 1.63 kHz, F_{min}: 124.99 ± 5.92 kHz, F>sub knee: 143.14 ± 1.64 kHz, duration: 7.41 ± 0.91 msec, with 12.29 ± 7.81 calls/sec.

In Kenya, Webala *et al.* (2019: 15) reported echolocation data from nine localities, where F_{max} varied between 148.9 and 153.6 for seven unsexed bats, 145.0 and 155.8 for eight males, and 145.5 and 150.9 for ; 5.0 - 9.7 for six males. The call durations varied respectively between 6.7 and 9.7, 5.4 and 10.6, and 5.0 and 9.7 msec.

MOLECULAR BIOLOGY:
DNA - Vallo *et al.* (2009).
Karyotype - Đulic and Mutere (1974), Peterson and Nagorsen (1975), Rautenbach *et al.* (1993) and Porter *et al.* (2010) all reported 2*n* = 32, FN = 60, and BA = 30. Peterson and Nagorsen (1975) and Rautenbach *et al.* (1993) also agreed on an acrocentric Y chromosome. However, Đulic and Mutere (1974) reported a metacentric X chromosome, Peterson and Nagorsen (1975) reported a subtelocentric X chromosome, and Rautenbach *et al.* (1993) reported a submetacentric X chromosome.
Protein / allozyme - Unknown.

HABITAT:
This species occurs in savanna, bushveld and coastal forest, and is usually associated with rivers and other water resources (Taylor, 2000: 140).

ROOST:
Weber and Fahr (2006: 4) indicate that *H. caffer*, in Guinea, largely or exclusively depends on the availability of caves as day roosts. In the Durban area, Taylor *et al.* (1999: 70) reported it roosting in a tunnel of the Songweni Dam.

DIET:
In their study of *H. caffer* bats from Skukuza (Kruger National Park, RSA), Dunning and Krüger (1996: 708) found that they overwhelmingly fed upon tympanate Lepidoptera, whereby relative numbers of noctuid, pyralid, and arctiid moths taken by the bats were proportional to the representation of these families in the general

population of moths in the area. They also took much less moths belonging to the Geometridae, and arctiid moths that were able to produce clicking sounds.

Taylor *et al.* (2017b: 245, 252 - 254) reported the diet from bats from the Limpopo province (RSA) to include: one unidentified beetle and seven genera or species of moths belonging to four families: *Sena* sp., *Mimallo amilia DHJ01*, *Xenopseustis* sp., *Pericyma atrifusa*, *Tycomarptes* sp., *Maurilia arcuata*.

From Sudwala (RSA), Jacobs (2000: 201) reported the following proportions of preys: Lepidoptera (65.6 ± 46.3), Coleoptera (19.1 ± 40.0), Isoptera (14.5 ± 35.6), Hemiptera (0.5 ± 1.2) and unknwon (0.3 ± 0.6).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention *H. caffer* as a possible prey of the Lanner falcon (*Falco biarmicus* Temminck, 1825), Peregrine falcon (*Falco peregrinus* Tunstall, 1771) and Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850).

POPULATION:
Structure and Density - Are extremely gregarious and capable of forming huge colonies where there is adequate roosting space. In Nigeria, at Shagunu (Menzies, 1973), a colony of about 1,000 individuals inhabited a cave five meters wide, 1-2 m high and 10-15 m deep. In Gabon they live in colonies of 200-1,000 and one exceptionally large cave contained an estimated 500,000 bats (Brosset, 1966c; Happold, 1987).
Trend - 2008 - Decreasing (Kock *et al.*, 2008c; IUCN, 2009)

REPRODUCTION AND ONTOGENY:
For Uganda, Mutere (1968) reported pregnancies between December and March and births in April.

Bernard and Meester (1982: 131) studied the reproductive cycle in *H. caffer* in Natal and found that follicular development began in February, with copulation and ovulation taking place from late April onwards. The duration of the gestation period was about 220 days (zygote: 21 days, embryo: 123 days and foetus: 76 days). Parturition took place in December, after which there was a lactation period until January, during which the bats were anoestrus.

Menzies (1973) claimed it can take up to two months before a blastocyst gets implanted, but this was revoked by Racey (1982: 83), who indicated that some of Menzies' illustrations proved otherwise.

In NE Gabon, Brosset and Saint Girons (1980: 226) found that *H. caffer* was reproducing with a boreal cycle (giving birth in March) in some caves, whereas in others they were following an austral cycle (giving birth in October). A line separating both groups seemed to run just north of the equator. For the northern group, mating occurred in November-December. In both groups, the single young was weaned after three and a half months. In the caves, where the females were following a boreal cycle, the males were in full spermatocytogenesis at the beginning of October. The spermiogenesis was starting in that period and this phase ended between 25 and 30 November. In the other caves, the males were in sexual rest between August and January.

PARASITES:
Adam and Landau (1973a: 5) report that *H. caffer* was rarely infected by a protozoan parasite of the genus *Polychromophilus* (Haemoproteidae). The bats were also found to carry low numbers of the the nycteribiid flies *Penicillidia fulvida* Bigot, 1885 and *Nycteribia schmidlii scotti* Falcoz, 1923, of which the prior was a major carrier of *Polychromophilus* sporozoites. Perkins and Schaer (2016: Suppl.) reported the presence of *Polychromophilus murinus* (Dionisi, 1899).

Wünschmann *et al.* (2010: 178) refer to Boulard (1975), who reported the first case of renal coccidiosis in a bat (on *H. caffer* and *Rhinolophus* sp.) from Sierra Leone and the Congo, and caused by *Klossiella killicki* Boulard, 1975.

Teixeira and Camargo [in Lima *et al.* (2013: 13)] described *Trypanosoma livingstonei* from two bats from Mozambique: *Rhinolophus landeri* (type host) and *H. caffer* (additional host) [see also Barbosa *et al.*, 2016: 215].

Vercammen-Grandjean and Fain (1958: 10, 12, 14, 20, 22, 30, 33) described *Trombigastia (Ascoschongastoïdes) ascoschongastoïdes*, *Trombigastia (Ascoschongastoïdes) berghei*, *Trombigastia (Scapularia) scapularia*, *Trombigastia (Trombigastia) laarmani*, *Trombigastia (Trombigastia) vinckei*, *Trombigastia (Trombigastia) minor*, and *Myotrombicula bidentipalpis* (Acari: Trombiculidae) from 77 *H. caffer centralis* specimens collected at Irangi, DRC. Fain (1959c: 239) described *Psorergates (Psorergatoides) hipposideros* (Acari: Psoridatidae) from a *H. caffer centralis* captured in Kakontwe cave, Jadotville (=Likasi), DRC.

Reviewing African chiggers (Acari: Trombiculidae), Stekolnikov (2018a: 26; 2018b: 268) indicated that *Gahrliepia nana* (Oudemans, 1910) was described from *H. caffer* from Durban,

where it was also the type host for *Austracarus polydiscum* (Oudemans, 1910) (Stekolnikov, 2018a: 43). Stekolnikov (2018a: 49, 50, 117, 119, 121, 154, 160, 179) also reported *Whartonia atracheata* Taufflieb and Mouchet, 1959, *Whartonia oweni* Vercammen-Grandjean and Brennan, 1957, *Trombigastia ascoschoengastoides* Vercammen-Grandjean and Fain, 1958, *Trombigastia berghei* Vercammen-Grandjean and Fain, 1958, *Trombigastia laarmani* Vercammen-Grandjean and Fain, 1958, *Trombigastia minor* Vercammen-Grandjean and Fain, 1958, *Trombigastia scapularia* Vercammen-Grandjean and Fain, 1958, *Trombigastia vinckei* Vercammen-Grandjean and Fain, 1958, *Microtrombicula irangiensis* Vercammen-Grandjean, 1965; *Microtrombicula minutissima* (Oudemans, 1910), and *Myotrombicula bidentipalpis* Vercammen-Grandjean and Fain, 1958.

Periglischrus moucheti Till, 1958 (Acari: Spinturnicidae) was reported by McKechnie *et al.* (2013: 112).

Streblidae: *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100), *Brachytarsina alluaudi* (Falcoz, 1923) in Botswana (Haeselbarth *et al.*, 1966: 101), Gabon (Obame-Nkoghe *et al.*, 2016: 5), *Brachytarsina longiarista* (Jobling, 1949) in Sierra Leone (Haeselbarth *et al.*, 1966: 101), *Raymondia alulata* Speiser, 1908 (Shapiro *et al.*, 2016: 253), *Raymondia aspera* Maa, 1968 in Mozambique (Shapiro *et al.*, 2016: 254), *Raymondia hardyi* in South Africa (Shapiro *et al.*, 2016: 254). *Raymondia huberi* Frauenfeld, 1856 may be associated but remains to be confirmed (Jobling, 1954 [in Haeselbarth *et al.* (1966: 102)]). *Raymondia huberi* Frauenfeld, 1856 group in Gabon (Obame-Nkoghe *et al.*, 2016: 5). *Raymondia intermedia* Jobling, 1936 (Shapiro *et al.*, 2016: 255). *Raymondia seminuda* Jobling, 1954 from Sierra Leone, the Congo, Tanzania, Zimbabwe, South Africa (Haeselbarth *et al.*, 1966: 103; Shapiro *et al.*, 2016: 255). *Raymondia setiloba* Jobling, 1954 from Katanga (Haeselbarth *et al.*, 1966: 104; Shapiro *et al.*, 2016: 256 [host as *H. caffer-ruber* complex]). *Raymondia waterstoni* Jobling, 1931 (Haeselbarth *et al.*, 1966: 104; Shapiro *et al.*, 2016: 256 [host as *H. caffer-ruber* complex]). *Raymondioides leleupi* Jobling, 1954 from Duékoué, Côte d'Ivoire (Haeselbarth *et al.*, 1966: 104). *Ascodipteron jonesi* Jobling, 1952 from Sudan, the Congo, Uganda and Tanzania (Haeselbarth *et al.*, 1966: 106). *Ascodipteron megastigmatos* Jobling, 1956 from Duékoué, Côte d'Ivoire (Haeselbarth *et al.*, 1966: 106). *Ascodipteron semirasum* Maa, 1965 from Botswana, but Maa (1965) doubts the correctness of the host-identification (Haeselbarth *et al.*, 1966: 106).
A *Brachytarsina allaudi* captured on a Gabonese "*H. caffer* complex" bat was carrying a *Polychromophilus melanipherus* blood parasite (Szentiványi *et al.*, 2019: Suppl.).
Theodor (1968) described *Raymondia allisoni* Theodor, 1968 from a *H. caffer* from Ghana, but Shapiro *et al.* (2016: 253) indicate that the bat species is probably not correct and they assigned it to the *H. caffer-ruber* complex. Shapiro *et al.* (2016: 255) also mention *Raymondia pagodarum* Speiser, 1900 from the species complex in Uganda (but here the original host was referred to as *H. ruber*), as well as *Raymondia simplex* Jobling, 1955 (from the DRC). Shapiro *et al.* (2016: 256) furthermore mention an unnamed *Raymondia* species (sp. A) from Congo. Szentiványi *et al.* (2019: Suppl.) indicated that a Gabonese "*H. caffer* complex" bat was parasitized by a *Raymondia huberi* group bat fly, which was carrying the blood parasite *Polychromophilus melanipherus*.

Nycteribiidae: *Nycteribia schmidlii* Schiner, 1853 (Haeselbarth *et al.*, 1966: 108; Duron *et al.*, 2014: 2108; Obame-Nkoghe *et al.*, 2016: 5). *Nycteribia scissa sudanica* Theodor, 1957 from Ethiopia, the Sudan and the Congo (Haeselbarth *et al.*, 1966: 108). *Nycteribia integra* Theodor and Moscona, 1954 (Haeselbarth *et al.*, 1966: 109). *Nycteribia ovalis* Theodor, 1957 from Sierra Leone (Haeselbarth *et al.*, 1966: 110). *Nycteribia tecta* Theodor, 1957 from Zimbabwe and South Africa, but Haeselbarth *et al.* (1966: 110) suggests these may represent a distinct subspecies. *Penicillidia pachymela* Speiser, 1901, from Somalia, Sudan, Kenya, Tanzania, the Congo, Guinea and the Cameroon Mts (Haeselbarth *et al.*, 1966: 114), and Zambia (Blackwell, 1980: 145 - itself infected by the fungus *Arthrorhynchus nycteribiae* (Peyritsch) Thaxter). *Eucampsipoda africana* Theodor, 1955 and *Penicilidia fulvida* Bigot, 1885, found both on bats from the *H. caffer* complex in Gabon (Obame-Nkoghe *et al.*, 2016: 5).

Haelewaters *et al.* (2018: 794) also mention the Nycteribiid *Penicillidia pachymela* Speiser, 1900, which might be the host for the fungus *Arthrorhynchus nycteribiae* (Peyr.) Thaxt.

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Hipposideros caffer*: Astroviruses, Coronaviruses and Paramyxoviruses.

Willoughby *et al.* (2017: Suppl.) report the following viruses: Chikungunya virus, Human coronavirus 229E, Rift Valley fever phlebovirus.

Astroviridae
10 of 57 bats from Mozambique, tested by Hoarau *et al.* (2018: 2) were positive for Astroviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in five individuals from Limpopo Province, South Africa. None were tested positive (0/5), neither did nine individuals from Oriental Province, DRC (0/9). See also note under "viruses" for the genus as possiblitiy.
Pfefferle *et al.* (2009) report the detection of several alpha- and betacoronaviruses from *H.* cf. *caffer/ruber*. The alphacoronaviruses were related to the human coronavirus HCoV-229E, and Porcine coronaviruses.
Anthony *et al.* (2017b: Suppl.) mention the beta-coronaviruses Predict_CoV_43 and Predict_CoV_44.
Both alpha- and betacoranoviruses were reported from Zimbabwe by Bourgarel *et al.* (2018: 255à.

Hepadnaviridae
Roundleaf bat HBV – detected in the lung and liver of *H.* cf. *caffer/ruber* from Gabon.

Nairoviridae
Orthonairovirus
Only three of the 36 *H.* cf. *caffer* specimens from Gabon tested by Müller *et al.* (2016: 3) were positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that one of the 80 *H.* cf. *caffer* specimens they examined from Ghana tested positive for *Morbillivirus*. Of the 337 specimens from Gabon they identified as belonging to *H.* cf. *caffer/ruber*, two tested positive for *Morbillivirus* and one for *Rubulavirus*.
Mortlock *et al.* (2015: 1841) reported that two out of six examined South African *H. caffer* specimens tested positive for *Paramyxovirus* sequences.

In *H. caffer* bats from Zimbabwbe, Bourgarel *et al.* (2018: 255) identified viruses belonging to the genus *Jeilongvirus*.

Phenuiviridae
Phlebovirus
de Jong *et al.* (2011: 11) and Luis *et al.* (2013: suppl.) report the occurrence of Rift Valley fever virus (RVFV), either by virus isolation or molecular evidence (see Fagre and Kading, 2019: 5).

Togaviridae
Alphavirus
de Jong *et al.* (2011: 10) and Luis *et al.* (2013: suppl.) reported Chikungunya virus occurring on *H. caffer*.

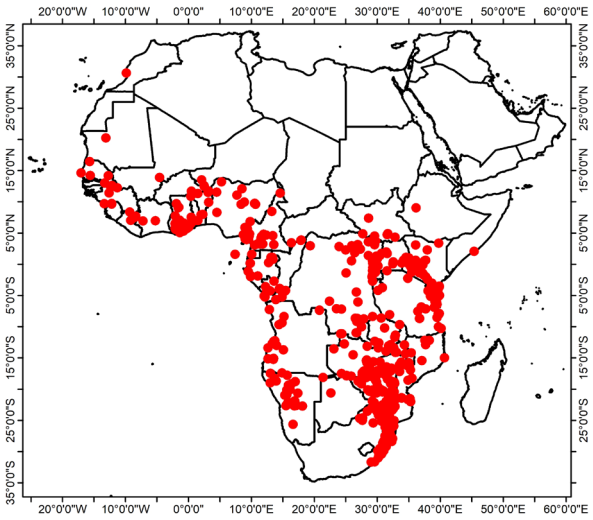


Figure 56. Distribution of *Hipposideros caffer*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Principé, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Swaziland, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Hipposideros camerunensis Eisentraut, 1956

*1956. *Hipposideros camerunensis* Eisentraut, Zool. Jb. Syst., 84 (3): 526, fig. 6 - 8. Publication date: 27 December 1956. Type locality: Cameroon: Buea, near [ca. 04 09 N 09 13 E] [Goto Description]. Holotype: SMNS 5194: ad ♂, skin and skull. Collected by: Prof. Dr. Martin Eisentraut; collection date: 29 April 1954; original number: 505. Presented/Donated by: ?: Collector Unknown. See Dieterlen *et al.* (2013: 294). Paratype: SMNS 5195: ad ♂, alcoholic (skull not removed). Collected by: Prof. Dr. Martin Eisentraut; collection date: 29 April 1954; original number: 510. Presented/Donated by: ?: Collector Unknown. See Hutterer (1984: 29 - 30), Dieterlen *et al.* (2013: 294). Paratype: SMNS 5197: ad ♂, skull and alcoholic. Collected by: Prof. Dr. Martin Eisentraut; collection date: 29 April 1954; original number: 511. Presented/Donated by: ?: Collector Unknown. See Hutterer (1984:

29 - 30), Dieterlen *et al.* (2013: 294). Paratype: ZFMK 1979.0138: ad ♀. Collected by: Prof. Dr. Martin Eisentraut; collection date: 29 April 1954; original number: 506. Exchanged from SMNS in March 1979; SMNS catalog number 5196 (see Hutterer, 1984: 29 - 30; Hutterer and Peters, 2010: 12), Dieterlen *et al.*, 2013: 294). - Etymology: Referring to the country where the type specimen was collected (Cameroon). (Current Combination)

2015. *H[ipposideros] camarunensis:* Gunnell, Winkler, Miller, Head, El-Barkooky, Gawad, Sanders, and Gingerich, Hist. Bio., 28 (1 - 2): 163. Publication date: 1 October 2015. (Lapsus)

2018. *Doryrhina camerunensis:* Musila, Monadjem, Webala, Patterson, Hutterer, De Jong, Butynski, Mwangi, Chen and Jiang, Zool. Res. (China), 40 (1): 21 (for 2019). Publication date: 17 October 2018. - Comments: Due to the view that *camerunensis* and *cyclops* are closely related, Musila *et al.* (2018a: 21) provisionally placed this taxon in the genus *Doryrhina*. (Name Combination)

TAXONOMY:
Simmons (2005: 369) as part of the *cyclops* species group.

Mickleburgh *et al.* (2008l) in IUCN (2009) report that there is debate as to whether all the records comprise a single species, or whether there might be two or three different species involved. The records from the Democratic Republic of Congo and Kenya could refer to other, possibly undescribed, species.

COMMON NAMES:
Chinese: 喀麦隆蹄蝠. Czech: pavrápenec kamerunský. English: Cameroon Leaf-nosed Bat, Greater Roundleaf Bat, Greater Cyclops, Eisentraut's Leaf-nosed Bat. French: Phyllorine du Cameroun, Phyllorine d'Eisentraut. German: Kamerun-Rundblattnase, Kamerun-Blattnase.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing uncertainties as to its taxonomic status, extent of occurrence and ecological requirements (Mickleburgh *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008l; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004ac; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
If it is a forest-dependent species, then it is probably suffering from ongoing forest loss. If future taxonomic studies show it to be restricted to Mount Cameroon, then it could be seriously threatened by habitat destruction (Mickleburgh *et al.*, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008l) [in IUCN (2009)] report that no conservation measures are currently in place. It is not known from any protected areas. Taxonomic studies are urgently needed to determine whether or not the three recorded localities all refer to the same species.

GENERAL DISTRIBUTION:
Hipposideros camerunensis is known only from three localities: Buea in Cameroon (type locality); Shabunda in eastern Democratic Republic of Congo; and at the Kakamega Forest in western Kenya close to Lake Victoria. If it is a single species, then it is likely to be found in future in intervening locations. Its elevational range is from sea-level to 500 m, and probably higher.

Native: Cameroon (Eisentraut, 1956b, 1963, 1973); Congo (The Democratic Republic of the); Kenya (Schlitter *et al.*, 1986).

ECHOLOCATION:
Webala *et al.* (2019: 15) reported a F value of 50.8 kHz for a male and 51.1 kHz for a female the Kakamega Forest (Kenya). The duration of the calls was 24.5 to 27.7 msec for the male's call and 23.1 to 27.1 msec for the female's.

HABITAT:
The Kakamega specimen was captured in 'Intermediate Evergreen Forest' (Schlitter *et al.*, 1986).

ROOST:
The type specimens were taken from a hollow tree (Eisentraut, 1963).

POPULATION:
Structure and Density - Very little known about the species. It is known form only three records in a general region that is not widely surveyed (Mickleburgh *et al.*, 2008l; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008l; IUCN, 2009).

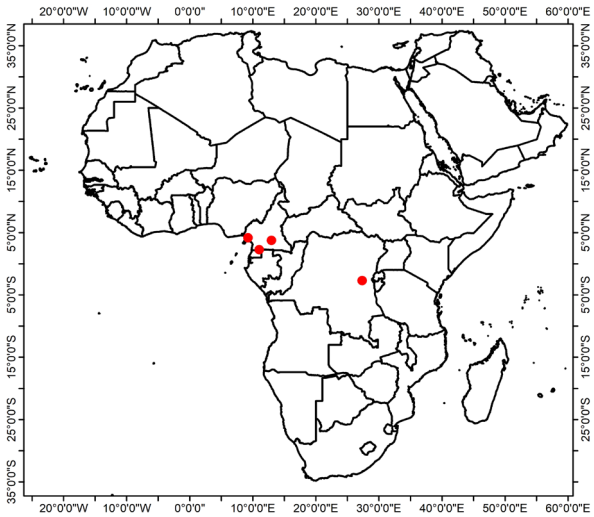


Figure 57. Distribution of *Hipposideros camerunensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the).

Hipposideros cf. centralis Andersen, 1906

2016. *Hipposideros cf. centralis:* Kruskop, Benda, Vasenkov and Lavrenchenko, Lynx, 47: 56.

TAXONOMY:
Generally, this taxon is considered to be a subspecies of *H. ruber*, but Kruskop *et al.* (2016: 57) consider the large-sized NE African individuals from the *H. caffer* group to represent a separate species, although they indicate that a genetic comparison with specimens from Uganda and NE DRC is still required.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia.

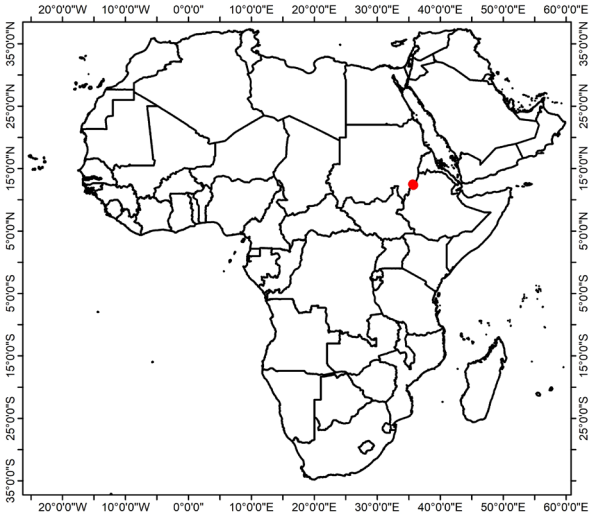


Figure 58 Distribution of *Hipposideros* cf. *centralis*

Hipposideros curtus G.M. Allen, 1921

*1921. *Hipposideros curtus* G.M. Allen, Rev. Zool. afr., 9 (2): 194. Publication date: December 1921. Type locality: Cameroon: Littoral province: on the Sanaga River: Sakbayeme [04 02 N 10 35 E] [Goto Description]. Holotype: MCZ 19305: ad ♀, alcoholic (skull not removed). Collected by: Rév. George W. Schwab; collection date: 1920. See Helgen and McFadden (2001: 142). - Comments: The cover of issue 9 (2) mentions 15 October 1921 as publication date, but the actual date might be December 1921. (Current Combination)

1937. *Hipposideros sandersoni* Sanderson, Animal Treasure, 290 (fig.), p. 296. Publication date: September 1937. Type locality: Cameroon: near Mamfe [05 47 N 09 18 E]. - Comments: ("bluish-grey and small"). The type locality (Mamfe) was originally situated in Nigeria, but is currently located in Cameroon.

TAXONOMY:
Simmons (2005: 370) placed it as part of the *bicolor* species group. Includes *sandersoni* (Hill, 1963a: 60).

The taxonomic relationship between *Hipposideros curtus* and *H. vittatus* is unclear and needs further investigation (Mickleburgh *et al.*, 2008dj; IUCN, 2009).

COMMON NAMES:
Czech: pavrápenec krátkoocasý. English: Short-tailed Leaf-nosed Bat, Short-tailed Roundleaf Bat. French: Phyllorine à queue courte. German: Kurzschwanz-Rundblattnase.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU B2ab(iii) ver 3.1 (2001)) because its area of occupancy (cave roosting localities) is probably less than 2,000 km², its distribution is severely fragmented, and there is continuing decline in the extent and quality of its habitat (Mickleburgh *et al.*, 2008dj; IUCN, 2009).

Assessment History -
2008 - VU B2ab(iii) ver 3.1 (2001) (Mickleburgh *et al.*, 2008dj; IUCN, 2009). 2004 - VU A3c ver 3.1 (2001) (Mickleburgh *et al.*, 2004da; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
Threats to this species include ongoing forest loss, and disturbance of cave roosting sites. A number of the few known roosts have already been deserted presumably because of disturbance (Mickleburgh *et al.*, 2008dj; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dj) [in IUCN (2009)] report that this species has not been recorded from any protected areas. There is an urgent need to protect any important roosting site, and to maintain suitable foraging habitat in the vicinity of these. Further field surveys are needed to locate additional populations of this species, and to determine if the species is present in Nigeria.

GENERAL DISTRIBUTION:
Hipposideros curtus is restricted to southwestern Cameroon and Equatorial Guinea (both Bioko island and Rio Muni). The species might be present in Nigeria, however, this needs confirmation. It is a lowland species found at elevations from sea-level to 500 m.

Native: Cameroon (Eisentraut, 1973); Equatorial Guinea (Bioko) (Juste B. and Ibáñez, 1994b).
Presence uncertain: Nigeria.

POPULATION:
Structure and Density - Has been rarely recorded and is known only from a few locations (Mickleburgh *et al.*, 2008dj; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008dj; IUCN, 2009).

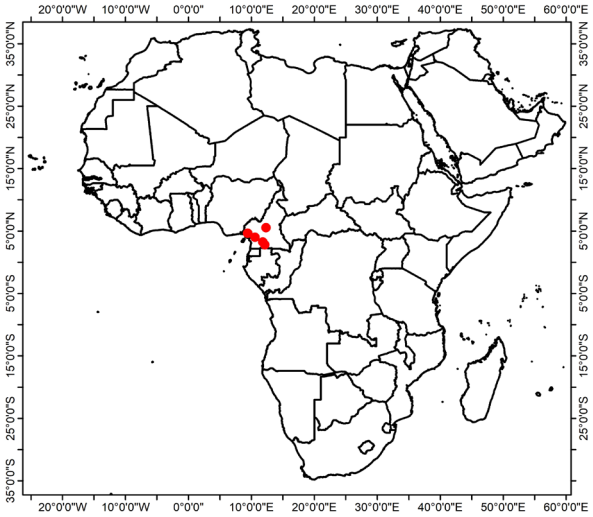


Figure 59. Distribution of *Hipposideros curtus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Cameroon.

Hipposideros fuliginosus (Temminck, 1853)

*1853. *Phyllorrhina fuliginosa* Temminck, Esquisses zoologiques sur la Côte de Guiné. 1e partie, les Mammifères, 77. Publication date: 1853. Type locality: Ghana: "Ghana" [Goto Description]. - Comments: Allen (1939a: 81) mentioned the type locality as "La côte de Guiné". Grubb *et al.* (1998: 79) mention the type locality as "La Côte de Guiné". Jentink (1888b: 167) gave it as 'Côte d'Or, Pays des Aschantes.').
1895. *Phyllorhina fuliginosa:* Bocage, J. Sci. mat. phys. nat., ser. 2, 4 (8): 4. Publication date: December 1895. (Name Combination)
2014. *Hipposideros fuliganosas:* Chawana, Alagaili, Patzke, Spocter, Mohammed, Kaswera, Gilissen, Bennett, Ihunwo, and Manger, Neuroscience, 277: 725. Publication date: 26 September 2014. (Lapsus)
2016. *Hipposideros fulginosus:* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 42. Publication date: 9 May 2016. (Lapsus)
? *Hipposideros fuliginosus:* (Name Combination, Current Combination)

TAXONOMY:
Simmons (2005: 371) as part of the *bicolor* species group.

Populations from central Africa may well represent a different species from those in western central (west of about 15°) and the Ethiopian records represent another, possibly undescribed, species (Mickleburgh *et al.*, 2008da in IUCN, 2009) based on J. Fahr *pers. comm.*). Herkt *et al.* (2017: Appendix S9) indicate that genetic tests evaluating the distinct species status are still lacking, and no clear major geographic gap between both putative species ranges can be discerned.

COMMON NAMES:
Czech: pavrápenec sazový. English: Sooty Leaf-nosed Bat, Sooty Roundleaf Bat, Dusky leaf-nosed bat. French: Phyllorine sombre, Phyllorine fuligineuse, Phyllorhine fuligineux. German: Temmincks Rundblattnase, Rußfarbene Rundblattnase.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008da; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008da; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004cp; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The major threat to this species is deforestation or degradation of its habitat. Presumably this is largely a result of logging operations and the conversion of land to agricultural use (Mickleburgh *et al.*, 2008da; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008da) [in IUCN (2009)] report that although there are no specific conservation measures in place for this bat, it is presumably present in several protected areas. There is a specific need to maintain large trees as roosting sites for the species. Further studies are needed into the taxonomy, distribution, natural history and possible additional threats to this species.

GENERAL DISTRIBUTION:
Hipposideros fuliginosus has been recorded in West Africa and Central Africa. It ranges from Guinea and Sierra Leone in the west, and has been recorded from Liberia, Côte d'Ivoire, Ghana and Nigeria. In Central Africa it is distributed in southern Cameroon, with scattered records from Gabon, Central African Republic, northern parts of Democratic Republic of the Congo and western Uganda. It is generally a lowland species, being recorded up to 500 m asl.

Native: Cameroon (Eisentraut, 1973); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 538); Côte d'Ivoire; Gabon; Ghana (Decher and Fahr, 2007: 16); Guinea (Fahr and Ebigbo, 2003: 128; Decher *et al.*, 2016: 265); Guinea-Bissau (Rainho and Ranco, 2001: 58); Liberia (Koopman, 1989b; Koopman *et al.*, 1995); Nigeria; Sierra Leone; Uganda.
Presence uncertain: Central African Republic; Congo; Equatorial Guinea.

DETAILED MORPHOLOGY:
Brain:
Adult hippocampal neurogenesis was studied by Chawana R. *et al.* (2016: 1551).

ECHOLOCATION:
In Guinea Fahr and Ebigbo (2003) reported the frequency of the CF-component at 122.5 ± 1.3 (120.0 - 123.3) kHz.

POPULATION:
Structure and Density - There is little information on its overall abundance. It is usually found in small groups, but sometimes in congregations of up two hundred bats (Mickleburgh *et al.*, 2008da; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008da; IUCN, 2009).

PARASITES:
DIPTERA:
Streblidae: *Raymondia huberi huberi* Frauenfeld, 1855 (Shapiro *et al.*, 2016: 254). *Raymondia seminuda* Jobling, 1954 in southern Nigeria (Haeselbarth *et al.*, 1966: 103).

VIRUSES:
Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that three out of 21 examined *H. fuliginosus* specimens from the DRC tested positive for *Paramyxovirus* sequences.

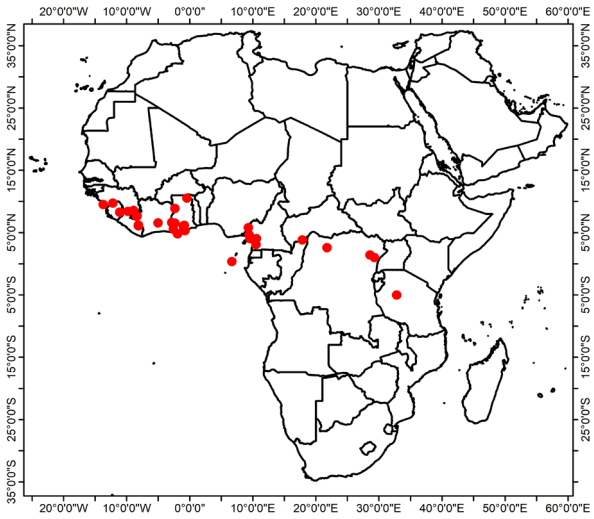


Figure 60. Distribution of *Hipposideros fuliginosus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Gabon, Ghana, Guinea, Liberia, São Tomé and Principé, Senegal, Sierra Leone, Tanzania.

Hipposideros jonesi Hayman, 1947

*1947. *Hipposideros jonesi* Hayman, Ann. Mag. nat. Hist., ser. 11, 14 (109): 71, fig. 1. Publication date: 19 November 1947. Type locality: Sierra Leone: Makeni [08 57 N 12 02 W] [Goto Description]. Holotype: BMNH 1947.629: ad ♀, skull and alcoholic. Collected by: Theo Simpson Jones; collection date: 12 December 1946; original number: 42. - Etymology: In honour of Mr. T.S. Jones, the collector of the type specimen. (Current Combination)

TAXONOMY:
Simmons (2005: 373) as part of the *bicolor* species group.

COMMON NAMES:
Czech: pavrápenec Jonesův. English: Jones' Leaf-nosed Bat, Jones' Roundleaf Bat, Jones's Roundleaf Bat, Western Africa leaf-nosed bat. French: Phyllorine de Jones, Phyllorine d'Afrique occidentale. German: Jones' Rundblattnase.

CONSERVATION STATUS:
Global - Listed as Near Threatened (NT ver 3.1 (2001)) since the species depends on caves for roost sites, and the area of occupancy might not be much greater than 2,000 km^2. The quality of its limited roosting habitat is likely to be declining through disturbance of caves, thus making the species close to qualifying for Vulnerable under criterion B2 (Mickleburgh *et al.*, 2008au; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) Mickleburgh *et al.*, 2008au; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004br; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is generally threatened by the disturbance of roosting caves and might additionally be threatened by subsistence hunting although this needs to be confirmed (Mickleburgh *et al.*, 2008au; IUCN, 2009). Nkrumah *et al.* (2018: 755) indicate that *H. jonesi* is a generalist in the Kwamang agro-ecosystem of Ghana, and as such, might not be sensitive to increased disturbance. However, they also mention that their results need to be cautiously interpreted.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008au) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species. It is not known if the species is present within any protected areas. There is a need to conserve important roosts for this species. Additional studies are needed into the distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Hipposideros jonesi is a West African endemic, closely associated with caves. It has been recorded from Sierra Leone and Guinea to Mali, Burkina Faso, Ghana and Nigeria. It is found between sea level and 1,400 m asl.

Native: Burkina Faso (Kangoyé *et al.*, 2015a: 608); Côte d'Ivoire; Ghana; Guinea (Decher *et al.*, 2016: 265); Liberia (Fahr, 2007a: 104); Mali; Nigeria (Happold, 1987); Sierra Leone (Hayman, 1947d; Grubb *et al.*, 1998).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Young (1975: 76) indicates that two distinct colour phases can be found: rufous (orange) and grey.

MOLECULAR BIOLOGY:
DNA - Unknown
Karyotype - Koubínová *et al.* (2010b) report for on a single male from Senegal, 2*n*= 32, Fna= 60 and FN= 64, these included 30 biarmed autosomes, including four metacentric, eight submetacentric and three subtelocentric, eight submetacentric and three subtelocentric pairs. A secondary constriction situated near the centromere was observed in one pair of the medium-sized submetacentric autosomes (approximately the 9th largest pair). The X chromosome was identified as a large metacentric element, the Y chromosome as a medium submetacentric.
Protein / allozyme - Unknown.

HABITS:
Lawer and Darkoh (2016: 429) found that this bat's activity declined with increasing lunar illumination, indicating that bright moonlight suppresses the nocturnal activities of both insectivorous bats and insects. They also found a negative association between wind speed and overal insectivorour bat activity (p. 430).

ROOST:
Weber and Fahr (2006: 4) indicate that in Guinea *H. jonesi* largely or exclusively depends on the availability of caves as day roosts.

DIET:
In the Kwamang agro-ecosystem in Ghana, E.K. Badu (in Nkrumah *et al.*, 2018: 755) found that the diet of *H. jonesi* consists of nearly 100 % Lepidoptera.

POPULATION:
Structure and Density - This species forms roosts of only a few animals, usually in the dozens rather than hundreds. There is a pronounced geographic morphological variation between populations, suggesting that there may be little movement of animals between populations (Mickleburgh *et al.*, 2008au; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008au; IUCN, 2009).

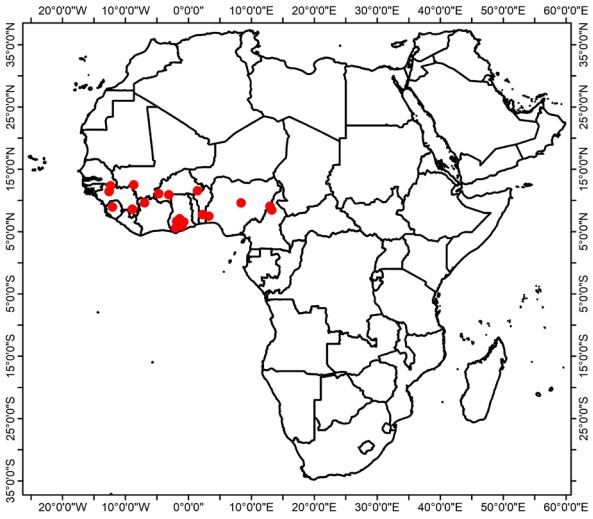


Figure 61. Distribution of *Hipposideros jonesi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Liberia, Mali, Nigeria, Senegal, Sierra Leone.

Hipposideros lamottei Brosset, 1985

*1985. *Hipposideros lamottei* Brosset, Mammalia, 48 (4): 548 (for 1984). Publication date: 1985. Type locality: Guinea: Mount Nimba: Pierré Richaud [07 41 N 08 22 W] [Goto Description]. Holotype: MNHN ZM-MO-1984-487: ad ♂. Collected by: André Brosset; collection date: December 1983. Paratype: MHNG ad ♂. Collected by: André Brosset; collection date: December 1983. Paratype: MNHN ZM-MO-1984-488: ad ♂. Collected by: André Brosset; collection date: December 1983. Paratype: MNHN ZM-MO-1984-489: ad ♂. Collected by: André Brosset; collection date: December 1983. (Current Combination)

TAXONOMY:
Simmons (2005: 373) *bicolor* species group. Distinction from *H. ruber* is not entirely clear (Koopman, 1993a: 173; Koopman *et al.*, 1995; Simmons, 2005: 373). Monadjem *et al.* (2013b: 341) state that, morphologically, *H. lamottei* falls within the *caffer/ruber* group.

COMMON NAMES:
Czech: pavrápenec nimbánský. English: Lamotte's Leaf-nosed Bat, Lamotte's Roundleaf Bat, Mount Nimba Leaf-nosed Bat. French: Phyllorine de Lamotte, Phyllorine du Mont Nimba. German: Mount Nimba-Rundblattnase, Lamottes Rundblattnase.

CONSERVATION STATUS:
Global - Listed as Critically Endangered (CE B1ab(I,ii,iii,iv,v)+2ab(I,ii,iii,iv,v) ver 3.1 (2001)) because its extent of occurrence is probably less than 100 km^2 and its area of occupancy (cave roosting sites) is likely to be less than 10 km^2, all individuals are in a single location (Mount Nimba), and there is continuing decline in the extent and

quality of its habitat (Mickleburgh *et al.*, 2008av; IUCN, 2009).
Kouame *et al.* (2012: 2748) indicate that *H. lamottei* is a highly threatened species, which only occurs in one single KBA [= Key Biodiversity Area] in the Upper Guinea Forest: Mount Nimba.
Collen *et al.* (2011: 2616) rank it on position 62 (as only African mainland Chiropteran) out of 100 mammal species requiring urgent conservation attention.

Assessment History -
2008 - CE B1ab(I,ii,iii,iv,v)+2ab(I,ii,iii,iv,v) ver 3.1 (2001) (Mickleburgh *et al.*, 2008av; IUCN, 2009). 2004 - CR B1ab(iii) ver 3.1 (2001) (Mickleburgh *et al.*, 2004bs; IUCN, 2004). 1996 - DD (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is believed to be highly threatened because of extensive iron ore mining activities underway, and planned, within its limited range on Mount Nimba. It is probably additionally threatened by general deforestation in parts of its range. Indiscriminate subsistence hunting of bats for food occurs in caves on Mount Nimba and likely impacts this species (Mickleburgh *et al.*, 2008av; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008av) [in IUCN (2009)] report that it is present within the Mount Nimba Strict Nature Reserve World Heritage Site. There is a need to enforce the protection of this area. Additional surveys are needed to learn more about the distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Known only from Mt. Nimba on Guinea-Liberia border, but probably more widespread. However, Fahr (2007a: 104) and Decher and Fahr (2007: 5) indicate that specimens from Liberia, Ghana, Sierra Leone and Cameroon (mentioned by Koopman *et al.*, 1995 and Grubb *et al.*, 1998) were re-identified as belonging to *H. caffer*. They restrict the distribution of *lamottei* to the Guinean side of Mt. Nimba. It has been recorded between 500 and 1,400 m asl.

Native: Guinea (Brosset, 1985; Denys *et al.*, 2013: 284).

ECHOLOCATION:
Monadjem *et al.* (2013b: 351) report a F_{max} of 119.0 (118 - 120) kHz for two specimens from Mount Nimba.

POPULATION:
Structure and Density - Only six specimens are currently known from two localities (Mickleburgh *et al.*, 2008av; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008av; IUCN, 2009).

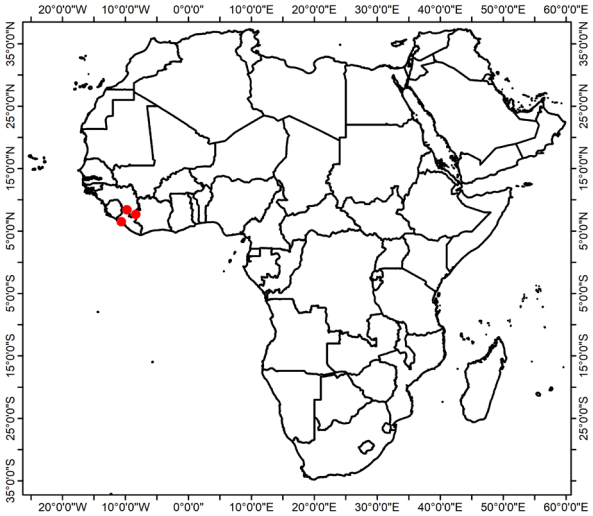


Figure 62. Distribution of *Hipposideros lamottei*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Guinea, Liberia.

Hipposideros marisae Aellen, 1954

*1954. *Hipposideros marisae* Aellen, Rev. suisse Zool., 61 (24): 474. Type locality: Côte d'Ivoire: Duékoué: White Leopard Rock [Goto Description]. Holotype: [Unknown] ad ♂. Collection date: 13 May 1953; original number: 400. See Aellen (1954: 474). - Comments: Type locality original: roche de la Panthère Blanche. - Etymology: In honour of Mrs. Aellen (Aellen, 1954: 474). (Current Combination)

TAXONOMY:
Simmons (2005: 374) as part of the *bicolor* species group. Monadjem *et al.* (2013b: 346) indicate that *H. marisae* is a sistergroup to *H. jonesi*.

COMMON NAMES:
Czech: pavrápenec Aellenův. English: Marisa's Leaf-nosed Bat, Aellen's Leaf-nosed Bat, Aellen's Roundleaf Bat. French: Phyllorine d'Aellen. German: Marisas Rundblattnase.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU B2b(ii,iii,iv,v) ver 3.1 (2001)) because its area of occupancy is probably less than 2,000 km^2, its distribution is possibly severely fragmented (roosting sites), there is continuing decline in the quality of its cave habitats (through disturbance), and there is likely to be a corresponding decline in subpopulations and individuals (with over hunting likely at some colonies) (Mickleburgh *et al.*, 2008aw; IUCN, 2009).

Assessment History -
2008 - VU B2b(ii,iii,iv,v) ver 3.1 (2001) (Mickleburgh *et al.*, 2008aw; IUCN, 2009). 2004 - EN A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2004bt; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is threatened by general deforestation, mining operations on Mount Nimba and the disturbance of roosting caves. It is likely harvested for subsistence use as food (Mickleburgh *et al.*, 2008aw; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008aw) [in IUCN (2009)] report that it is present within the Mount Nimba Strict Nature Reserve World Heritage Site. There is a need to protect important roost sites and areas of suitable forest habitat. Further studies are needed into the distribution of this species.

GENERAL DISTRIBUTION:
This West African species has been recorded from seven localities in Guinea, Liberia (central and western uplands), and Côte d'Ivoire, and two localities in Sierra Leone. It may range into Ghana, although there is no record from this country (Grubb *et al.*, 1998). It is a lowland species recorded between sea level and 650 m asl.

Native: Côte d'Ivoire (Aellen, 1954); Guinea; Liberia (Kuhn, 1965; Hill, 1982a; Wolton *et al.*, 1982; Koopman *et al.*, 1995; Monadjem and Fahr, 2007: 53); Sierra Leone (Weber *et al.*, 2019: 22 - first record). Presence uncertain: Ghana.

ECHOLOCATION:
Monadjem *et al.* (2013b: 351) report F_{max} to be 146.0 kHz at Mount Nimba.

In Sierra Leone, Weber *et al.* (2019: 21) recorded two females calling at 142.5 (141.0 - 144.0) kHz and two males at 146.5 (146.0 - 147.0) kHz.

HABITAT:
Weber *et al.* (2019: 22) indicate that this is an extremely rare species, which might depend on suitable caves as day roost and forest habitats.

POPULATION:
Structure and Density - It is generally considered to be a very rare species (Mickleburgh *et al.*, 2008aw; IUCN, 2009). Monadjem *et al.* (2013b: 342) state that this species has not been captured nor seen since 1990.

Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008aw; IUCN, 2009).

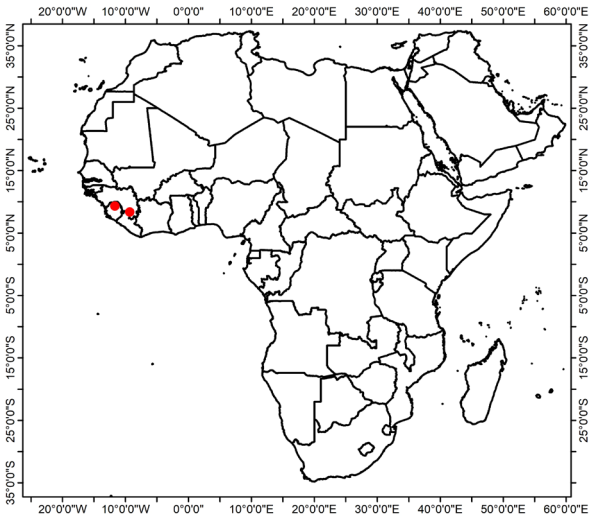


Figure 63. Distribution of *Hipposideros marisae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Côte d'Ivoire, Guinea, Liberia, Sierra Leone.

Hipposideros megalotis (Heuglin, 1861)

*1861. *Phyllorrhina megalotis* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 4, 8. Publication date: 1861. Type locality: Eritrea: Bogos country [=Keren region] [ca. 15 45 N 38 20 E] [Goto Description]. Holotype: SMNS 984: ad ♂, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See: Dieterlen *et al.* (2013: 294). - Comments: Type specimen: SMNS, ???. Horácek *et al.* (2000: 98) mention "Monatsber. Königl. Preuss. Akad. Wiss. Berlin: 329". Nancy Simmons (pers. comm.) checked this and rejected this reference. - Etymology: From the Greek adjective "*μέγα*" (méga), meaning "big" and the neuter Greek substantive "*οὖς*" (genitive "*ώτός*", "*ûs*", "*ōtós*"), meaning "ear" referring to the large ears of the species (see Lanza *et al.*, 2015: 145).

? *Hipposideros megalotis:* (Name Combination, Current Combination)

TAXONOMY:
Placed in the subgenus *Syndesmotis* by Legendre (1982), Gaucher and Brosset (1990) and Horácek *et al.* (2000: 98) include it with a question mark). Horácek *et al.* (2000: 98) as part of the *megalotis* species group, followed by Simmons (2005: 374).

COMMON NAMES:
Chinese: 串耳蹄蝠. Czech: pavrápenec ušatý. English: Large-eared Leaf-nosed Bat, Ethiopian Large-eared Leaf-nosed Bat, Ethiopian Large-eared Roundleaf Bat, Big-eared leaf-nosed bat. French: Phyllorine à grandes oreilles d'Ethiopie, Phyllorine à grandes oreilles. German: Großohr-Rundblattnase. Italian: Ipposìdero orecchiùto.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) because, although it is seldom recorded, it has a relatively wide distribution, is tolerant of a range of habitats, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ax; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008ax; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004bu; IUCN, 2004). 2000 - LR/nt (Hilton-Taylor, 2000). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species remain poorly known. Its is suspected to be threatened by habitat loss resulting from the conversion of land to agricultural use, and by disturbance of roosting sites (Mickleburgh *et al.*, 2008ax; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ax) [in IUCN (2009)] report that there are no direct conservation measures in place for this species. It is not known if the species is present in any protected areas. Additional studies are needed into the distribution, abundance, general ecology and threats to this little-known species.

GENERAL DISTRIBUTION:
Hipposideros megalotis has been reported from Eritrea (including the type locality of Keren (Heuglin, 1861)), Ethiopia (including Sidamo in southern Ethiopia (Hayman and Hill, 1971)), Kenya (where it has been recorded from the localities of Kinangop and Nakuru (Hayman, 1954)), Somalia, Djibouti (Heuglin, 1861; Pearch *et al.*, 2001) and from Jeddah in Saudi Arabia (Gaucher and Brosset, 1990). It has been reported at elevations of up to 2,000 m asl.

Native: Djibouti (Heuglin, 1861; Pearch *et al.*, 2001); Eritrea (Heuglin, 1861); Ethiopia (Hayman and Hill, 1971); Kenya (Hayman, 1954); Saudi Arabia (Gaucher and Brosset, 1990).
Presence uncertain: Somalia (Senna, 1905).

POPULATION:
Structure and Density - Little is known about the population of this species. Very few animals have ever been recorded (Mickleburgh *et al.*, 2008ax; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ax; IUCN, 2009).

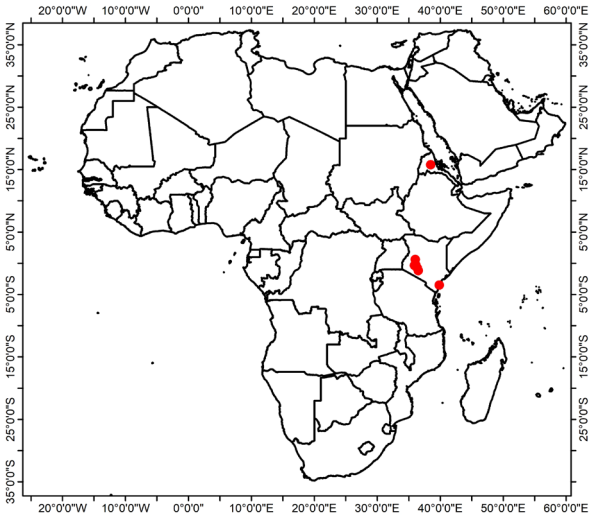


Figure 64. Distribution of *Hipposideros megalotis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Eritrea, Ethiopia, Kenya.

Hipposideros ruber (Noack, 1893)

*1893. *Phyllorhina rubra* Noack, Zool. Jahrb. Abt. Syst. Oekol. Geogr. Tiere, 7: 586, pl. 18, fig. 14, 15. Publication date: 23 December 1893. Type locality: Tanzania: Eastern province: Ngerengere River [ca 07 00 S 38 00 E]. Holotype: ZMB 89571: skin only. Collected by: Dr. Emin Pasha; collection date: 20 May 1890. Formerly Noack collection number 5, see Turni and Kock (2008: 38). Holotype: ZMB no number: skin only. Collected by: Dr. Emin Pasha; collection date: 20 May 1890. Formerly Noack collection number 5; see Turni and

Kock (2008: 38). - Comments: Allen (1939a: 81) mentioned the type locality as "Lugerrunjere Fluss, Tanganyika Territory". Grubb *et al.* (1998: 80) mention the type locality as "Lugerrunjere Fluss = Ngerengere River, Tanzania - probably Ngerengere village, 32 miles east of Morogor according to Swynnerton, 1945, Proc. Zool. Soc. Lond., 115: 69". - Etymology: From the Latin "*ruber*" meaning red.

1906. *Hipposiderus caffer centralis* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 17 (99): 275, 277. Publication date: 1 March 1906. Type locality: Uganda: Entebbe [Ntebbi] [00 04 N 32 28 E, 3 800 ft] [Goto Description]. Holotype: BMNH 1899.8.4.8: ad ♂, skin only. Collection date: 5 April 1893. Presented/Donated by: Sir Frederic John Jackson.

1906. *Hipposiderus caffer guineensis* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 17 (99): 275, 278. Publication date: 1 March 1906. Type locality: Gabon: 70 mi (105 km) from Gaboon: Como River [ca. sea level] [Goto Description]. Holotype: BMNH 1897.12.1.11: ad ♀, skin only. Collected by: George Latimer Bates Esq. Collection date: 3 June 1897; original number: GLB 215. Note: caught under large rock, Fang name- Otan. - Comments: Considered a valid subspecies by Grubb *et al.* (1998: 80).

1917. *Hipposideros caffer niapu* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 431. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): NE Congo: Niapu [02 25 N 26 28 E] [Goto Description]. Holotype: AMNH 49414: ad ♂, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 27 January 1914; original number: 2322. Topotype: MCZ 17224: ♂, alcoholic (skull not removed). Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 27 February 1914. Presented/Donated by: ?: Collector Unknown.

2016. *Hipposideros aff. ruber:* Nkrumah, Vallo, Klose, Ripperger, Badu, Drosten, Kalko, Tschapka and Oppong, Acta Chiropt., 18 (1): 239. Publication date: June 2016. - Comments: Nkrumah *et al.* (2016b: 3) indicate that this is the same form as "*H. ruber* lineage D from Vallo *et al.* (2009: 196), and which is evolutionarily distant to *Hipposideros ruber* s. str. from East Africa. (Name Combination)

2018. *H[ipposideros] rubber:* Malekani, Musaba, Gembu, Bugentho, Toengaho, Badjedjea, Ngabu, Mutombo, Laudisoit, Ewango, Van Cakenberghe, Verheyen, Asimonyo, Masudi, Bongo and Ngbolua, Nat. Conserv. Res., 3 (1): 67.. Publication date: January 2018. (Lapsus)

2018. *Hip[posideros] caffer rufer:* Bourgarel, Pfukenyi, Boué, Talignani, Chiweshe, Diop, Caron, Matope, Missé and Liégeois, Infec. Gen. Evol., 58: 255. Publication date: 10 January 2018. (Lapsus)

? *Hipposideros caffer guineensis:*

? *Hipposideros caffer ruber:* (Name Combination)

? *Hipposideros ruber centralis:* (Name Combination)

? *Hipposideros ruber guineensis:* (Name Combination)

? *Hipposideros ruber niapu:* (Name Combination)

? *Hipposideros ruber ruber:* (Name Combination)

? *Hipposideros ruber:* (Name Combination, Current Combination)

TAXONOMY:

Simmons (2005: 376) recognised it as part of the *bicolor* species group, and indicated that the subspecies limits are problematic, and it possible that this species complex includes more than one species. Vallo *et al.* (2007: 257; 2009: 193) indicate that two sympatric lineages exist in *ruber* based on analysis of complete sequences of the mitochondrial gene for cytochrome *b*, with possibly a third form in West Africa. Mitochondrial DNA analyses on specimens from the Niokolo Koba National Park in Senegal indicated that two distinct lineages of *H.* aff. *ruber* exists in that area (Vallo *et al.*, 2011b: 84).

Decher *et al.* (2016: 265) indicate that they provisionally include all Simandou records (Guinea), previously named *H. caffer* or *H. ruber* in *H.* cf. *ruber*.

Nkrumah *et al.* (2016a: 240) used *H.* aff. *ruber* for their Ghanaian specimen as their cytochrome *b* genotype belongs to the D lineage, which is rather distant from *H. ruber* s.s. from East Africa. Nkrumah *et al.* (2017: 348) assigned their Ghanaian bats to *H.* cf. *ruber* as these include multiple genetic lineages.

COMMON NAMES:

Chinese: 诺氏蹄蝠. English: Noack's Leaf-nosed Bat, Noack's Roundleaf Bat, Red Leaf-nosed Bat.

French: Phyllorine rouge, Phyllorine de Noack. German: Noacks Rundblattnase, Kamerun-Blattnase.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ay; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008ay; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004bv; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is locally threatened by the loss and conversion of suitable habitat. It is also threatened in parts of its range by collection for subsistence use (Mickleburgh *et al.*, 2008ay; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ay) [in IUCN (2009)] report that in view of its wide range it seems likely that the species is present in a number of protected areas. It has been recorded from the Manga Forest Reserve of Tanzania (Doggart *et al.*, 1999b). No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Hipposideros ruber is a widespread species recorded throughout much of West, Central, and East Africa and part of southern Africa including Angola, southern Democratic Republic of the Congo, northern and eastern Zambia, southern Malawi and northwestern Mozambique. It is found between sea level and 2,300 m asl.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 625,018 km^2.

Native: Angola (Hayman, 1963; Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 538); Benin; Burkina Faso (Kangoyé *et al.*, 2015a 608); Burundi (Hayman *et al.*, 1966); Cameroon; Central African Republic (Lunde *et al.*, 2001: 537); Chad; Congo (Bates *et al.*, 2013: 318 - 1st authenticated records); Congo (The Democratic Republic of the) (Allen, 1917; Römer, 1862; Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 538) ; Côte d'Ivoire; Equatorial Guinea; Ethiopia; Gabon; Gambia (Emms and Barnett, 2005: 50); Ghana (Decher and Fahr, 2007: 13 - 15); Guinea (Fahr and Ebigbo, 2003: 128; Denys *et al.*, 2013: 283; Decher *et al.*, 2016: 265 mention it as "*Hipposideros cf. ruber*"; Weber and Fahr, 2007); Guinea-Bissau; Kenya; Liberia (Monadjem and Fahr, 2007: 50); Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 538); Mali; Mozambique (Monadjem *et al.*, 2010d: 538; Monadjem *et al.*, 2010c: 381); Niger; Nigeria (Happold, 1987; Rwanda (Hayman *et al.*, 1966); Saõ Tomé (Rainho *et al.*, 2010a: 28); Senegal; Sierra Leone; Sudan; Tanzania , United Republic of (Cunneyworth, 1996b; Doggart *et al.*, 1999b); Togo; Uganda (Kityo and Kerbis, 1996: 61); Zambia (Monadjem *et al.*, 2010d: 538).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Lucati and López-Baucells (2016: Suppl.) report on five albino and nine piebald (all-white fur/skin patches, eyes always normally coloured) specimens from mines in Tanzania (Howell and Mainoya, 1974: 155; Howell, 1980).

ECHOLOCATION:
From Irangi (Kivu province, DRC), Heller (1992: 75) reported that *H. ruber* emitted calls with frequencies between 130 and 140 kHz, distinguishing them from *H. caffer*, which emitted calls at a higher frequency.

Fahr and Ebigbo (2003) reported for an individual of *H* cf. *ruber* from the Simandou Range in southeastern Guinea a CF-component of 146.7 kHz. At Sengwa in Zimbabwe, Jacobs (1996) and Fenton and Bell (1981) reported a highest frequency of 138 kHz. Monadjem *et al.* (2010c: 378) reported from Mozambique that the peak echolocation frequencies ranged between 132 - 136 kHz (ANABAT) and 130.5 kHz (Petterson D240x). Rainho *et al.* (2010a: 21) report the call parameters from Saõ Tomé Island.

Monadjem *et al.* (2013b: 351) report on two lineages of *H.* cf. *ruber* from Mount Nimba: C1 with a F_{max} of 147.7 ± 1.45 (145 - 150) Khz, and E1 with F_{max} of 127.5 (127 - 128) kHz.

Jones and Siemers (2010: 449 - 450) indicated that males emit pulses with a higher frequency than females, and that the CF-frequency is positively related to the body condition (mass/forearm length).

Trentin and Rovero (2011: 56) describe the call from bats at Uzungwa Scarp Forest Reserve, Tanzania, as having a first modulated component starting at 143.9 kHz, which increases to a maximum frequency of 148.6 kHz, which continues for about 7 msecs, and then drops to 121.4 kHz in about 1 msec. The maximum intensity is at 144.8 kHz.

For three Kenyan males and two females, Webala *et al.* (2019: 15) reported F_{max} between 132.6 and 134.5, and 140.4 and 145.3 kHz, whereas the duration ranged from 7.4 to 8.8 and 7.3 to 7.7 msec respectively.

In Sierra Leone, Weber *et al.* (2019: 21) recorded calls from two types of *H. ruber*: **C1** (n=3): 145.7 ± 4.5 (142.0 - 152.0) kHz and **D** 4 FF: 122.5 ± 2.4 (120.0 - 125.0) kHz and 2 MM: 127.0 kHz.

MOLECULAR BIOLOGY:
DNA - Lim (2007), Vallo *et al.* (2007).
Karyotype - Koubínová *et al.* (2010b) report on seven females from Senegal, 2*n*= 32, Fna= 60 and FN= 64, they comprised 30 biarmed autosomes, including four metacentric, eight submetacentric and three subtelocentric, eight submetacentric and three subtelocentric pairs, a secondary constriction situated near the centromere was observed in one pair of the medium-sized submetacentric autosomes (approximately the 9th largest pair). The X chromosome was identified as a large metacentric element, the Y chromosome as a medium submetacentric.
Denys *et al.* (2013: 284) report the following karyotype for a male *H.* cf. *ruber* from the Guinean Mount Nimba area: 2*n* = 32, FNa =60, including 15 pairs of meta- and submetacentric chromosomes. The X chromosome is middle-sized submetacentric and the Y chromosome is small subtelocentric.

Protein / allozyme - Unknown.

HABITAT:
In Ghana, Nkrumah *et al.* (2016b: 5) reported *H.* aff. *ruber* to prefer foraging in seminatural habitats, followed by mixed farm areas, and, to a much lesser extent, tree farms and savanna grasslands.

HABITS:
Russo *et al.* (2010b: 701) report *H. ruber* to be diurnally active on the island of São Tomé, and indicate that adult males were much more active during the daytime than females, whereas during the night the opposite was true, possibly leading to a temporal niche partitioning. Russo *et al.* (2010a: 271) indicate that about one fifth of a colony may be out during daytime, also due to the absence of forest-dwelling avian predators.

In Ghana, Nkrumah *et al.* (2016a: 239) found that during the night, males of *H.* aff. *ruber* returned more often to their cave roosts than females. Based on that data for 13 bats, they calculated the bat's homerange as 36 ± 35 (6 - 95) ha. The foraging range covered 50 % of this and the core area 2 %. Nkrumah *et al.* (2016b: 6) found that females had a night activity pattern that peaks between 6 and 8 p.m., with a smaller peak around midnight and another peak between 5 and 6 a.m. In between the flight duration dropped to almost zero. In males, the activity peaked around 8 p.m., midnight and between 4 and 5 a.m. However, their activity in the first part of the night did only decrease by a maximum of 10 minutes. Nkrumah *et al.* (2017: 350) found that activity patters of the bats differed from cave to cave.

ROOST:
Weber and Fahr (2006: 4) indicate that *H. ruber* largely or exclusively depends on the availability of caves as day roosts in Guinea.

In Ghana, Nkrumah *et al.* (2016a: 239) found that caves were used as main roost, but that *H.* aff. *ruber* also used trees as individual night roosts. In the Mframabuom cave, the roost contained some 3,500 individuals (together with *H. abae, H. jonesi* and *Nycteris* cf. *thebaica*).

DIET:
Bell and Fenton (1984) [in Fenton, 1986a] found that *H. ruber* depends on flutter to find its prey and varies its hunting pattern by taking both flying prey and gleaning targets from surfaces such as foliage and water. They also found no restriction to a specific prey species or size class.

Nkrumah *et al.* (2017: 353) reports that *H.* cf. *ruber* feeds primarlily on Lepidoptera in Ghana.

POPULATION:
Structure and Density - This is one of the most common bats in Africa, with some colonies containing up to 500,000 individuals (Mickleburgh *et al.*, 2008ay; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ay; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Trentin and Rovero (2011: 50) captured nine lactating and two pregnant females in December 2005 at Uzungwa Scarp Forest Reserve, Tanzania.

In Kwamang (Ghana), the bats gave birth from late March to early May (Nkrumah *et al.*, 2017: 348).

In Sierra Leone, Weber *et al.* (2019: 23) reported two pregnant females (type "**C1**") on 1 and 7 April, and one pregnant (24 March) and one lactating (2 April) female (type "**D**").

PARASITES:
Peralta-Rodríguez *et al.* (2012: 1006) report on the infection of *H. ruber* by *Spirura hipposiderosi* Khalil, 1975 (Nematode) in Tanzania.

In his review of African chiggers (Acari: Trombiculidae), Stekolnikov (2018a: 49, 50, 72, 117, 119, 121, 123, 173, 179, 184) reported the presence of *Whartonia lepidopteriscuta* Vercammen-Grandjean, 1965, *Whartonia oweni* Vercammen-Grandjean and Brennan, 1957, *Riedlinia willmanni* Vercammen-Grandjean and Minter, 1964, *Trombigastia ascoschoengastoides* Vercammen-Grandjean and Fain, 1958, *Trombigastia berghei* Vercammen-Grandjean and Fain, 1958, *Trombigastia laarmani* Vercammen-Grandjean and Fain, 1958 and *Trombigastia minor* Vercammen-Grandjean and Fain, 1958, *Trombigastia scapularia* Vercammen-Grandjean and Fain, 1958, *Trombigastia vinckei* Vercammen-Grandjean and Fain, 1958, *Afrotrombicula machadoi* (Taufflieb, 1962), *Microtrombicula tanzaniae* Goff, 1982, *Myotrombicula bidentipalpis* Vercammen-Grandjean and Fain, 1958, and *Oudemansidium howelli* (Goff, 1983).

Decher *et al.* (2016: 266) found the bat fly *Penicillida allison* Theodor, 1968 (Nycteribiidae) on a Guinean "*H.* cf. *ruber*".

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - See also note under "viruses" for the genus as possiblitiy.
Corman *et al.* (2015: 11859) tested 1,611 Ghanese *H.* cf. *ruber* specimens, of which 62 (3.8 %) tested positive for 229E-related coronavirsues.
Anthony *et al.* (2017b: Suppl.) mention the beta-coronavirus Predict_CoV_20.
Willoughby *et al.* (2017: Suppl.) report Human coronavirus 229E.

Flaviviridae
In Uganda, Kading *et al.* (2018: 3) found neutralizing antibodies against non-specific Flaviviruses.

Hantaviridae (formerly included in Bunyaviridae)
Hantavirus
Witkowski *et al.* (2016: 113) report a new hantavirus from Gabon: Makokou virus (MAKV). Arai *et al.* (2019: 2) tetatively assigned this virus to the genus *Mobatvirus*.

Hepadnaviridiae
Hepatitis B virus (HBV)
Drexler *et al.* (2013c: 16152) report on four out of 51 examined *H.* cf. *ruber* specimens from Gabon that were positive for roundleaf bat HBV (RBHBV). Nie *et al.* (2017: 89) refer to this virus as horseshoe bat HBV (HBHBV).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) reported that two of the 117 specimens they identified as belonging to *H.* cf. *ruber* from Ghana tested positive for *Morbillivirus*. Two of the 337 specimens from Gabon, they identified as *H.* cf. *caffer/ruber* also tested positive for *Morbillivirus* and one other specimen for *Rubulavirus*.

In their overview table, Maganga *et al.* (2014a: 8) report the following viruses were already found on *H.* cf. *ruber*: Rift Valley Fever virus (RVF), Rubulavirus, Morbillivirus unclassified, Coronavirus.

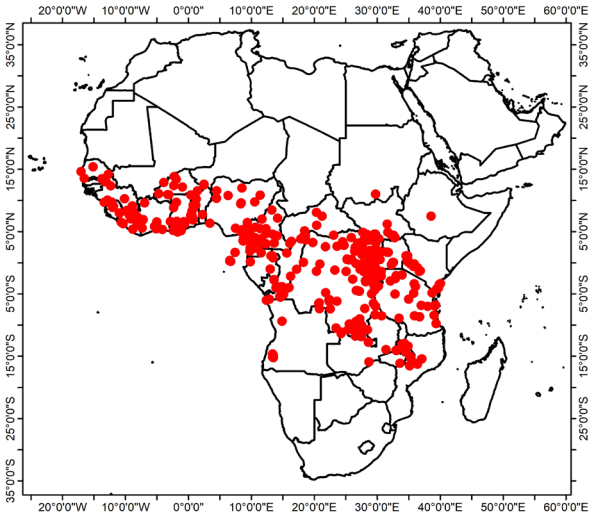


Figure 65. Distribution of *Hipposideros ruber*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, São Tomé and Principé, Senegal, Sierra Leone, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia.

Hipposideros tephrus (Cabrera, 1906)

1861. *Phyllorrhina bicornis* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 4, 7. Publication date: 1861. Type locality: Eritrea: Kérén region [ca. 15 45 N 38 20 E] [Goto Description]. Lectotype: ZMB 2795: ♂, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: undated. Formerly in SMNS. Lectotype designated by Turni and Kock (2008: 36). - Comments: Meester *et al.* (1986: 43) and Turni and Kock (2008:36) mentioned it as *Phyllorhina bicornis*.

*1906. *Hipposiderus tephrus* Cabrera, Bol. r. Soc. espan. Hist. nat. , 6: 358. Publication date: June 1906. Type locality: Morocco: Mogador [=Essaouira] [31 31 N 09 46 W]. Holotype: MNCN 110: ad ♂. Collected by: Mr. Martínez de la Escalera; collection date: 29 August 1905. See Ibáñez and Fernández (1989: 11). Paratype: MNCN 111: ad ♀. See Ibáñez and Fernández (1989: 11). (Current Combination)
1939. *Hipposideros braima* Monard, Arq. Mus. Bocage, 10: 73, fig. 5. Publication date: March 1939. Type locality: Guinea-Bissau: Bagíngarà [12 35 N 14 28 W] [Goto Description]. Holotype: [Unknown] ad ♀. Original number: 602. See Monard (1939: 73).
1965. *Hipposideros braimah:* Rosevear, Bats of West Africa, 221, 226. - Comments: Lapsus for braima Monard, 1939 (see Kock, 1969a: 130).
2014. *Hipposideros (caffer) tephrus:* Moores and Brown, Go-South Bull., 11: 19. (Name Combination)
? *Hipposideros caffer tephrus:*
? *Hipposideros tephrus:* (Name Combination, Current Spelling)

TAXONOMY:
Hayman and Hill (1971) and Simmons (2005: 376) recognised it as a subspecies of *caffer*. Vallo *et al.* (2009: 200) suggest that this taxon is elevated to species rank based on the genetic distance, the small size and the wide geographical separation from South-African true *Hipposideros caffer*.

COMMON NAMES:
Czech: pavrápenec sahelský. Dutch: Cabrera's rondbladneus. English: Lesser leaf-nosed bat, Lesser (Sundevall's) Leaf-nosed Bat. French: Phyllorine cendrée, Rhinolophe de Cafrerie. German: Marokkanische Rundblattnase.

GENERAL DISTRIBUTION:
Morocco to Senegal, and Yemen (Vallo *et al.*, 2009; Benda *et al.*, 2011b: 29). *H. tephrus* is confined to the coastal areas of northern Morocco. Probably Mauritania (Padial and Ibáñez, 2005: 240); Ethiopia (Lavrenchenko *et al.*, 2004b: 133); SW Saudi Arabia. Possibly Gambia (Emms and Barnett, 2005: 50), Guinea (Fahr and Ebigbo, 2003: 128, as "*Hipposideros* cf. *caffer*"), Benin (Capo-Chichi *et al.*, 2004: 162), Liberia (Fahr, 2007a: 104).

Native: Burkina Faso (Kangoyé *et al.*, 2015a: 608); Mauritania (Allegrini *et al.*, 2011: 2); Morocco (Disca *et al.*, 2014: 209; Moores and Brown, 2014: 20); Yemen (Benda *et al.*, 2011b: 29).

ECHOLOCATION:
Mayer *et al.* (2007) reported a CF-component of 133 to 137 kHz for Morocccan specimens. See also Jones *et al.* (1993).

Disca *et al.* (2014: 226) indicate that the type of call is FC-FM, with the following parameters: F_{start}: 147.1 ± 1.1 kHz, F_{end}: 128.2 ± 5.4 kHz, F_{peak}: 146.8 ± 1.3 kHz, bandwidth: 19 ± 4.7 kHz, duration: 6.6 ± 1.1 msec. They also mention (p. 213) that the maximum energy is in the FC part of the third harmonic. The start frequency is also at least 10 kHz above the value provided by Dietz et al. (2009).

Moores and Brown (2014: 21) recorded the following values for social calls at Bou Jerif fortress, Morocco: F_{peak}: 46.7 kHz, F_{start}: 55 kHz, F_{end}: 29 kHz, duration: 8 msec.

MOLECULAR BIOLOGY:
DNA - Vallo *et al.* (2009).
Karyotype - Koubínová *et al.* (2010b) report on three females and two males from Senegal, 2*n*= 32, Fna= 60 and FN= 64, they comprised of 30 biarmed autosomes, including four metacentric, eight submetacentric and three subtelocentric pairs. A secondary constriction situated near the centromere was observed in one pair of the medium-sized submetacentric autosomes (approximately the 9th largest pair). The X chromosome was identified as a large metacentric element, the Y chromosome as a medium submetacentric.
Protein / allozyme - Unknown.

PARASITES:
Okafor (1988: 11) reported the presence of the cestode *Oochoristica agamae* Baylis, 1919 (Eucestoda, Linstowiidae) from *H. caffer tephrus* specimens from Nsukka, Nigeria.

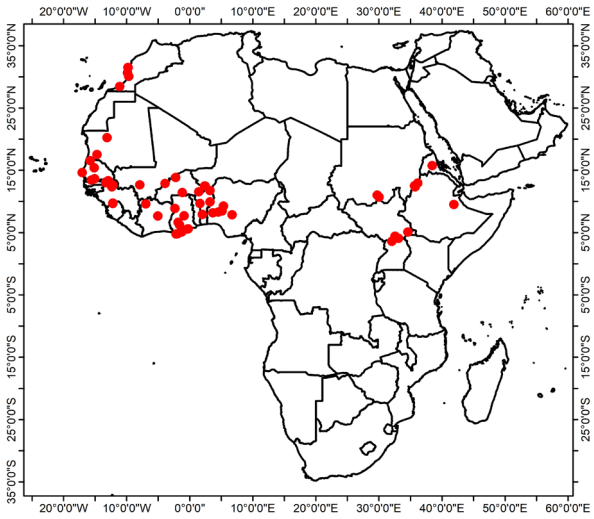


Figure 66. Distribution of *Hipposideros tephrus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Burkina Faso, Côte d'Ivoire, Eritrea, Ethiopia, Ghana, Mali, Mauritania, Morocco, Niger, Nigeria, Senegal, Sierra Leone, South Sudan, Sudan, The Gambia, Uganda.

Genus ***Macronycteris*** Gray, 1866

*1866. *Macronycteris* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 82. Publication date: May 1866 [Goto Description]. - Comments: Type species: *Rhinolophus gigas* Wagner, 1845, by monotypy (see Decher and Fahr, 2005: 1; Jackson and Groves, 2015: 246). - Etymology: From the Greek "*μακρός*", meaning large and "*νυκτερις*", meaning bat (see Palmer, 1904: 393).

TAXONOMY:
This taxon was longtime considered to be a synonym of *Hipposideros*, but molecular analyses of Cyt-*b* by Foley *et al.* (2017) indicated that its representatives are sufficiently different from that genus to be assigned to a separate genus.

MOLECULAR BIOLOGY:
Karyotype -
Foley *et al.* (2017: 11) indicate that the karyotype of the genus *Hipposideros* is very conservative, with almost all species having 2*n* = 32. Both *M. commersoni* and *M. gigas*, however, have 2*n* = 52.

†***Macronycteris besaoka*** (Samonds, 2007)

*2007. *Hipposideros besaoka* Samonds, Acta Chiropt., 9 (1): 49, fig 5A - C, 6A - D. Type locality: Madagascar: Anjohibe cave [Goto Description]. Holotype: UA 9478:. Right maxialla: see Samonds (2007: 49). - Etymology: The word *besaoka* is derived from the Malagasy and means 'big chin' (see Samonds, 2007). - Phonetics: bay-SOH-ka. (Current Combination)

2019. *M[acronycteris] besaoka:* Rakotoarivelo, Goodman, Schoeman and Willows-Munro, PeerJ, 7 (e5866): 15. Publication date: 17 January 2019. (Current Combination)

TAXONOMY:
Goodman *et al.* (2016: 435) examined some *besaoka* skulls and found these to have a more robust mandibula and lower teeth than both other Madagascan "*Hipposideros*" [=*Macronycteris*"] species (*commersoni* and *cryptovalorna*), but further DNA study is required to see whether it is genetically distinct from either of them.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Samonds (2007: 49 - 53) found samples in deposits (TW-10) dated at 10,000 yrs old or younger within the Anjohibe cave, Madagascar.

Timeframe:
Pleistocene.

HABITAT:
Rakotoarivelo *et al.* (2019: 14) presume that *M. besaoka* was ecologically similar to *M. commersoni*.

Macronycteris commersoni (E. Geoffroy St.-Hilaire, 1813)

*1813. *Rhinolophus Commersonii* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 20: 263, pl. 5. Publication date: 1813. Type locality: Madagascar: Tuléar province: Fort Dauphin [25 02 S 47 00 E] [Goto Description]. Neotype: FMNH 175972: ad ♀, skull and alcoholic. Collected by: Steven M. Goodman; collection date: 9 December 2002; original number: SMG 13401. Presented/Donated by: ?: Collector Unknown. Type locality: Madagascar: Province de Fianarantsoa, Parc National de l'Isalo, along Sahanafa River, near foot of Bevato Mountain, 28 km south-east of Berenty-Betsileo, 22°19.0'S, 45°17.6'E, 550 m a.s.l. (see Goodman *et al.*, 2016: 437). - Etymology: Geoffroy's description was based on drawings and notes found among Mr. Philibert Commerson's papers, in who's honour Geoffroy named this species (see Smithers, 1983: 133; Taylor, 2005).

2017. *M[acronycteris] commersonii:* Foley, Goodman, Whelan, Peuchmaille and Teeling, Acta Chiropt., 19 (1): 10. Publication date: June 2017. (Current Combination)

? *Hipposideros commersoni commersoni:* (Name Combination)

? *Hipposideros commersoni:* (Name Combination)

? *Hipposideros sp. cf. H. commersoni:*

TAXONOMY:
Simmons (2005: 369, 372, 377) restricts "*Hipposideros commersoni*" to Madagascar, and assigns "*H. gigas*", "*M. vittatus*" (including *marugensis*) and "*H. thomensis*" as the mainland forms based on morphology and echolocation differences.

A combined molecular and morphological study by Rakotoarivelo *et al.* (2015: 1) indicates that cryptic species exist in Madagascan *M. commersoni*, but also that a further fine-scale phylogeographic study is needed to fully resolve the systematics of this species (see *M. cryptovalorona*). Rakotoarivelo *et al.* (2019: 1) investigated this further and found several lineages in bats from the western part of Madagascar: the animals from northern Madagascar formed a single monophyletic clade (clade C), whereas the animals from the southwestern part of the island (clade B) showed more phylogeographical partitioning where different mtDNA haplotypes frequencies were detected between populations from different bioclimatic regions.

Goodman *et al.* (2016: 439) point out that the orginal spelling by Geoffroy (1813) was "*Rhinolophus Commersonii*", but that most of the subsequent authors spelled it with only one "i". They refer to article 33.3.1 of the ICZN code to maintain the usage of the single "i" version.

COMMON NAMES:
Afrikaans: Commerson se bladneusvlermuis, Commerson-bladneusvlermuis, Commersonse Blaarneusvlermuis. Czech: pavrápenec Commersonův. English: Commerson's Leaf-nosed Bat, Giant Leaf-nosed Bat, Commerson's roundleaf bat, Commerson's Rhinolph. French: Chauve-souris de Commerson à nez feuillu, Phyllorine de Commerson. German: Madagaskar-Rundblattnase, Riesen-Rundblattnase, Marungu-Rundblattnase. Portuguese: Morcego de nariz enfolhado de commerson.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Sabatier and Legendre (1985: 23) reported the presence of *M. commersoni* (and *Hipposideros* sp.) in the Tsimanampetsotsa deposit.
Samonds (2007: 45 - 46, 58 - 60) found samples in deposit (OLD SE locality) dated at 10,000 yrs old or younger and deposit (SS2) which was collected from the surface near the main cave entrance, the dating attemps revealed that this sample was contaminated, therefore no date is known, these two sites identified specimens belonging to *M.* sp. cf. *commersoni*. Samonds (2007: 54 - 55) also found *M. commersoni* within the deposit (NCC-1 locality) dating at 69,000 to 86,800 years old, from within the Anjohibe cave, Madagascar.
Gunnell *et al.* (2014: 3) refer to Goodman and Junkers (2013), who report on fossil material from the Andrahomana cave in Madagascar.

CONSERVATION STATUS:
Global - This species is listed [as *Hipposideros commersoni*] as Near Threatened (NT ver 3.1 (2001)) in view of the significant threat from hunting in the west, which is likely to have resulted in a decline in the region of 20 - 25 % over the past 15 years. Almost qualifies as threatened under criterion A. However, as this species is generally widespread across Madagascar, occurs both in and outside a number of protected areas, and has an ability to tolerate some degree of habitat modification, it is unlikely to be declining fast enough to warrant listing in a threatened category (Andriafidison *et al.*, 2008d; IUCN, 2009).

Assessment History -

2008 - NT ver 3.1 (2001) (Andriafidison *et al.*, 2008d; IUCN, 2009). 2004 - Not assessed (IUCN, 2004).

MAJOR THREATS:
Andriafidison *et al.* (2008d) state that besides habitat loss, it is also threatened by hunting and is particularly vulnerable at roosting sites where bats are hunted as they emerge at dusk (Goodman *et al.*, 2008d; Jenkins and Racey, 2008). It can be legally hunted on between the first of February and the first of May (Anonymus, 2007b: 6). In the extreme south-west of Madagascar, there were an estimated 140,000 individuals harvested for food annually between January and March (Goodman, 2006). This hunting is thought to occur throughout western Madagascar in areas where local people live in close proximity to roosting colonies (Jenkins and Racey, 2008).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008d) report that this species occurs in a number of protected areas as well as other forest areas that are actively managed for conservation (Goodman *et al.*, 2005a; Rakotoarivelo and Randrianandrianina, 2007; Ranivo and Goodman, 2007b).

Due to the existence of several clades within *M. commersoni*, Rakotoarivelo *et al.* (2019: 16) stress the conservation importance of the localities where clade C was found to occur: Analamera, Ankarana, Montagne d'Ambre, and Marovaza.

GENERAL DISTRIBUTION:
Madagascar; adjacent small islands.

GEOGRAPHIC VARIATION:
Ranivo and Goodman (2007b: 48) indicate that there is a clinal variation in *commersoni* on Madagascar, where the individuals from the north are larger than those from the south. In the Isalo region, both sizes were found together, which might indicate that there are two cryptic species.

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 56) reported that the baculum of *commersoni* has a bifurcated distal tip, a straight central shaft and a basal portion that is narrower than the distal part; length: 3.73 ± 0.540 (3.00 - 4.52) mm, width: 1.92 ± 0.330 (1.48 - 2.41) mm. In the bat's clades (sensu Rakotoarivelo *et al.*, 2015), they found two morphotypes with some slight differences: Morphotype A/Clade B: distinct bicurcated distal tip, sometimes with an indentation; length: 3.77 ± 0.545 (3.00 - 4.52) mm, width: 1.94 ± 0.325 (1.50 - 2.41) mm; Morphotype B/Clade C: "This same structure is also found in certain animals allocated to Clade C, with the exception of two" (unfortunately, without further details); length: 3.05, 3.37 mm, width: 1.48, 1.69 mm.

ECHOLOCATION:
In Madagascar Russ *et al.* (2001) recorded a constant-frequency of 64 kHz. Kofoky *et al.* (2009: 379) reported the calls of 28 individuals from six different sites in Madagascar, which produced narrowband and long CF calls which terminate with brief FM elements with a high duty cycle (31.2 %) and maximum energy at about 66.6 kHz. The calls consisted of a maximum of three harmonics most energy in the fundamental or second harmonic.

Ramasindrazana *et al.* (2015b: 85) reported a sexual dimorphism in bats from the western half of Madagascar. In males, the average forearm length was 93.1 mm and they emitted calls at 68.6 kHz. In females, the average forearm length was 83.9 mm and their calls were at 72.9 kHz. They also found that females from the far northern part of the island (Ankarana) emitted calls that were much lower than expected from size.

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotype - 2N = 52 and FN = 60, containing one large metacentric, a medium-sized submetacentric, three pairs of medium-to-small-sized metacentrics. The others are acrocentric. The X chromosome is a large sub-metacentric one and the Y an acrocentric (see Richards *et al.*, 2016d: 187, 191).

Protein / allozyme - Unknown.

HABITAT:
Dammhahn and Goodman (2013: 108) indicate that the lower one-half of forest and perhaps partially open areas form the foraging habitat of this species. The home range of males is 31.8 ± 9.2 ha and of females 41.7 ± 12.9 ha (Razafimanahaka *et al.*, 2016: 423).

HABITS:
Bouchard (2001b: 109) mentions that males scent-mark their territories and mates by rubbing them with their glandular areas.

ROOST:
M. commersoni roosts singly in trees at some sites (Jenkins and Racey, 2008). Razafimanahaka *et al.* (2016: 427) found that these roosts are generally on braches of trees (*Uapaca ferruginea* Baill., *Canarium boivinii* Engl., *Diospyros* sp., *Gaertnera* sp. and *Erythroxylum corymbosum* Boivin ex Baill.) with a diameter at breast height of

about 8.2 ± 0.7 cm and at 5.4 ± 0.2 m above the ground. *Aucoumea klaineana* Pierre [angouma, gaboon, or okoumé], an introduced tree in plantations, is hardly used by the bats. The mean distance between the roost and the foraging area was 313.9 ± 15.3 m (max: 1.6 km).

MIGRATION:
Reher *et al.* (2019: 121) found that *M. commersoni* was only present in two southwestern Madagascan caves during the wet season, whereas other species such as *Triaenops menamena* and *Miniopterus mahafaliensis* were present in both the dry and wet season.

DIET:
Razakarivony *et al.* (2005) examined the stomachs of 11 individuals and found that 90 % of the diet were Coleoptera. Rakotoarivelo *et al.* (2007) found *M. commersoni* mainly to consume Coleoptera, but also included large-bodied taxa such as Cicadidae, Lucanidae, and Passalidae.

In the Tsimanampetsotsa NP, Ramasindrazana *et al.* (2012: 120-121) reported feacal pellets containing 76.2 ± 19.1 volume percent Coleoptera, 20.0 ± 20.0 Blattaria, 2.4 ± 1.0 Homoptera/Hemiptera and 1.4 ± 0.9 Hymenoptera. No Blattaria were found during the wet season, whereas the percentage Coleoptera rose to 93.0 (from 72.0 in the dry season).

Rakotondramanana *et al.* (2015: 78) report the following prey items (mean volume percentages ± 1 SD, mean frequency percentages ± 1 SD): Coleoptera (46.6 ± 38.85, 77.7 ± 36.36); Hymenoptera (6.6 ± 11.49, 26.1 ± 40.70); Lepidoptera (8.2 ± 13.34, 26.1 ± 37.85); Isoptera (37.4 ± 40.53, 49.2 ± 48.41); Homoptera (0.9 ± 3.49, 6.7 ± 19.85); Blattoidea (0.2 ± 0.98, 0.2 ± 0.98); Arachnida (0.04 ± 0.20, 0.77 ± 3.92).

PREDATORS:
Goodman *et al.* (1991: 22) reported an almost intact skull in a pellet from the Madagascar Long-eared Owl *Asio madagascariensis*. Additionally, Goodman and Griffiths (2006) found that *M. commersoni* comprised 0.6 % of the total biomass predated by the barn owl (*Tyto alba*).

Mikula *et al.* (2016: Supplemental data) mention the Madagascan serpent eagle (*Eutriorchis astur* (Sharpe, 1875)) as avian diurnal predator.

ACTIVITY AND BEHAVIOUR:
Preliminary observations in Madagascar reveal that foraging behavior of *M. commersoni* involves short hunting flights from night perches (Russ *et al.*, 2003).

REPRODUCTION AND ONTOGENY:
Razafimanahaka *et al.* (2016: 429) recorded flying juveniles in early February and March, which suggests that births take probably place in January. They were also unable to catch females in nets in January, possibly because they were not foraging or because they had moved to materity roosts.

PARASITES:
Gomard *et al.* (2016: 5) reported the presence of *Leptospira* bacteria in 13 out of 27 tested bats (48.1 %).

VIRUSES:
Rhabdoviridae
The serum of one of six bats tested by Mélade *et al.* (2016a: 6) showed a reaction against *Duvenhage lyssavirus*, and one of four against *European bat lyssavirus 1*.

UTILISATION:
Goodman (2006) observed in February 2005, in south-western Madagascar, that local people were extensively hunting *M. commersoni*. This coincided with the onset of famine in the region. Goodman (2006) describes the hunting method used by local inhabitants. In PN d'Ankarafantsika, local people - while collecting forest tubers - occasionally encounter roosting *M. commersoni* which are taken back to the village and eaten (Jenkins and Racey, 2008).
In the villages *M. commersoni* is either roasted over a fire or boiled.
Goodman (2006) concluded that harvest level of *M. commersoni* (ca. 70,000 - 140,000 bats annually) surpasses the likely productivity of the species in the area. Goodman *et al.* (2002) suggested that hunting at the Mitoho Cave in PN de Tsimanampetsotsa may have been the reason *M. commersoni* abandoned the site.
See also Goodman *et al.* (2008d) and Jenkins and Racey (2008).

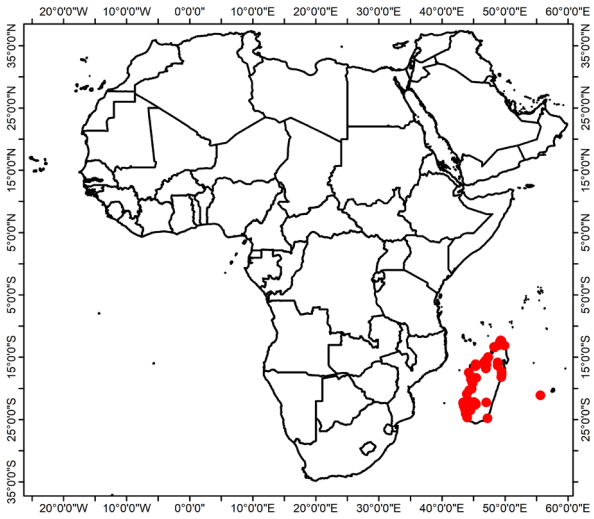


Figure 67. Distribution of *Macronycteris commersoni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar, Réunion.

Macronycteris cryptovalorona (Goodman, Schoeman, Rakotoarivelo and Willows-Munro, 2016)

*2016. *Hipposideros cryptovalorona* Goodman, Schoeman, Rakotoarivelo and Willows-Munro, Zool. J. Linn. Soc., 177 (2):428, 443. Publication date: 20 May 2016. Type locality: Madagascar: Fianarantsoa province: Parc National de l'Isalo, along Sahanafa River, near foot of Bevato: Berenty-Betsileo, 28 km SE [22 19.0 S 45 17.6 E, 550 m] [Goto Description]. Holotype: FMNH 175970: ad ♀, skull and alcoholic. Collected by: Steven M. Goodman; collection date: 9 December 2002; original number: SMG 13399. Presented/Donated by: ?: Collector Unknown. Type locality: Madagascar: Province de Fianarantsoa, Parc National de l'Isalo, along Sahanafa River, near foot of Bevato, 28 km south-east of Berenty-Betsileo, 22°19.0'S, 45°17.6'E, 550 m a.s.l. Paratype: FMNH 184173: ♀. Collected by: Steven M. Goodman; collection date: February 2005; original number: SMG 14582. Presented/Donated by: ?: Collector Unknown. - Etymology: The name is derived from the Greek "kryptos", meaning hidden or concealed, and from the Sakalava dialect of Malagasy "valorona", which is the local vernacular name of *Hipposideros* and refers to its distinct nasal structure, and can be translated as "eight nose", referring to the complicated and multiple layers of the nose structure (see Goodman *et al.* (2016: 444).

2017. *M[acronycteris] cryptovalorona* Foley, Goodman, Whelan, Puechmaille and Teeling, Acta Chiropt., 19 (1): 10. Publication date: June 2017. (Current Combination)

TAXONOMY:
Analysing the cyt *b* sequences of 148 Madagascan *M. commersoni* s.l. specimens, Goodman *et al.* (2016: 428) found three well-supported monophyletic clades: A, B, and C. Clades B and C form a monophyletic lineage, which they were able to refer to *M. commersoni* s.s. Clade A showed a 9 to 11 % sequence variation with *M. commersoni* s.s., enough to warrant a separate species status. This new species is known from two adult females only.

COMMON NAMES:
English: Madagascar cryptic leaf-nosed bat. French: La Phyllorhine cryptique de Madagascar. German: Kryptische Madagaskar-Rundblattnase.

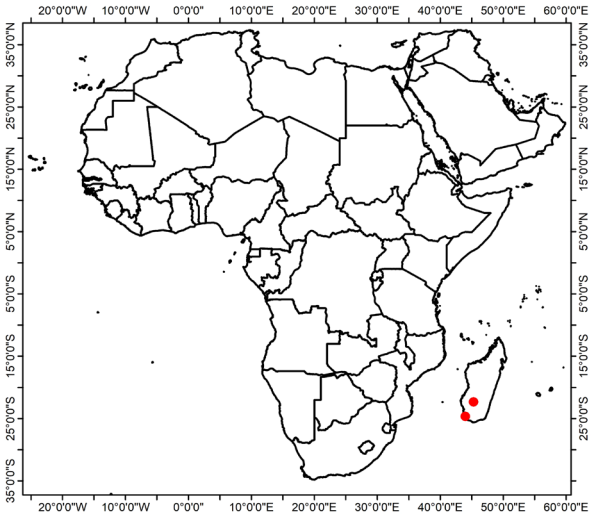


Figure 68. Distribution of *Macronycteris cryptovalorona*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Macronycteris gigas (Wagner, 1845)

*1845. *Rhinolophus gigas* Wagner, Arch. Naturgesch. Berlin, 11 (1): 148. Publication date: 1845. Type locality: Angola: Benguela [12 34 S 13 24 E, 160 m].

1906. *H[ipposiderus]. gigas gambiensis* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 17 (97): 42. Publication date: 1 January 1906. Type locality: The Gambia: "Gambia" [Goto Description]. Holotype: BMNH 1842.9.27.36: ad ♀, alcoholic (skull not removed). Presented/Donated by: 13th Earl of Edward Smith Stanley Derby.

1917. *Hipposideros gigas niangaræ* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 438, pl. 51, fig. 1. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Niangara [03 24 N 27 52 E] [Goto Description]. Holotype: AMNH 49103: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 2 June 1913; original number: 2069.

1939. *Hipposideros gigas viegasi* Monard, Arq. Mus. Bocage, 10: 70. Publication date: March 1939. Type locality: Guinea-Bissau: Madina Boé [11 45 N 14 13 W] [Goto Description]. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 909. Syntype: [Unknown] ♂, skin and skull. Collected by: P. Rigaux; collection date: 9 March 1938; original number: 910. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 911. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 912. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 913. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 914. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 917. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 918. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 919. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 920. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 921. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 922. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 923. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 924. Syntype: [Unknown] ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 926. Syntype: NMBA 5266/9283: ♂. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 915. Syntype: NMBA 5267/9284: ♀. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 908. Syntype: RMCA 15305: ♂, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 925. Syntype: RMCA 15306: ♀, skin and skull. Collected by: Dr. Albert Monard; collection date: 9 March 1938; original number: 916. - Comments: Monard (1939: 70) mentions a series of 19 specimens (nrs 908 to 926 and 14 skulls).

2017. *Macronycteris gigas:* Foley, Goodman, Whelan, Puechmaille and Teeling, Acta Chiropt., 19 (1): 7. Publication date: June 2017. (Current Combination)

? *Hipposideros commersoni gigas:* (Name Combination)

? *Hipposideros commersoni niangarae:*

? *Hipposideros commersoni:* (Name Combination)

? *Hipposideros gigas gigas:* (Name Combination)

? *Hipposideros gigas niangarae:*

? *Hipposideros gigas:* (Name Combination, Current Combination)

? *Hipposideros marungensis marungensis:*

? *Hipposideros marungensis:*

TAXONOMY:
McWilliam (1982: 9) found two forms of "*Hipposideros commersoni*" occurring sympatrically in Kenya, which he separated into "*H. commersoni*" and "*H. gigas*", with the latter species being significantly larger and heavier than the prior.

Simmons (2005: 369, 372, 377) restricts "*Hipposideros commersoni*" to Madagascar, and assigns *H. gigas*, *H. vittatus* (including *marugensis*) and *H. thomensis* as the mainland forms based on morphology and echolocation differences. Meester *et al.* (1986) state that Hayman and Hill (1971) note that *marungensis* may be antedated by *vittata* Peters, 1852, from Ibo Island, which is more often regarded as a synonym of the subspecies *gigas* Wagner, 1845 (Allen, 1939a, Ellerman *et al.*, 1953, Hill, 1963a).

The karyotypic studies for the African mainland forms (*M. vittatus* and *M. gigas*) indicate that they share the exact same numbers and forms (Porter *et al.*, 2010); Rautenbach *et al.*, 1993; Koubínová *et al.*, 2010b). Koubínová *et al.* (2010b) suggest that African mainland forms may belong to the same species.

COMMON NAMES:
Afrikaans: Commerson se bladneusvlermuis, Commerson-bladneusvlermuis, Commersonse Blaarneusvlermuis. Chinese: 巨蹄蝠. Czech: pavrápenec obrovský. English: Commerson's Leaf-nosed Bat, Giant Leaf-nosed Bat, Commerson's roundleaf bat, Commerson's Rhinolph. French: Chauve-souris de Commerson à nez feuillu, Phyllorine de Commerson. German: Madagaskar-Rundblattnase, Riesen-Rundblatt-nase, Marungu-Rundblattnase. Kinande (DRC): Mulima. Portuguese: Morcego de nariz enfolhado de commerson.

GENERAL DISTRIBUTION:
Gambia over Liberia (Monadjem *et al.*, 2016y: 365 as *Hipposideros gigas*), Ghana (Decher and Fahr, 2007: 17 as *Hipposideros gigas*), Benin (Capo-Chichi *et al.*, 2004: 162), Central African Republic (Lunde *et al.*, 2001: 537), Republic of the Congo (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 538 as *H. vittatus*; Bates *et al.*, 2013: 335, as *H. commersoni*) to Ethiopia, south to Angola (Crawford-Cabral, 1989: 17, as *H. c. gigas*; Monadjem *et al.*, 2010d: 538, as *H. gigas* and *H. vittatus*), Zambia (Ansell, 1967; Ansell, 1974; Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Zimbabwe (Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Namibia (Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Botswana (Smithers, 1971; Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Transvaal (South Africa (Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Malawi (Happold *et al.*, 1988; Happold and Happold, 1997b: 818; Monadjem *et al.*, 2010d: 538 as *H. vittatus*) and Mozambique (Monadjem *et al.*, 2010d: 538, Monadjem *et al.*, 2010c: 381 as *H. vittatus*).

Rainho and Ranco (2001: 54) report "*H. commersoni*" from Guinea-Bissau (see also Peters, 1870; Seabra, 1900c; Monard, 1939; Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992).

DETAILED MORPHOLOGY:
Baculum - Unknown.
Brain - Kruger *et al.* (2010a) describe - based on three brains from Kenya, and using immunohistochemical methods - the nuclear organization of the cholinergic, catecholaminergic and serotonergic systems. Kruger *et al.* (2010b) also describe the distribution of Orexin-A immunoreactive cell bodies and terminal networks.

ECHOLOCATION:
O'Shea and Vaughan (1980) reported an ultrasonic frequency of 155 kHz for Masalani in Kenya. A highest frequency of 62 kHz was recorded at Sengwa in Zimbabwe by Jacobs (1996) and Fenton and Bell (1981), and at Pafuri in South Africa by Aldridge and Rautenbach (1987). Monadjem *et al.* (2010c: 381) reported from Mozambique [as *M. vittatus*] that the peak echolocation frequencies ranged between 64 - 66 kHz (ANABAT). Rainho *et al.* (2010a: 21) report [as *Hipposideros thomensis*] the calls of 10 individuals from Saõ Tomé.

Monadjem *et al.* (2013b: 351) report the F_{max} to be 52.0 ± 0.41 (51 - 53) kHz for four specimens from Mount Nimba.

For two unsexed bats, two females and three males from the Shimoni cave in Kenya, Webala *et al.* (2019: 15) reported an F_{max} value ranging between 54.8 and 55.3, 53.4 and 54.3, and 53.4 and 54.1 kHz, respectively. The duration of the calls were respectively 12.3 to 14.6, 17.1 to 19.2, and 10.4 to 15.7 msec.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported for female individuals with a diplod number of $2n = 52$, FN = 60?, and BA = 10?. Porter *et al.* (2010) found the same diploid number described by Rautenbach *et al.* (1993) for a single male Gabonese specimen reported as *Hipposideros gigas*, with six pairs of biarmed and 20 pairs of acrocentric chromosomes (including the sex chromosomes). Koubínová *et al.* (2010b) reported for two females from Senegal [as "*Hipposideros*

gigas"] a 2*n*= 52, and FNa= 60, supposing the X chromosomes to be (sub)metacentric. The autosomes would then consist of one pair of large metacentrics, two pairs of medium-sized submetacentrics, one pair of small submetacentrics, one pair of small metacentrics, and 20 pairs of acrocentrics, the two smallest acrocentric pairs were of a dot-like appearance.
Protein / allozyme - Unknown.

HABITAT:
Monadjem *et al.* (2016y: 365) recorded this species widely in forested and disturbed habitats in the Mount Nimba area, at altitudes between 460 and 1,060 m. In Angola, it occurs in lowland forest and moist savanna (Beja *et al.*, 2019: 388).

DIET:
Andreas (2010: 266) indicates that there is some proof from Senegal that *M. gigas* might be carnivorous, as was already suggested by Eger and Mitchell (2003) for *M. commersoni*.

REPRODUCTION AND ONTOGENY:
Kurta and Kunz (1987: 82) report that, at birth, the young has about 25.2 % of the mother's body mass (28.0 versus 111.0 g).
Kurta and Kunz (1987: 227) indicate that in Gabon, all adult females (of *M. commersoni*) were pregnant between July and October (with implantation occurring in mid June), and generally gave birth in October. The young is being fed with milk until the beginning of May. The males were in full spermiogenesis by mid April.

PARASITES:
DIPTERA:
Nycteribiidae: *Nycteribia schmidlii scotti* Falcoz, 1923, *Eucampsipoda africana* Theodor, 1955, and *Penicilidia fulvida* Bigot, 1885 (Obame-Nkoghe *et al.*, 2016: 5, Gabon)

Streblidae: *Brachytarsina allaudi* (Falcoz, 1923) (Obame-Nkoghe *et al.*, 2016: 5, Gabon) Szentiványi *et al.* (2019: Suppl.) indicated that a similar bat fly from a Gabonese "*Hipposideros gigas*" was carrying an *Arsenophonus* sp. bacteria. *Raymondia huberi* Frauenfeld, 1856 group (Obame-Nkoghe *et al.*, 2016: 5, Gabon).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in "*Hipposideros commersonii*" [as they considered "*H. vittatus*" to be a separate species, the bats probably represent *M. gigas*]: Astroviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 to 1999, for antibodies for SARS-CoV in sera of 16 individuals from the Oriental Province, DRC. None tested positive (0/16). Tong *et al.* (2009) found coronavirus RNA in this bat, collected in 2006 in Kenya. In Nigeria, Quan *et al.* (2010) screened the gastrointestinal tissue for the presence of coronaviruses by PCRs.

Filoviridae - Filoviruses
Marburgvirus:
Towner *et al.* (2007) reported on one individual [as *Hipposideros gigas*] from Gabon, which they tested for Marburg virus RNA by conventional and real-time RT-PCR and for anti-Marburg virus IgG antibodies by ELISA. The results were negative.

Ebolavirus:
Fiorillo *et al.* (2018: 7) included "*Hipposideros gigas*" in their Ebola distribution model, indicating that there is evidence that suggests their relation with filoviruses infection cases, although they provide no details on this.

Flaviviridae
Pegivirus (BPgV) - 1 out of 5 Nigerian specimens examined by Quan *et al.* (2013: Table S5) was infected by clade K type *Pegivirus*.
Maganga *et al.* (2014a: 5) tested 227 bats from Gabon of which only one tested positive for a *Flavivurus*.

Nairoviridae
Orthonairovirus
Ishii *et al.* (2014: 2) isolated a new Nairovirus (tentatively called Leopards Hill Virus - LPHV) from a *H. gigas* specimen collected in the Leopards Hill cave in Lusaka, Zambia. In a test on 129 specimens from Gabon, Müller *et al.* (2016: 3) found 32 of them positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Rhabdoviridae
Lyssavirus - Rabies related viruses:
In Nigeria, Quan *et al.* (2010) did not detect any lyssavirus-specific antigens from the brains by use of direct fluroescent anitbody testing.
Shimoni:
Kuzmin *et al.* (2010a) detected a new lyssavirus, Shimoni bat lyssavirus from the brain of a dead "*H. commersoni*" bat found in the coastal region of Kenya. Genetic distances demonstrated that this may be a new lyssavirus species.

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that two of the 20 specimens they examined from Ghana tested positive for *Morbillivirus*, and one for *Rubulavirus*.

In their overview table, Maganga *et al.* (2014a: 8) report that the following viruses were already

found on "*Hipposideros gigas*": Rubulavirus, Morbillivirus unclassified, Flavivirus, Shimoni bat virus, SARS-like CoV

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Niger, Nigeria, São Tomé and Principé, Senegal, Tanzania, The Gambia, Togo.

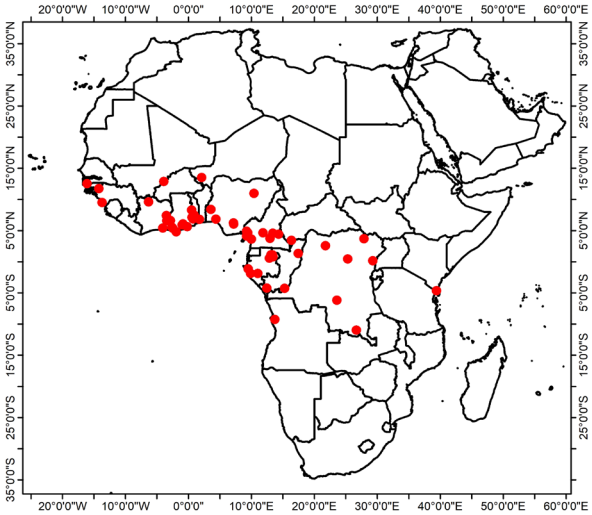


Figure 69. Distribution of *Macronycteris gigas*

Macronycteris vittatus (Peters, 1852)

*1852. *Phyllorrhina vittata* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 32, pl. 6; pl. 13, fig 7 - 13. Publication date: 1852. Type locality: Mozambique: Cap Delgado group [=Querimba islands]: Ibo Island [ca. 12 20 S] [Goto Description]. Syntype: ZMB 363: ♀, alcoholic, skull and skeleton. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). Syntype: ZMB 37150: ♂, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. Legs and wings missing, see Turni and Kock (2008: 40). - Etymology: From the feminine Latin adjective *vittàta* meaning "striped", referring to the occurrence of dorsal light bands in this species (Lanza *et al.*, 2015 149).

1879. *Phyllorhina commersoni:* Dobson, Proc. zool. Soc. Lond., 1878, IV: 879. Publication date: April 1879.

1887. *Phyllorhina commersonii var. marungensis* Noack, Zool. Jb. Syst., 2 (2): 272, pl. 10, fig. 31 - 33. Publication date: 7 May 1887. Type locality: Congo (Democratic Republic of the): W Shore Lake Tanganyika, Marungu: Qua Mpala [=Mpala / Pala] [06 43 S 29 31 E] [Goto Description]. Syntype: ZMB 6312: ♂, skin and skull. Collected by: Richard Böhm; collection date: 12 July 1883. See Turni and Kock (2008). Syntype: ZMB 86257: skin and skull. Collected by: Richard Böhm; collection date: 12 July 1883. Old number A4269; see Turni and Kock (2008). Syntype: ZMB 86258: skull only. Collected by: Richard Böhm; collection date: 12 July 1883. Old number A4268; see Turni and Kock (2008). Syntype: ZMB 86259: skull only. Collected by: Richard Böhm; collection date: 12 July 1883; original number: A4270. See Turni and Kock (2008). - Comments: Actually, in Noack (1887: 272), the name is mentioned as "*Phyllor hinacommersonii Peters, var. marungensis N.*". Noack (1887: 272) also mentions five specimens, including one female, collected in July-August. Ansell and Dowsett (1988: 34) refer to Hayman and Hill (1971: 28) who indicate that *marungensis* may be antedated by *vittata* Peters, 1852.

1891. *Phyllorhina commersoni var. thomensis* Bocage, J. Sci. mat. phys. nat., ser. 2, 2 (6): 88. Publication date: September 1891. Type locality: São Tomé and Principé: São Tomé Island [Goto Description]. - Comments: Bocage (1891: 88) mentions one male and one female specimen.

1904. *Hipposideros Commersoni mostellum* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (77): 385. Publication date: 1 May 1904. Type locality: Kenya: Tana River [ca. 02 33 S 40 31 E, 700 ft] [Goto Description]. Holotype: BMNH 1889.3.8.3: ad ♂, skin and skull. Presented/Donated by: H.C.V. Hunter Esq.

1993. *Hipposideros commersoni matungensis:* Koneval, Honors Projects - Illinois Wesleyan University: 1. (Lapsus)

2017. *M[acronycteris] thomensis:* Foley, Goodman, Whelan, Puechmaille and Teeling, Acta Chiropt., 19 (1): 10. Publication date: June 2017. (Current Combination)

2017. *M[acronycteris] vittatus:* Foley, Goodman, Whelan, Puechmaille and Teeling, Acta Chiropt., 19 (1): 10. Publication date: June 2017. (Current Combination)

2018. *Macronycteris vittata:* Musila, Monadjem, Webala, Patterson, Hutterer, De Jong, Butynski, Mwangi, Chen and Jiang, Zool. Res. (China), 40 (1): 21 (for 2019). Publication date: 17 October 2018. (Alternate Spelling)
2018. *Macronycteris vittata:* Musila, Syingi, Gichuki and Castro-Arellano, J. Bat Res. Conserv., 11 (1): 44.. (Name Combination)
? *Hipposideros commersoni marungensis:*
? *Hipposideros commersoni:* (Name Combination)
? *Hipposideros thomensis:* (Name Combination)
? *Hipposideros vittatus:* (Name Combination, Current Combination)
? *Macronycteris vittatus:* (Current Combination)

TAXONOMY:
Simmons (2005: 369, 372, 377) restricts "*Hippposideros commersoni*" to Madagascar, and assigns *H. gigas*, *H. vittatus* (including *marugensis*) and *H. thomensis* as the mainland forms based on morphology and echolocation differences. Meester *et al.* (1986) state that Hayman and Hill (1971) noted that *marungensis* may be antedated by *vittata* Peters, 1852, from Ibo Island, which is more often regarded as a synonym of the subspecies *gigas* Wagner, 1845 (Allen, 1939a, Ellerman *et al.*, 1953, Hill, 1963a).

The karyotypic studies for the African mainland forms (*M. vittatus* and *M. gigas*) indicate that they share the exact same numbers and forms (Porter *et al.*, 2010); Rautenbach *et al.*, 1993; Koubínová *et al.*, 2010b). Koubínová *et al.* (2010b) suggests that African mainland forms may belong to the same species.

Foley *et al.* (2017: 3) indicate that the morphological characters used to distinguish *M. gigas* from *M. vittatus* are not straightforward and that these are generally used in combination with habitat and distribution data, which is complicated by the fact that their distributions partially overlap. They also indicate that the differences between the forms *gambensis* [sic], *marungensis, niangarae* and *viegasi* have been based on non-molecular characters, and as such the assignment of these synonyms is not yet definitive.

COMMON NAMES:
Chinese: 大白纹蹄蝠. Czech: pavrápenec pruhovaný. English: Striped Leaf-nosed Bat. German: Streifen-Rundblattnase. Italian: Ipposìdero vittàto.

CONSERVATION STATUS:
Global -

Assessment History -
2008 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2008z; Mickleburgh *et al.*, 2008z).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016v). 2004 - considered a vagrant not assessed, single locality (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).
Bioko: Conenna *et al.* (2017: Suppl.) mentioned the status of "*Hipposideros thomensis*" as Least Concern (LC).

GENERAL DISTRIBUTION:
Gambia over Benin (Capo-Chichi *et al.*, 2004: 162), Ghana (Decher and Fahr, 2007: 17 as *H. gigas*), Burkina Faso (Kangoyé *et al.*, 2015a: 608); Central African Republic (Lunde *et al.*, 2001: 537), Republic of the Congo (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 538 as *H. vittatus*) to Ethiopia, south to Angola (Crawford-Cabral, 1989: 17, as *H. c. gigas*; Monadjem *et al.*, 2010d: 538, as *H. gigas* and *H. vittatus*; Taylor *et al.*, 2018b: 62), Zambia (Ansell, 1967; Ansell, 1974; Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Zimbabwe (Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Namibia (Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Botswana (Smithers, 1971; Monadjem *et al.*, 2010d: 538 as *H. vittatus*), Transvaal (South Africa (Monadjem *et al.*, 2010d: 538 as *H. vittatus*)), Malawi (Happold *et al.*, 1988; Happold and Happold, 1997b: 818; Monadjem *et al.*, 2010d: 538 as *H. vittatus*) and Mozambique (Monadjem *et al.*, 2010d: 538, Monadjem *et al.*, 2010c: 381 as *H. vittatus*; Madagascar; adjacent small islands; Saõ Tomé (Rainho *et al.*, 2010a: 26 as *H. thomensis*).

Reported from the Tanzanian island of Pemba by O'Brien (2011: 287).

Rainho and Ranco (2001: 54) report "*H. commersoni*" from Guineu-Bissau (see also Peters, 1870; Seabra, 1900c; Monard, 1939; Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,043,916 km^2.

DETAILED MORPHOLOGY:
Baculum - Unknown.

Brain - Using immunohistochemical methods, Kruger *et al.* (2010a) describe the nuclear organization of the cholinergic, catecholaminergic and serotonergic systems based on three brains from Kenya. Kruger *et al.* (2010b) also describe the distribution of Orexin-A immunoreactive cell bodies and terminal networks.

Koneval (1993) described several significant differences in the hyoid morphology of "*Hipposideros commersoni matungensis*" (from Kenya) and other bats of the family Rhinolophidae (including Hipposideridae): a modified stylohyal, fused to the auditory bulla; loss of the stylohyoid; addition of a new muscle, possibly from the stylopharyngeus; a modified mylohyoid profundus; and insertion of the ceratohyoid onto only the stylohyal. She found this morphology to be closest related to this of the east Asian *H. armiger*.

ECHOLOCATION:
O'Shea and Vaughan (1980) reported an ultrasonic frequency of 155 kHz for Masalani in Kenya. A highest frequency of 62 kHz was recorded at Sengwa in Zimbabwe by Jacobs (1996) and Fenton and Bell (1981), and at Pafuri in South Africa by Aldridge and Rautenbach (1987). From Mozambique, Monadjem *et al.* (2010c: 381) reported [as *H. vittatus*] that the peak echolocation frequencies ranged between 64 - 66 kHz (ANABAT). Rainho *et al.* (2010a: 21) reports [as *H. thomensis*] the calls of 10 individuials from Saõ Tomé.

Musila *et al.* (2018c: 44) [referring to Monadjem *et al.* (2010d: 162]) mention a high-duty, constant frequency call with a peak frequency of 61 kHz.

Two males and 7 females from three localities in Kenya had F^{max} values between respectively 67.9 and 70.1, and 64.3 and 69.7 kHz, whereas the duration was 14.3 to 17.9 msec for the males and 10.6 to 17.8 for the females.

In Sierra Leone, Weber *et al.* (2019: 21) recorded calls from a male and a female with a CF value of 62.5 (62.0 - 63.0) kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported for female individuals with a diplod number of $2n$ = 52, FN = 60?, and BA = 10?. Porter *et al.* (2010) found the same diploid described by Rautenbach *et al.* (1993) for a single male Gabonese specimen reported as "*Hipposideros gigas*", with six pairs of biarmed and 20 pairs of acrocentric chromosomes. While, Koubínová *et al.* (2010b) reported for two females from Senegal [as *H. gigas*] a $2n$= 52, and FNa= 60, including a pair of large metacentrics, three pairs of medium-sized sub-metacentrics, one pair of small submetacentrics, one pair of small metacentrics, and 20 pairs of acrocentrics, the two smallest acrocentric pairs were of a dot-like appearance.
Protein / allozyme - Unknown.

ROOST:
In Angola, *M. vittatus* roosts in very large colonies in cave, mainly in the southern part of the country (Beja *et al.*, 2019: 388).

PREDATORS:
Messana *et al.* (1985: 337) shows a photo, taken in a cave in Somalia, on which a dead body of "*Hipposideros commersoni*" is being fed on by *Phaeophilacris* sp. (Insecta: Orthoptera: Grillidae) and *Tura mesopotamica* Taiti & Ferrara, 1985 (Isopoda: Porcellionidae).

REPRODUCTION AND ONTOGENY:
A pregnant female was recorded on 26 March by Weber *et al.* (2019: 23) in Sierra Leone.

PARASITES:
HAEMOSPORIDA:
Blood samples from Zambian *M. vittatus* examined by Qiu *et al.* (2019: 236) revealed the presence of two *Trypanosoma* sp., very similar to *T. conorhini* and *T. dionisii* clades.

DIPTERA:
Streblidae: *Ascodipteron variisetosum* Maa, 1965 from Robertspoort, Liberia and Ghana, where the cysts were found under the upper arm (Haeselbarth *et al.*, 1966: 107, hosts identified as *H. commersoni*). *Raymondia huberi huberi* Frauenfeld, 1855 (Shapiro *et al.*, 2016: 254).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in "*Hipposideros vittatus*": Paramyxovirus.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 to 1999, for antibodies for SARS-CoV in sera of 16 individuals from the Oriental Province, DRC. None tested positive (0/16). Tong *et al.* (2009) found coronavirus RNA (Kenya-bat-coronavirus [BtKY07]) from fecal material in 2006 in Kenya, and was similar to *Rousettus sp.* coronaviruses from China. In Nigeria, Quan *et al.* (2010) screened the gastrointestinal tissue for the presence of coronaviruses by PCRs.
One out of 123 (0.8 %) Kenyan bats tested by Tao *et al.* (2017: Suppl.) was positive for CoV.

Filoviridae - Filoviruses

Marburgvirus - Towner *et al.* (2007) as *H. gigas*, tested 1 individual from Gabon for Marburg virus RNA by conventional and real-time RT-PCR and for anti-Marburg virus IgG antibodies by ELISA; the results were negative.

Flaviviridae
Hepacivirus (BHV) - Quan *et al.* (2013: Table S5) report 2 with clade A infected Kenyan specimens on a total of 75 tested (2.7 %), and 4 specimens (5.3 %) that were infected with clade D virus.
Pegivirus (BPgV) - Quan *et al.* (2013: Table S5) also indicated that 2 of the 75 specimens were infected with a clade K type *Pegivirus*.

Polyomaviridae
Polyomavirus - Conrardy *et al.* (2014: 259) examined nine "*Hipposideros commersoni*" specimens from the Shimoni cave (Kenya), and found one of them testing positive for this virus.

Rhabdoviridae
Lyssavirus - Rabies related viruses
In Nigeria, Quan *et al.* (2010) did not detect any lyssavirus-specific antigens from the brains by use of direct fluroescent antibody testing.
Shimoni - Kuzmin *et al.* (2010a) detected a new lyssavirus, Shimoni bat lyssavirus from the brain of a dead "*H. commersoni*" bat found in the coastal region of Kenya. Genetic distances demonstrated that this may be a new lyssavirus species.
Fikirini rhabdovirus (FKRV)
Kading *et al.* (2013) report on this new rhabdovirus from a *M. vittatus* specimen collected at Three Caves, Shimoni cave in Southern Kenya.
Horton *et al.* (2014: Table S1) tested 77 Kenyan "*H. commersoni*" specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

ANTHROPOPHILOUS:
Dandurand *et al.* (2018: 284) studied the influence of condensation-corrosion processes caused by urine and droppings on the walls of Drotsky's cave (Botswana) and their consequences on archaeological remains and cave art.

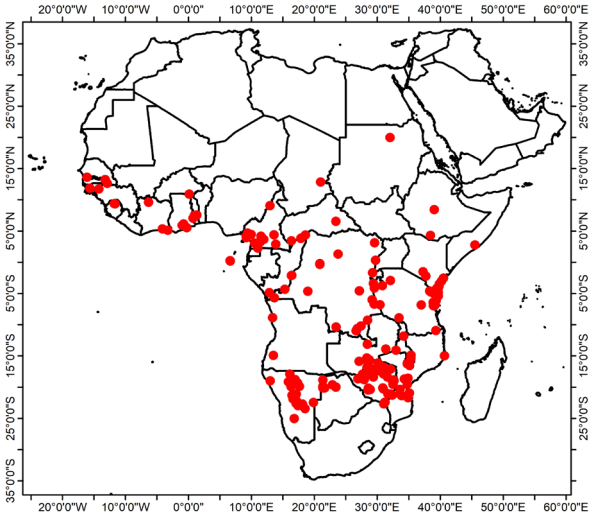


Figure 70. Distribution of *Macronycteris vittatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Botswana, Burundi, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Ghana, Guinea-Bissau, Kenya, Madagascar, Malawi, Mozambique, Namibia, Niger, Rwanda, São Tomé and Principé, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, The Gambia, Togo, Zambia, Zimbabwe.

†Genus ***Palaeophyllophora*** Revilliod, 1917

1917. *Palaeophyllophora* Revilliod, Abh. Grossherz.-hess. Geol. Landesanst., 7: 1??.

†***Palaeophyllophora tunisiensis*** (Ravel, 2016)

*2016. *?Palaeophyllophora tunisiensis* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 368, figs 6, 7. Publication date: 30 September 2016. Type locality: Tunisia: Kassérine province: Dejbel Chambi National Park: Chambi [35 14 03 N 08 45 29 E, 630 m] [Goto Description]. - Etymology: The species name refers to the country from which uit was described: Tunisia.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Late lower Eocene to early middle Eocene.
Timeframe:

Family MEGADERMATIDAE H. Allen, 1864

*1864. *Megadermatidae* H. Allen, Monograph of North American Bats, xxiii, 1. - Comments: Type genus: *Megaderma* Geoffroy, 1810. See Handley (1980: 10) for the correct formation of the family name. (Current Combination)
1866. *Megadermata* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1865: 256. - Comments: In Part (see Taylor, 1934). Originally included the genera *Rhinopoma* É. Geoffroy, 1818; *Megaderma* É. Geoffroy, 1810; *Nycteris* É. Geoffroy & G. Cuvier, 1795; and *Nyctophilus* Leach, 1821 (see Jackson and Groves, 2015: 241).
1866. *Megadermina* Gray, Proc. zool. Soc. Lond., 1866, I: 83. Publication date: May 1866.
1872. *Megadermidae* Gill, Arr. Families of Mammalia, p. 17. - Comments: Originally included the subfamilies Vampyrinae Peters, 1865 [= Family Phyllostomidae Gray, 1825], Glossophaginae Bonaparte, 1845 and Stenoderminae Gill, 1872 (see Jackson and Groves, 2015: 241).
1893. *Megadermatini* Winge, Samling af Afhandlinger. E Museo Lundii, 2 (1): 24. - Comments: Proposed as tribe (?) and originally included the genera *Nycteris* É. Geoffroy and G. Cuvier, 1795 and *Megaderma* É. Geoffroy, 1810 (see Jackson and Groves, 2015: 241).

TAXONOMY:
Based on morphological data, the Family Megadermatidae was placed in the superfamily Rhinolophoidea with the families Nycteridae, Rhinolophidae and Hipposideridae (Simmons, 1998; Simmons and Geisler, 1998), but more recent molecular studies have contradicted many groupings based on morphological data. Hand (1985, 1996) and Griffiths *et al.* (1992) have provided alternative phylogenies for the group.

See Handley (1980) [in Corbet and Hill (1992: 89)] for correct formation of family name.

No subfamilies recognized (Simmons, 2005: 379).

Known genera of the family Megadermatidae: †***Saharaderma*** Gunnell, Simons and Seiffert, 2008; ***Cardioderma*** Peters, 1873; ***Lavia*** Gray, 1838; *Macroderma* Miller, 1906; *Megaderma* E. Geoffroy, 1810.

COMMON NAMES:
Czech: lyronosovití, kožnatcovití, megadermovití. Dutch: Onechte vampieren. English: False Vampire Bats, Large-winged Bats. Finnish: Valevampyyrit. French: Mégadermatidés. German: Grossblattnasen, Großblattnasen, Falsche Vampire. Italian: Megadermàtidi, Fàlsi vampìri. Norwegian: Storøreflaggermus, falske vampyrer. Russian: Лжевампиры. Vietnamese: Họ dơi ma.

ETYMOLOGY OF COMMON NAME:
The common name of the family, false vampire bats, stems from the old, erroneous belief that they fed on blood, as do the true vampire bats of the New World (Happold, 2013ay: 401). There are no blood-sucking bats in Africa.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The Megadermatidae appear in the late Eocene or early Oligocene of Europe (Butler, 1978). Butler and Hopwood (1957) reported an indetermined species of Megadermatidae from the early Miocene at Rusinga. The locality was corrected by Butler (1984: 185) to Kaswanga, where it was found in the Hiwegi Formation.

Russell and Sigé (1970) suggest that *Afropterus gigas* Lavocat, 1961, is a megadermatid.

Shi and Rabosky (2015: 1532) indicate that the Megadermatidae split of from the Rhinopomatidae some 34 million years ago. They also reported (p. 1537) the family-level stem age to be 53.4 Mya and the crown age 27.2 Mya.

DENTAL FORMULA:
$^{0113}/_{2123}$ = 26.
Except in one non-African species, which has two upper premolars.

Genus ***Cardioderma*** Peters, 1873

*1873. *Cardioderma* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 488. Publication date: 23 June 1873. - Comments: Type species: *Megaderma cor* Peters, 1872. - Etymology: From the Greek "*καρδία*", meaning heart and "*δέρμα*", meaning skin, referring to the "cordiform" base of the central longitudinal crest of the nose-leaf (see Palmer, 1904: 160; Csada, 1996: 3). (Current Combination)

TAXONOMY:
See Simmons (2005).

Known species of the genus *Cardioderma*: ***cor*** (Peters, 1872), ***†leakeyi*** Gunnell, Butler, Greenwood and Simmons, 2015.

COMMON NAMES:
Czech: srdcoví lyronosi. English: Heart-nosed Bats, African False Vampire Bats. French: Cardiodermes. German: Herznasen-Fledermäuse. Italian: Cardiodèrma.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Cardioderma sp. has been found in the early Pleistocene deposits in Olduvai (Butler and Greenwood, 1965; Butler, 1978).

†*Cardioderma leakeyi* Gunnell, Butler, Greenwood and Simmons, 2015

*2015. *Cardioderma leakeyi* Gunnell, Butler, Greenwood and Simmons, Am. Mus. Novit., 3846: 1, 7, figs 4B-D, 5C. Publication date: 16 December 2015. Type locality: Tanzania: Arusha province: Olduvai Gorge: Bed I, FLK NI, Layer 2. [Goto Description]. - Etymology: Named in honor of Louis S.B. Leakey who was instrumental in initiating and leading the search for vertebrate fossils, especially fossil humans, in East Africa (Gunnell *et al.*, 2015a: 7).

SIMILAR SPECIES:
The teeth of *C. leakeyi* are on average 18 - 20 % larger than those of *C. cor* (Gunnell *et al.*, 2015a: 8).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe: Pleistocene.

Cardioderma cor (Peters, 1872)

*1872. *Megaderma cor* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 194. Type locality: Ethiopia: "Ethiopia". Holotype: ZMB 4181: ad ♂, skull and alcoholic. Collection date: undated. Vendor Gerrard; see Turni and Kock (2008: 28). - Etymology: From the neuter Latin substantive *cor* meaning "heart", used as an apposition, referring to the heart-shaped noseleaf (see Lanza *et al.*, 2015: 167).
? *Cardioderma cor:* (Current Combination)

TAXONOMY:
See Csada (1996, Mammalian Species, 519).

COMMON NAMES:
Chinese: 非洲假吸血蝠. Czech: lyronos srdcový, megaderma africká. Dutch: Hartneusvleermuis. English: Heart-nosed Bat, African Heart-nosed Bat, African False Vampire Bat, Heart-nosed Big-eared Bat. French: Cardioderme à nez en cœur, Pseudo-vampire à nez en cœur. German: Herznasen-Fledermaus. Italian: Cardiodèrma nàso a cuòre, Fàlso vampìro dàl nàso a cuòre.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008b; IUCN, 2004).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008b; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004a; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
Mickleburgh *et al.* (2008b) [in IUCN (2009)] report that there appear to be no major threats to this species, however, further studies are needed into the impact of disturbance on roosting sites.

CONSERVATION ACTIONS:
The species has been recorded from protected areas in Kenya (e.g. Tsavo West National Park (Vaughan, 1976; Aggundey and Schlitter, 1984) and is likely to be present in protected areas in some other East African countries. Additional studies are needed into the impact of disturbance on this species (Mickleburgh *et al.*, 2008b; IUCN).

GENERAL DISTRIBUTION:
Cardioderma cor is distributed from north-east Sudan (near the Red Sea) south to central Tanzania. The distribution extends from the border area of Uganda and Sudan in the west, to east Somalia (near the tip of the Horn of Africa) in the east.

Native: Djibouti (Pearch *et al.*, 2001: 397); Eritrea; Ethiopia (Glass, 1965: 179); Kenya; Somalia; Sudan; Tanzania; Uganda, Zanzibar.

DETAILED MORPHOLOGY:
Baculum - Unknown
Brain - Based on three brains from Kenya, Kruger *et al.* (2010a) describe the nuclear organization of the cholinergic, catecholaminergic and seroton-ergic systems, using immunohistochemical methods. Kruger *et al.*, 2010b) describe the distribution of Orexin-A immunoreactive cell bodies and terminal networks based on three brains from Kenya.

ECHOLOCATION:
See O'Shea and Vaughan (1980) and Taylor *et al.* (2005).

Davies *et al.* (2013b: Table S8) report a peak frequency of 56.7 kHz and a range between 39.6 and 90.9 Khz.
Kanuch *et al.* (2015: 55) found that the bats emitted relative broadband FM signals with a very sort duration (2 ms). The average peak frequency was 50.4 kHz (49.2 - 51.7 kHz), and the mean inter-signal interval was 186 ms (130 - 286 ms). The signals also had a second (around 65 kHz) and third (around 88 kHz) component, which are probably not true harmonics.

Smarsh and Smotherman (2016: 429) report up to four harmonics, of which the second and third are emphasized and the first suppressed. They also present the following data (p. 435): F_{peak}: 49.13 ± 1.39 kHz, F_{max}: 62.19 ± 2.29 kHz, F_{min}: 40.14 ± 0.73 kHz, bandwidth: 22.04 ± 2.72 kHz, duration: 1.34 ± 0.06 ms, and interpulse interval: 47.53 ± 22.19 ms. Furthermore, males had significantly lower F_{min} values than females.

HABITAT:
Typically this species has been recorded from lowland savanna, shrubland, and the coastal strip, and in some instances, it may be observed in river valleys (Varty and Hill, 1988; Csada, 1996). Highest altitudinal record is 940 m (Csada, 1996). Stanley *et al.* (2007c: 58) mention that *C. cor* is a common resident of baobab trees (*Adansonia digitata* L.).

HABITS:
McWilliam (1987a: 243) reported that *C. cor* males sing to mark their feeding territories. Contrary to echolocation calls, which are produced nasally, these songs are produced orally (Smarsh and Smotherman, 2017: 2), and are seasonally. Smarsh and Smotherman (2017: 11) also found that *C. cor* reacted to play-back sounds by producing faster, lower-frequency songs.

Smarsh and Smotherman (2016: 429) [referring to Bogdanowicz and Owen (1990)] mention that *Cardioderma cor* is a surface gleaner, which sits in perches and scans the environment, rotating its body and pinnae until it detects a prey to pick off the surface in the dense scrub habitat. Vaughan (1976) [in Fenton, 1986a], however, indicated that *C. cor* alternates between prey on the ground and flying prey, either from a perch about 1 m from the ground or from flight.

ROOST:
It roosts alone, or in small numbers, in caves, hollow trees (e.g. baobab) and abandoned buildings (Kingdon, 1974; Vaughan, 1976; Ryan and Tuttle, 1987; Csada, 1996; Pearch *et al.*, 2001; Smarsh and Smotherman, 2016: 429). When roosting in trees, open sites are preferred, since this species doesn't seem to be very agile in roosting situations (Kunz, 1996: 50). In the Mago National Park (Ethiopia), Kanuch *et al.* (2015: 55) found that dozens of male and female bats were roosting in two underground cesspits of the toilet, which they entered through waste holes.

POPULATION:
Structure and Density - Although there is little overall information on the abundance of this species, up to 81 bats have been found roosting in a hollow baobab tree (Vaughan, 1976).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008b; IUCN, 2009). 2004 - Unknown (Mickleburgh *et al.*, 2004a; IUCN, 2004).

ACTIVITY AND BEHAVIOUR:
Smotherman *et al.* (2016: 537) refer to Vaughan (1976) and McWilliam (1987a) in describing the song structure for this species as consisting of different syllable types in a basic motif.

REPRODUCTION AND ONTOGENY:
Tuttle and Stevenson (1982: 121) mention that both males and females need about 16 months to attain sexual maturity.

Matthews (1941) and Krutzsch (2000: 95) indicate that the central duct of the ampullary gland seems to act as a temporary storage site for spermatozoa. They also mention that *C. cor* is the only polyoestrous species in the Megadermatidae, all others are seasonally monoestrous.

Vaughan (1976) and Kunz and Hood (2000: 418) suggest that paternal recognition of young would occur in monogamous species, such as *C. cor*, where males participate in the care of young. The males also defend the foraging territories in which

young bats learn to feed (Kunz and Hood, 2000: 440).

MATING:
Vaughan (1976), McWilliam (1987a), and McCracken and Wilkinson (2000: 351) report this species to be monogamous.

PARASITES:
PROTOZOA
Kassahun *et al.* (2015: 168) tested one *C. cor* specimen from Awash-Methara (Ethiopia) and found it to be infected by *Leishmania tropica* Wright, 1903.

ACARI
Trombiculidae: *Grandjeana kanuchi* Kalúz and Ševcík, 2015 collected and described from *C. cor* in Ethiopia (Kalúz and Ševcík, 2015: 381; Stekolnikov, 2018a: 136).

DIPTERA
Streblidae: *Raymondia huberi huberi* Frauenfeld, 1855 (Shapiro *et al.*, 2016: 254). *Raymondia planiceps* Jobling, 1930 (Haeselbarth *et al.*, 1966: 102; Kanuch *et al.*, 2015: 55; Shapiro *et al.*, 2016: 255); *Raymondia seminuda* Jobling, 1954 in Ethiopia (Jobling (1954) in (Haeselbarth *et al.*, 1966: 104).

Nycteribiidae: *Basilia daganiae* Theodor and Moscona, 1954 from Mombasa, Kenya (Haeselbarth *et al.*, 1966: 110).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Cardioderma cor*: Adenoviruses and Astroviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Tong *et al.* (2009) found coronavirus RNA in fecal samples collected of one bat collected in Kenya in 2006.

Tao *et al.* (2017: 3) indicate that one (25 %) of the Kenyan *C. cor* they examined tested positive for CoV.

Paramyxoviridae
Conrardy *et al.* (2014: 259) tested 14 individuals from Kenya with the use of an RT-PCR assay. Of the 10 individuals tested from Panga Yambo cave, one individual tested positive for paramyxovirus RNA that grouped phylogenetically to an *Otomops martiensseni*-related paramyxovirus.

Polyomaviridae
Cardioderma PyV KY336 - Tao *et al.*, 2012 detected polyomavirus DNA in fecal/oral swabs from Kenya in 2006.

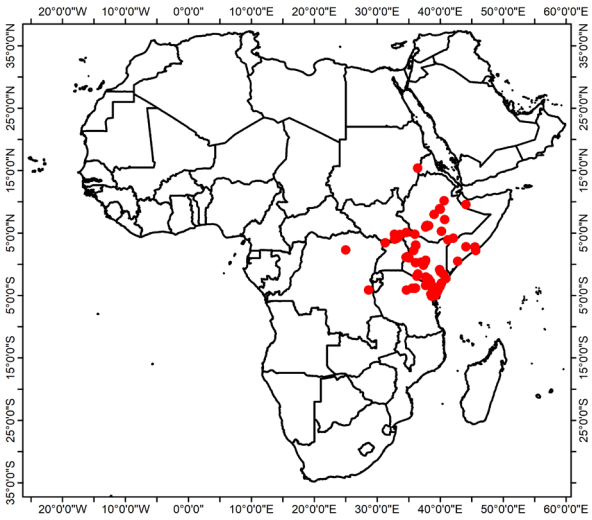


Figure 71. Distribution of *Cardioderma cor*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Egypt, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, Tanzania, Uganda.

Genus ***Lavia*** Gray, 1838

*1838. *Lavia* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 490. Publication date: 1 February 1838. - Comments: Type species: *Megaderma frons* E. Geoffroy Saint-Hilaire, 1810. - Etymology: From "*lavo*" meaning fine, elegant, splendid (see Vonhof and Kalcounis, 1999: 4). Lanza *et al.* (2015: 172), however, indicate that *lavo* is a Latin verb meaning "wash, wash away, wash off, wet, moisten, bathe, soak", while its passive Latin perfect participle *lauta* (corresponding to a feminine verbal adjectiv) actually means - besides "washed", "clean", and "sumptuous" - "splendid" and "magnificent", referring to the beauty of the animal. (Current Combination)

1846. *Livia:* Agassiz, Nomenclator. Zool., Mamm., addenda 6. (Lapsus)

TAXONOMY:
See Simmons (2005).

Known species of the genus *Lavia*: ***frons*** (E. Geoffroy, 1810.

COMMON NAMES:
Czech: žlutokřídlí lyronosi. English: Yellow-winged Bats. French: Mégadermes à ailes orangées. German: Gelbflügel-Fledermäuse. Italian: Fàlsi vampìri dàlle àli giàlle.

Lavia frons (E. Geoffroy St.-Hilaire, 1810)

1800. *Vespertilio megalotis* Bechstein. Type locality: South Africa: Great Namaqualand: Orange River, 50 mi [=75 km] N. - Comments: Nomen oblitum. See Grubb (2004: 91 - 92) for a discussion.
*1810. *Megaderma frons* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 15: 192. Type locality: Senegal: "Senegal". Holotype: MNHN 928:. Number 175 in Rode (1941: 236). Skull number A6844. Paratype: MNHN 929: skin only. Skull removed and lost. Number 175a in Rode (1941: 236). Paratype: MNHN 929.C: skin only. Number 175b in Rode (1941: 2436). Paratype: MNHN 929.D: skin only. Number 175c in Rode (1941: 236). - Etymology: From the Latin "*frons*" meaning forehead (see Vonhof and Kalcounis, 1999: 4).
1905. *Lavia rex* Miller, Proc. Biol. Soc. Wash., 18: 227. Publication date: 9 December 1905. Type locality: Kenya: Taveta [03 23 S 37 40 E] [Goto Description]. Holotype: USNM 18993/38197: ad ♂, skin and skull. Collected by: Dr. William Louis Abbott; collection date: 1889. Skin catalogued 24 June 1890; skull catalogued 18 February 1904: see Miller (1905: 227), Lyon and Osgood (1909: 260), Poole and Schantz (1942: 118).
1907. *Lavia frons affinis* K. Andersen and Wroughton, Ann. Mag. nat. Hist., ser. 7, 19 (110): 138, 140. Publication date: 1 February 1907. Type locality: Sudan: White Nile: Kaka [10 41 N 32 13 E] [Goto Description]. Holotype: BMNH 1901.8.8.3: ad ♂, skin only. Collected by: R. McDonald Hawker Esq. - Comments: Not mentioned by Vonhof and Kalcounis (1999: 1).
? *Lavia frons frons:* (Name Combination)
? *Lavia frons rex:* (Name Combination)
? *Lavia frons:* (Name Combination, Current Combination)

TAXONOMY:
See Vonhof and Kalcounis (1999, Mammalian Species, 614). Grubb (2004: 91) calls *Megaderma frons* a "nomen protectum".

COMMON NAMES:
Azande (DRC): Ndima. Chinese: 黃翼蝠. Czech: lyronos žlutokřídlý, weloblánec lupenatý, megaderma žlutokřídlá. English: Yellow-winged Bat, African Yellow-winged Bat. Finnish: Keltapoimulepakko. French: Feuille de Daubenton, Megaderme à ailes orangées, Lavie à ailes jaunes, Le Megaderme feuille, Megaderme à ailes orangées. German: Gelbflügelige Großblattnase, Gelbflügel-Fledermaus. Italian: Fàlso vampìre dàlle ali giàlle. Kiluba (DRC): Kasusu. Kinande (DRC): Kakoro kombe.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008n; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008n; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004y; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
While Vonhof and Kalcounis (1999) state that the effects of human activity on population dynamics of this bat are unknown, there do not appear to be any major threats to the species (Mickleburgh *et al.*, 2008n; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008n) [in IUCN (2009)] report that it is present in a number of protected areas (e.g. Garamba National Park, Democratic Republic of the Congo). Other than studies into the possible effects of human activity on population dynamics of this bat, and additional research into the range of this species, no conservation measures are currently needed for this widespread species.

GENERAL DISTRIBUTION:
Lavia frons is broadly distributed south of the Sahara from Gambia and Senegal, through much of West and Central Africa, to southern and central Sudan, Eritrea, Ethiopia and Somalia in the east; ranging southwards as far as northern Zambia and northern Malawi. It is typically a lowland species found below 2,000 m asl.

Native: Benin (Capo-Chichi *et al.*, 2004: 162); Burkina Faso (Kangoyé *et al.*, 2015a: 610); Burundi; Cameroon; Central African Republic; Chad; Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 539); Côte d'Ivoire; Eritrea; Ethiopia (Yalden *et al.*, 1996; Lavrenchenko *et al.*, 2004b: 132); Gabon; Gambia (Grubb *et al.*, 1998); Ghana; Guinea; Guinea-Bissau (Seabra, 1900a; Monard, 1939; Rainho and Ranco, 2001: 46); Kenya (Aggundey and Schlitter, 1984); Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988; Vonhof and Kalcounis, 1999; Monadjem *et al.*, 2010d: 539); Mali; Niger; Nigeria; Rwanda (Baeten *et al.*, 1984; Senegal; Sierra Leone; Somalia (Funaioli and Simonetta, 1966); Sudan; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 61); Zambia (Ansell, 1967; Ansell, 1978; Monadjem *et al.*, 2010d: 539).
Presence uncertain: Namibia, Zanzibar.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data: Fa: 59.5 mm, mass: 23 g, wing loading: 7.8 N/m^2, aspect ratio: 5.2.

DENTAL FORMULA:
Dorst (1953a: 83 - 84) indicates that he was unable to find any trace of a milk dentition in a foetus of about 35 mm in size (Fa: 25 mm), but also that the permanent teeth were already perfectly formed, but were not yet grown above the gum.

SEXUAL DIMORPHISM:
Krutzsch (2000: 115) mentions the presence of dorsal skin glands in males.

Kangoyé *et al.* (2015a: 610) found no differences in body and cranial measurements between the two sexes.

ECHOLOCATION:
See Taylor *et al.* (2005).

Davies *et al.* (2013b: Table S8) report a peak frequency of 18.5 kHz and a range between 16.9 and 82.9 kHz.

Smarsh and Smotherman (2016: 429) report up to four harmonics of which the second and third are emphasized and the first suppressed, with males having a significantly lower F_{min}. They also provide the following data: F_{peak}: 42.21 ± 2.35 kHz, F_{max}: 48.50 ± 2.08 kHz, F_{min}: 35.08 ± 1.25 kHz, bandwidth: 13.42 ± 3.04 kHz, duration: 3.25 ± 2.98 ms, and interpulse interval: 53.99 ± 32.24 ms.

HABITAT:
R.B. Woosnam [in Thomas, 1910b: 488] mentions it to be plentiful among the acacia trees on the plains around the south end of Ruwenzori at 3,400 ft (1,000 m), where it was found hanging fully exposed to the sun.

HABITS:
Vaughan and Vaughan (1987) [in McCracken and Wilkinson (2000: 353)] found that the single young remains closely associated with both parents at roost sites and on the foraging area for up to 50 days after it becomes volant.

Smarsh and Smotherman (2016: 430) consider *L. frons* to be an aerial-hawker, capturing insects in vegetation gaps.

ROOST:
L. frons roosts in trees, but prefers relatively open sites as it seems to be less agile in roosting situations (Kunz, 1996: 50). McCracken and Wilkinson (2000: 351) indicate that male/female pairs roost in the same territory, and that pair-specific roost sites and foraging areas remain stable for at least several months.
Smarsh and Smotherman (2016: 429) indicate that *L. frons* roost in male-female pairs in Acacia trees within a foraging territory.

PREDATORS:
Schätti (1984: 339) refers to Loveridge (in Allen, 1940), who found a specimen in the stomach of a Black Mamba (*Dendroaspis polylepis*).
Mikula *et al.* (2016: Supplemental data) mention the Grey kestrel (*Falco ardosiaceus* Vieillot, 1823), Common kestrel (*Falco tinnunculus* Linnaeus, 1758) and Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as avian diurnal predators.

POPULATION:
Structure and Density - Although there is little information on the abundance of this species, it is probably uncommon (Vonhof and Kalcounis, 1999).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008n; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Smotherman *et al.* (2016: 537) refer to Wickler and Uhrig (1969) and Vaughan and Vaughan (1986) in describing the song structure for this species as consisting of simple syllable types in a basic motif.

REPRODUCTION AND ONTOGENY:
Vaughan and Vaughan (1987: 217) report that females give birth to one young, which hangs on to its mother for about a week, and then starts flying. The young is weaned about 20 days after its first flight, but remains at least 50 days in close contact with its parents, during which time it learns to become a skilled opportunistic forager.

MATING:
Duron *et al.* (2014: 351) reports that *L. frons* is a monogamous species.

PARASITES:
SIPHONAPTERA
Pulicidae: *Echidnophaga aethiops* Jordan and Rothschild, 1906 locality not mentioned (Haeselbarth *et al.*, 1966: 135).
Ischnopsyllidae: *Chiropteropsylla brockmani* Rothschild, 1915 widespread (Haeselbarth *et al.*, 1966: 192).

ANTHROPOPHILOUS:
Jeffreys (1944: 73) [referring to Schweinfurt (1878)] mentions the following "Among the Bongo of the Anglo-Egyptian Sudan much the same superstition lurks - 'Spirits, devils and witches have their general appellation of 'Bitaboh', wood-goblins being specially called 'Ronga'. Comprehended under the same term are all the bats (especially the *Megaderma frons*, which flutters about from tree to tree in broad daylight).'"

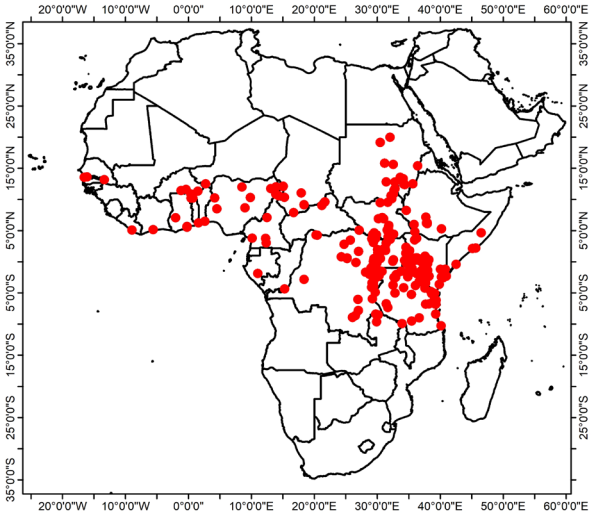


Figure 72. Distribution of *Lavia frons*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Côte d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia.

Genus ***Megaderma*** E. Geoffroy St.-Hilaire, 1810

*1810. *Megaderma* E. Geoffroy St.-Hillaire, Ann. Mus. Hist. nat. Paris, 15: 197. - Comments: Type species: *Vespertilio spasma* Linnaeus, 1758. - Etymology: From the Greek "*μέγας*", meaning great or large and "*δέρμα*", meaning skin, referring to the large wings and interfemoral membrane (see Palmer, 1904: 403). (Current Combination)
1847. *Eucheira* Hodgson. - Comments: not *Eucheira* Westwood, 1838, an insect.
1866. *Spasma* Gray.
1872. *Lyroderma* Peters.
1961. *Afropterus* Lavocat, Notes Mém. Serv. Mines Carte geol. Maroc, 155: ?. - Comments: Mid Miocene-Pliocene in Morocco.

TAXONOMY:
Includes *Lyroderma*, but see Hand (1985).
Two subgenera (*Megaderma* and *Lyroderma*) are recognized by Corbet and Hill (1992) and Simmons (2005: 380).

Known species of the genus *Megaderma*: †***gigas*** Lavocat, 1961; †***jaegeri*** Sigé, 1976; *lyra* E. Geoffroy, 1810 – Afganistan to southern China, Burma, Thailand, Cambodia, Laos, Vietnam; south to Sri Lanka and western Malaysia; Bangladesh (Simmons, 2005: 380); *spasma* (Linnaeus, 1758) – Sri Lanka and India through south east Asia (including Vietnam) to Lesser Sundas, the Philippines and Molucca Isls, various adjacent islands (Simmons, 2005: 380).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
gigas (Lavocat, 1961) fossil bat from the Pliocene.

†***Megaderma gaillardi*** (Trouessart, 1898)

*1898. *Miomegaderma gaillardi* Trouessart, Catalogus Mammalium tam viventium quam fossilium. Berlin., 84. Type locality: France: La Grive St. Alban.
1961. *Afropterus gigas* Lavocat, Notes Mém. Serv. Mines Carte geol. Maroc, xxx.. Type locality: Morocco: Beni Mellal.
2013. *Megaderma gaillardia:* Stoetzel, Palaeog., Palaeoclim., Palaeoecol., 392: 363. (Lapsus)

? *Megaderma gaillardi:*

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Middle Miocene (Astaracanian).

GENERAL DISTRIBUTION:
Europe and Morocco Hugueney *et al.* (2015: 472).

†***Megaderma gigas*** (Lavocat, 1961)

*1961. *Afropterus gigas* Lavocat, Notes Mém. Serv. Mines Carte geol. Maroc, 155: ?. Type locality: Morocco: Beni Mellal. - Comments: Mio-Pliocene.
? *Megaderma gigas:* (Name Combination, Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe: Pliocene.

†***Megaderma jaegeri*** Sigé, 1976

*1976. *Megaderma jaegeri* Sigé, Géol. Médit., 3 (2): xxx. Type locality: Morocco: Béni Mellal. (Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Middle Miocene.

GENERAL DISTRIBUTION:
Morocco (Hugueney *et al.* (2015: 472).

†Genus ***Saharaderma*** Gunnell, Simons and Seiffert, 2008

*2008. *Saharaderma* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 3, 7. - Comments: Type species - *Saharaderma pseudovampyrus*. - Etymology: For the 'Sahara Desert' in combination with *derma*, Greek for skin, and the common ending for several genera of megadermatids (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Known species of the genus *Saharaderma*:
†***pseudovampyrus*** Gunnel, Simons and Seiffert, 2008.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

†***Saharaderma pseudovampyrus*** Gunnell, Simons and Seiffert, 2008

*2008. *Saharaderma pseudovampyrus* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 3, 7, fig. 7. Type locality: Egypt: Fayum Depression: Quarry L-41: Lower Sequence, Jebel Qatrani Formation. Holotype: CGM 83672:. Right dentary p4-m3: see Gunnell *et al.* (2008: 7). - Comments: latest Eocene, Priabonian. - Etymology: 'Pseudo- and Vampyrus' in reference to the common name of megadermatids (False Vampire Bats), from Slavic, 'wampir', blood-sucking ghost (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Timeframe:
Latest Eocene (Priabonian), Lower Sequence, Jebel Qatrani formation.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

Family RHINOLOPHIDAE Gray, 1825

*1825. *Rhinolophidae* Gray, Zool. Journ., 2 (6): 242. - Comments: Type genus: *Rhinolophus* Lacépède, 1799. Corbet and Hill (1992: 90) mention "Bell, 1836: 599" as author. Jackson and Groves (2015: 242) mention "T. Bell, 1836: 599" as author of this spelling, but attributed the family name to Gray, 1825. (Current Combination)

1825. *Rhinolophina* Gray, Ann. Philos., 10 (5): 338. - Comments: Proposed as tribe and originally containing the genera *Megaderma* É. Geoffroy, 1810; *Rhinolophus* Lacépède, 1799; *Nycteris* É. Geoffroy & G. Cuvier, 1795; *Mormoops* Leach, 1821 and *Nyctophilus* Leach, 1821. Jackson and Groves (2015: 241, 242) placed this name in the synonymy of both Rhinolophoidea and Rhinolophidae.

1827. *Rhinolophina* Lesson, Mannuel de mammalogie, p. 81. - Comments: In Part (see Taylor, 1934).

1854. *Rhinolophides* Gervais, Histoire naturelle des mammifères, p. 200. - Comments: In Part (see Taylor, 1934).

1855. *Histiorhina* Van der Hoeven, Handboek Dierkunde, 2nd ed., 2: 1033. - Comments: Proposed as tribe (?), which was not based on a genus name (see Jackson and Groves, 2015: 242).

1865. *Rhinolophi* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, p. 256. - Comments: In Part (see Taylor, 1934). Originally included the genera *Rhinolophus* Lacépède, 1799; *Phyllorrhina* Bonaparte, 1837 [1832–1841] [= *Hipposideros* J. Gray, 1831b]; and *Coelops* Blyth, 1848 (see Jackson and Groves, 2015: 242).

1883. *Phyllorhinidae* de Rochebrune, Act. Soc. Linn. Bordeaux, 37 (4) 7: 94. - Comments: Originally included the genus *Phyllorhina* Leach, 1816 [= *Rhinolophus* Lacépède, 1799]. Howev,er the name is unavailable (see Jackson and Groves, 2015: 242).

1893. *Rhinolophini* Winge, Samling af Afhandlinger. E Museo Lundii, 2 (1): 24. - Comments: Proposed as tribe (?) and originally included the genera *Phyllorhina* [sic] Bonaparte, 1837 [1832–1841] [= *Hipposideros* J. Gray, 1831]; *Anthops* Thomas, 1888: *Rhinonicteris* J. Gray, 1847; *Triaenops* Dobson, 1871; *Coelops* Blyth, 1848; and *Rhinolophus* Lacépède, 1799 (ee Jackson and Groves, 2015: 242).

TAXONOMY:
Koopman and Jones, 1970; Swanepoel *et al.* (1980: 157), Harrison and Bates (1991: 51), Corbet and Hill (1992: 104 - with comment), Pavlinov *et al.* (1995), Peterson *et al.* (1995: 66), Hutson *et al.* (2001: 16) and Simmons (2005: 350) included the Hipposideridae. Hill (1982b) listed Hipposideridae as a distinct family, without comment and Hill and Smith (1984) retained this separation and discussed the question.

Foley *et al.* (2014: 319) state that the Rhinolophidae form a fully supported monophyletic group, but that the intrafamilial relationships are less well resolved than for the Hipposideridae.

Currently known genera of the family Rhinolophidae: ***Rhinolophus*** Lacépède, 1799.

COMMON NAMES:
Czech: vrápencovití, vlastní vrápenci. Dutch: Hoefijzerneusvleermuizen, Hoefijzerneuzen. English: Horseshoe bats. Finnish: Hevosenkenkäyököt, Kaviokuonoyököt. French: Rhinolophidés, Fers-à-cheval, Rhinolophes. German: Hufeisennasen, Hufeisennasen-Fledermäuse. Italian: Rinolòfidi. Norwegian: Hesteskoneser, Ekte hesteskonese. Polish: podkowcowate. Romanian: Lilieci cu pliuri nazale. Russian: Подковоносые. Vietnamese: Họ dơi lá.

ETYMOLOGY OF COMMON NAME:
They are called horseshoe bats because the anterior nose-leaf is shaped like a horseshoe.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The Rhinolophidae, date from the late Eocene or early Oligocene of Europe and have been recorded in Africa only from the Mio-Pliocene of

Morocco (Lavocat, 1961) and the late Pliocene of Makapansgat (De Graaf, 1960).
The family-level stem and crown ages were calculated as 49.9 and 49.8 Mya by Shi and Rabosky (2015: 1537).

BIOGEOGRAPHY:
During the Miocene at about 17 Ma, the *Rhinolophus* diversified into distinct clades (Foley *et al.*, 2014: 320).

FUNCTIONAL MORPHOLOGY:
Using micro computed tomography (micro-CT) scans, Curtis A. A. and Simmons N. B. (2016: 310) examined the turbinal morphology in the Rhinolophidae and found strangely formed maxilloturbinal bones within the respiratory airway. These looked distinct in form from the scrolled, branched, or plate shaped turbinals reported in other mammals, including other nasophonating bats.

VIRUSES:
Coronaviridae
SARS-related coronaviruses have only been detected in the *Rhinolophus* genus.

Genus ***Rhinolophus*** Lacépède, 1799

*1799. *Rhinolophus* Lacépède, Tabl. Div. Subd. Orders Genres Mammifères, 15. - Comments: Type species (by monotypy): *Vespertilio ferrum-equinum* Schreber, 1774. Conserved by Opinion 91 (1926) and Direction 24 (1955) (see Corbet and Hill, 1992: 91). - Etymology: From the Greek "*ρις*" or "*ρινός*", meaning nose and "*λόφος*", meaning crest, referring to the complex nose-leaf, consisting of three parts (Palmer, 1904: 606; Taylor, 2005). Lanza *et al.* (2015: 76) translate "*λόφος*" as "comb", which leads to "with a comb on the nose or, more properly, on the snout". (Current Combination)

1816. *Phyllorhina* Leach, Systematic Catalogue of the species of indigenious Mammals in the British Museum, 5. - Comments: Type species: *Vespertilio minutus* Montagu, 1808. By subsequent designation (see Jackson and Groves, 2015: 243). Not *Phyllorrhina* Bonaparte, 1831 (Mammalia, Chiroptera, Rhinolophidae), a Nomen nudum according to Palmer (1904: 535), nor *Phyllorrhina* Bonaparte, 1837 [1832–1841] (Mammalia, Chiroptera, Hipposideridae) (see Jackson and Groves, 2015: 243).

1836. *Rhinocrepis* Gervais, Dictionnaire Pittoresque d'Histoire naturelle, 4 (2): pt. 318, p. 617. - Comments: Type species: *Vespertilio ferrum-equinum* Schreber, 1774. By "implication" according to Allen (1939a: 72) or by subsequent designation (Palmer, 1904: 606).

1847. *Aquias* Gray, Proc. zool. Soc. Lond., 1847, XV (clxix): 15. Publication date: 13 April 1847. - Comments: Type species: *Rhinolophus luctus* Temminck, 1838 / *Rhinolophus trifoliatus* Temminck, 1834. Restricted to *R. luctus* by Ellerman *et al.* (1953): see Meester *et al.* (1986: 36).

1866. *Phyllotis* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 81. Publication date: May 1866. - Comments: Type species (by monotypy): *Rhinolophus philippinensis* Waterhouse, 1843. Preoccupied by *Phyllotis* Waterhouse 1837 (Mammalia, Rodentia, Cricetidae) (see Jackson and Groves, 2015: 243).

1867. *Cœloephyllus* Peters, Proc. zool. Soc. Lond., 1866, III: 427. Publication date: April 1867. - Comments: Type species: *Rhinolophus cœlophyllus* Peters, 1867.

1867. *Coelophyllus* Peters, Proc. zool. Soc. Lond., 1866, III: 427. Publication date: April 1867. - Comments: Type species (by monotypy): *Rhinolophus coelophyllus* Peters, 1867 (see Jackson and Groves, 2015: 243).

1901. *Euryalus* Matschie, Sber. Ges. naturf. Freunde Berlin, 225. - Comments: Type species (by monotypy): *Rhinolophus mehelyi* Matschie, 1901. Described as a subgenus of *Rhinolophus* (see Meester *et al.*, 1986: 36; Jackson and Groves, 2015: 243). - Etymology: From the specific name *euryale* ("*Ευρυάλη*"), being one of the Gorgons (see Palmer, 1904: 279).

1941. *Rhinophyllotis* Troughton, Furred Animals of Australia, 1st edn: 342. - Comments: Type species (by monotypy): *Rhinolophus megaphyllus* Gray, 1834. Redescription for *Rhinophyllotus* Iredale and Troughton, 1934, "nomen nudum" (see Meester *et al.*, 1986: 36).

1951. *Rhinomegalophus* Bourret, Bull. Mus. natn. Hist. nat., Paris, sér. 2, 23 (6): 607. - Comments: Type species (by monotypy): *Rhinomegalophus paradoxolophus* Bourret, 1951 (see Jackson and Groves, 2015: 243).

1973. *Rhinomegaphyllus:* Thonglongya, Mammalia, 37: 587. - Comments: Lapsus for *Rhinomegalophus* Bourret, 1951 (see Eger and Fenton, 2003: 1). (Lapsus)

1993. *Rhinilophus:* Amr and Qumsiyeh, Ent. News, 104 (1): 44. (Lapsus)
2003. *Indorhinolophus* Guillén-Servent, Francis and Ricklefs, in: Csorba, Ujhelyi and Thomas, Horseshoe Bats of the World.
2015. *Rhrynolophus:* Thies and Lewis, Occ. Pap. Mus. Texas Tech Univ., 330: 7. Publication date: 10 February 2015. (Lapsus)
2015. *Rhynolophus:* Thies and Lewis, Occ. Pap. Mus. Texas Tech Univ., 330: 7. Publication date: 10 February 2015. (Lapsus)
2018. *Rhinolphus:* Leopardi, Holmes, Gastaldelli, Tassoni, Priori, Scaravelli, Zamperin and De Benedictis, Infec. Gen. Evol., 58: 283. Publication date: 30 January. (Lapsus)
? *Rhinolophus sp.:*

TAXONOMY:
The radiation (about 15 million years ago) of Rhinolophidae into five main clades apparently occurred rapidly and the distinct clades could be regarded as different genera (Servent *et al.*, 2003: xvi). Following tradition Servent *et al.* (2003: xvi) split the six subgenera (*Aquias*, *Phyllorhina*, *Rhinolophus*, *Indorhinolophus*, *Coelophyllus*, *Rhinophyllotis*) into groups corresponding to smaller lineages in the phylogeny. All African and Palaearctic species are contained within a single clade (Servent *et al.*, 2003: xvii). This confirms the views proposed by Bogdanowicz (1992) and Bogdanowicz and Owen (1992), who suspected that the relationship was monophyletic. Qumsiyeh *et al.* (1988) studied protein electrophoresis of a limited number of African taxa, which grouped together in their phylogeny. All African and Palaeartic Rhinolophid species karyotyped show a diploid number of 58, which differs from all other *Rhinolophus* with the exception of some populations of *R. hipposideros* (Zima *et al.*, 1992b). Servent *et al.* (2003: xvii) note that the geographical distribution of taxa and the phylogeny are strongly congruent.

Species groups recognized by Servent *et al.* (2003: xvi), for African taxa:
Rhinolophus: ***R. landeri*** - *landeri*, *alcyone*, ?*guineensis*. ***R. euryale*** - *blasii*, *euryale*, *mehelyi*. ***R. capensis*** - ?*capensis*, ?*swinnyi*, ?*denti*, *simulator*. ***R. adami*** - ?*adami*, ?*maendeleo*. ***R. ferrumequinum*** - *ferrumequinum*, *clivosus*, ?*silvestris*, ?*deckenii*. ***R. maclaudi*** - ?*maclaudi*, *ruwenzorii*. ***R. fumigatus*** - *fumigatus*, *eloquens*, *hildebrandti*, *darlingi*.

Stoffberg *et al.* (2010a: 6 - 7) refer to Guillén-Servent *et al.* (2003), who, based on the complete cytochrome *b* gene, propose that *Rhinolophus* should be divided into six subgenera: *Aquias* (*trifoliatus* group), *Coelophyllus* (*affinis*, *coelophyllus*, *euryotis*, and *pearsonii* groups), *Indorhinolophus* (*rouxi* group), *Phyllorhina* (*hipposideros* group), *Rhinolophus* (*adami*, *capensis*, *euryale*, *ferrumequinum*, *fumigatus*, *landeri*, and *maclaudi* groups), and *Rhinophyllotis* (*acuminatus*, *borneensis*, *macrotis*, *malayanus*, *megaphyllus*, and *pusillus* groups), and confirm most of these.

See Csorba *et al.* (2003: 1 - 3) for key to species. See Taylor *et al.* (2019: 316) for a discussion on the recent increase in Afro-Madagascan species.

Known species of the genus *Rhinolophus*: ***†maghrebensis*** Gunnell, Eiting, and Geraads, 2011; *acuminatus* Peters, 1871 – Thailand, Laos, Cambodia, Peninsular Malaysia and Sabah, Borneo, Sumatra (including Nias and Engano Isls), Java, Karkatau, Lombok, and Bali (Indonesia), Palawan, Balabac, Busuanga (Philippines) (Csorba *et al.*, 2003: 98; Simmons, 2005: 350); ***adami*** Aellen and Brosset, 1968; *affinis* Horsfield, 1823 – India and Nepal to south China and Vietnam, through Malaysia to Borneo and Lesser Sunda Isls, Andaman Isls (India) (Csorba *et al.*, 2003: 68; Simmons, 2005: 351); ***alcyone*** Temminck, 1853; *arcuatus* Peters, 1871 – Sumatra to Philippines, New Guinea and South Molucca Isls (Csorba *et al.*, 2003: 20; Simmons, 2005: 351); *beddomei* K. Andersen, 1905 – southern India, Sri Lanka (Csorba *et al.*, 2003: 123; Simmons, 2005: 351); ***blasii*** Peters, 1867; *bocharicus* Kastchenko and Akimov, 1917 – Kyrgyzstan, western Tajikistan, northeastern Iran, Uzbekistan, Turkmenistan, Afghanistan (Csorba *et al.*, 2003: 35; Simmons, 2005: 352); *borneensis* Peters, 1861 – Borneo, Labuan and Banguey Isls (Malaysia), Java, Karimata Isls and South Natuna Isls (Indonesia), Cambodia, Laos and Vietnam (Csorba *et al.*, 2003: 70; Simmons, 2005: 352); *canuti* Thomas and Wroughton, 1909 – Java, Bali, Timor (Indonesia) (Csorba *et al.*, 2003: 22; Simmons, 2005: 352); ***capensis*** Lichtenstein, 1823; *celebensis* K. Andersen, 1905 – Java, Bali, Timor, Sulawesi, Sangihe, Kangean and Talaud Isls (Indonesia) (Csorba *et al.*, 2003: 72; Simmons, 2005: 352); ***clivosus*** Cretzschmar, 1828; *coelophyllus* Peters, 1867 – western Malaysia, Thailand, Burma, Laos (Csorba *et al.*, 2003: 24; Simmons, 2005: 353); *cognatus* K. Andersen, 1906 – Andaman Isls (India) (Csorba *et al.*, 2003: 99; Simmons, 2005: 353); ***cohenae*** Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012; *convexus* Csorba, 1997 –

Peninsular Malaysia, Laos (Csorba *et al.*, 2003: 100; Simmons, 2005: 353); *cornutus* Temminck, 1834 – Japan (Csorba *et al.*, 2003: 102; Simmons, 2005: 353); *creaghi* Thomas, 1896 – Borneo, Madura Isl, Kalimantan (Indonesia), Sabah, Sarawak (Malaysia) (Csorba *et al.*, 2003: 25; Simmons, 2005: 354); ***darlingi*** K. Andersen, 1905; ***deckenii*** Peters, 1868; ***denti*** Thomas, 1904; ***eloquens*** K. Andersen, 1905; ***euryale*** Blasius, 1853; *euryotis* Temminck, 1835 – Aru Isls, Buru, Bacan, Amboina, Seram and Tanimbar Isls, Kai Isls, Halmahera and Sulawesi (Indonesia), New Guinea, Bismarch Arch, adjacent small islands (Csorba *et al.*, 2003: 27; Simmons, 2005: 355); ***ferrumequinum*** (Schreber, 1774); *formosae* Sanborn, 1939 – Taiwan (Csorba *et al.*, 2003: 124; Simmons, 2005: 355); ***fumigatus*** Rüppell, 1842; ***gorongosae*** Taylor, MacDonald, Goodman, Kearney, Cotterill, Stoffberg, Monadjem, Schoeman, Guyton, Naskrecki and Richards, 2018; ***guineensis*** Eisentraut, 1960; ***hildebrandtii*** Peters, 1878; ***hilli*** Aellen, 1973; ***hillorum*** Koopman, 1989; ***hipposideros*** (Brechstein, 1800); ***horaceki*** Benda and Vallo, 2012; *imaizumii* Hill and Yoshiyuki, 1980 – Iriomote Isl and Yaeyama Isl (Japan: Ryukyu Isls) (Csorba *et al.*, 2003: 104; Simmons, 2005: 357); *inops* K. Andersen, 1905 – Philippines except Palawan region (Csorba *et al.*, 2003: 29; Simmons, 2005: 357); *keyensis* Peters, 1871 – Many islands in Indonesia (Simmons, 2005: 357); ***landeri*** Martin, 1838; *lepidus* Blyth, 1844 – Afghanistan, Pakistan, northern India, Nepal, Burma, Thailand, Szechwan and Yunnan (China), Peninsular Malaysia, Sumatra (Indonesia) (Csorba *et al.*, 2003: 106; Simmons, 2005: 358); ***lobatus*** Peters, 1852; *luctus* Temmink, 1834 – India, Nepal, Burma, Sri Lanka, south China, Vietnam, Cambodia, Laos, Thailand, Peninsular Malaysia, Borneo, Sumatra, Java and Bali (Indonesia) (Csorba *et al.*, 2003: 126; Simmons, 2005: 358); ***mabuensis*** Taylor, Stoffberg, Monadjem, Scoeman, Bayliss and Cotterill, 2012; ***maclaudi*** Pousargues, 1897; *macrotis* Blyth, 1844 – Pakistan, northern India, Nepal to south China, Burma, Thailand, Laos, Vietnam and Peninsular Malaysia, Sumatra (Indonesia), Philippines (Csorba *et al.*, 2003: 87; Simmons, 2005: 358); *madurensis* K. Andersen, 1918 – Madura and Kangean Isls (Indonesia) (Simmons, 2005: 358); ***maendeleo*** Kock, Csorba and Howell, 2000; *malayanus* Bonhote, 1903 – Thailand, Burma, Cambodia, Laos, Vietnam, Peninsular Malaysia (Csorba *et al.*, 2003: 74; Simmons, 2005: 359); *marshalli* Thonglongya, 1973 – Thailand, Burma, Vietnam, Laos, Peninsular Malaysia (Csorba *et al.*, 2003: 89; Simmons, 2005: 359); *megaphyllus* Gray, 1834 – eastern New Guinea; Misima Isl (Louisiade Arch.), Goodenough Isl (D'Entrecasteaux Isls) and Bismarck Arch. (Papua New Guinea), Moluccas, Lesser Sundas, eastern Queensland, eastern New South Wales and eastern Victoria (Australia) (Csorba *et al.*, 2003: 76; Simmons, 2005: 359); ***mehelyi*** Matschie, 1901; *mitratus* Blyth, 1844 – India (Csorba *et al.*, 2003: 131; Simmons, 2005: 360); *monoceros* K.Andersen, 1905 – Taiwan (Csorba *et al.*, 2003: 108; Simmons, 2005: 360); *montanus* Goodwin, 1979 – Timor (Indonesia) (Csorba *et al.*, 2003: 91; Simmons, 2005: 360); ***mossambicus*** Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012; *nereis* K. Andersen, 1905 – Anamba and North Natuna Isls (Indonesia) (Csorba *et al.*, 2003: 78; Simmons, 2005: 360); *osgoodi* Sanborn, 1939 – Yunnan (China) (Csorba *et al.*, 2003: 109; Simmons, 2005: 360); *paradoxolophus* (Bourret, 1951) – Vietnam, Thailand, Laos and China (Csorba *et al.*, 2003: 92; Simmons, 2005: 360); *pearsoni* Horsfield, 1851 – northern India, Nepal, Bhutan, Burma, Tibet, Szechwan, Anhwei and Fukien (China) to Vietnam, Laos, Thailand, Peninsular Malaysia (Csorba *et al.*, 2003: 83; Simmons, 2005: 360); *philippinensis* Waterhouse, 1843 – Phillipines, Kai Isls, Sabah, Sarawak and Sulawesi (Indonesia), Borneo, New Guinea, northeastern Queensland (Australia) (Csorba *et al.*, 2003: 94; Simmons, 2005: 361); *pusillus* Temminck, 1834 – India, Nepal, Thailand, Burma, Laos, south China, Peninsular Malaysia, Mentawai Isls, Java and Lesser Sunda Isls (Indonesia), small adjacent islands (Csorba *et al.*, 2003: 112; Simmons, 2005: 361); *rex* G. M. Allen, 1923 – southwestern China (Csorba *et al.*, 2003: 96; Simmons, 2005: 361); ***rhodesiae*** Roberts, 1946; *robinsoni* K. Andersen, 1918 – western Malaysia, Thailand, adjacent small islands (Simmons, 2005: 361); *rouxii* Temminck, 1835 – Sri Lanka, peninsular India to southern Burma and Vietnam (Csorba *et al.*, 2003: 117; Simmons, 2005: 362); *rufus* Eydoux and Gervais, 1836 – Philippines (Csorba *et al.*, 2003: 30; Simmons, 2005: 362); ***ruwenzorii*** J. Eric Hill, 1942; ***sakejiensis*** Cotterill, 2002; *sedulus* K. Andersen, 1905 – Peninsular Malaysia, Sarawak and Sabah (Malaysia), Borneo (Indonesia) (Csorba *et al.*, 2003: 128; Simmons, 2005: 362); *shameli* Tate, 1943 – Burma, Thailand, Laos, Cambodia, Peninsular Malaysia (Csorba *et al.*, 2003: 31; Simmons, 2005: 363); *shortridgei* K. Andersen, 1918 – northern India, Burma (Csorba *et al.*, 2003: 114; Simmons, 2005: 363); *siamensis* Gyldenstolpe, 1917 – Thailand, Laos, Vietnam (Simmons, 2005: 363); ***silvestris*** Aellen, 1959; ***simulator*** K.Andersen, 1904; ***smithersi*** Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012; *sinicus* K. Andersen, 1905 – southern China, Nepal, northern India, Vietnam (Csorba *et al.*, 2003: 119; Simmons, 2005: 363); *stheno* K. Andersen, 1905 – Vietnam, Thailand, Laos, Peninsular Malaysia, Sumatra and Java (Indonesia) (Csorba *et al.*, 2003: 80; Simmons,

2005: 363); *subbadius* Blyth, 1844 – northeastern India, Nepal, Vietnam, Burma (Csorba *et al.*, 2003: 115; Simmons, 2005: 364); *subrufus* K. Andersen, 1905 – Philippines except Palawan region (Csorba *et al.*, 2003: 33; Simmons, 2005: 364); ***swinnyi*** Gough, 1908; *thomasi* K. Andersen, 1905 – Burma, Vietnam, Thailand, Laos (Csorba *et al.*, 2003: 121; Simmons, 2005: 364); *trifoliatus* Temminck, 1834 – northeastern India, southwestern Thailand and Burma, Peninsular Malaysia, Sarawak and Sabah (Malaysia), Singapore, Borneo, Sumatra, Riau Archipelago, Banguey Isl, Java, Banka Isl and Nias Isl (Indonesia) (Csorba *et al.*, 2003: 130; Simmons, 2005: 364); *virgo* K. Andersen, 1905 – Philippines (Csorba *et al.*, 2003: 81; Simmons, 2005: 364); *yunanensis* Dobson, 1872 – Yunnan (China), Burma, Thailand, northeastern India (Csorba *et al.*, 2003: 85; Simmons, 2005: 365); ***ziama*** Fahr, Vierhaus, Hutterer and Kock, 2002.

Nesi *et al.* (2015: 1) indicate that the taxonomy and true number of species of African *Rhinolophus* remains unresolved because of the highly convergent morphology observed across taxa, and that the current species delimitation is based on slight variations in morphological measurements and echolocation call frequency. Due to the extensive phenotypic variation, these characters are not always very clearly separable and as such the true diversity of the the genus is most probably underestimated, based on these methods alone.

COMMON NAMES:
Czech: vrápenci, wrápenecové, vrápníkové, vrápeníkové, podkováčkové, vrápenec. Dutch: Hoefijzerneuzen. English: Horseshoe bats. French: Rhinolophes, Fers-à-cheval. German: Hufeisennasen, Hufeisennasen-Fledermäuse. Italian: Fèrri di cavàllo, Rinòlofi. Kiluba (DRC): Kasusu.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The approximate fossil date for the crown *Rhinolophus* is placed at about 37.2 MYA by Shi and Rabosky (2015: 1532).

Three or four *Rhinolophus* species were reported by Avery (2007: 619) from Pleistocene deposits at Wonderwerk Cave, South Africa.

Geraads *et al.* (2010: 279) reported the presence of *Rhinolophus* in Late Cenozoic (ca. 2.5 MYA) deposits in Ahl al Oughlam, Morocco.

BIOGEOGRAPHY:
See Servent *et al.* (2003: xii - xxiv) for discussion on phylogeny and biogeography of the horseshoe bats.

During the Miocene at about 17 Mya, *Rhinolophus* diversified into three distinct clades, two of these clades showed distinct geographical origins (Foley *et al.*, 2014: 320). In Eastern/South Eastern Asia represented by *R. trifoliatus* and *R. luctus* and East Asia represented by *R. pearsoni*, *R. sinicus*, *R. creaghi*, *R. shameli* and *R. pusillus*. While the clade that contains *R. hipposideros*, *R. ferrumequinum* and *R. euryale* is less clear indicating a widespread geographical origin including Europe, East Asia, Middle East and Africa.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Schmieder *et al.* (2015) studied the wing morphology of five species of European Rhinolophid bats, which also occur in northern Africa: *R. blasii, R. euryale, R. ferrumequinum, R. hipposideros*, and *R. mehelyi*, and they provide a table of geometric differences (p. 8).

DENTAL FORMULA:
The dental formula is variable, usually $^{1123}/_{2133}$ = 32.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
Santana and Lofgren (2013: 2521) investigated the evolution of skull morphology and modularity in the recent radiation of rhinolophid bats and predict that nasal echolocation has resulted in the evolution of a third cranial module (the 'nasal dome'), in addition to the two cranial modules conserved across mammals.

FUNCTIONAL MORPHOLOGY:
Jacobs *et al.* (2007a) found that in Africa the peak echolocation frequency was inversely correlated with size in the Rhinolophidae, while for rhinolophids from around the world, peak frequency was inversely correlated with forearm length. Similarly, there was an inverse correlation between mass and peak frequency, between forearm and peak frequency and between wing loading and peak frequency in the African Rhinolophidae (Jacobs *et al.*, 2007a).

ECHOLOCATION:
Jacobs *et al.* (2014: 2829) found that echolocation frequency was positively correlated with bite force, which suggests that its evolution is influenced by a trade-off between the masticatory and sensory functions of the skull. In support of this, variation in skull shape was explained by both echolocation frequency (80 %) and bite force (20 %). They also found that selection has acted on the nasal capsules, which have a frequency-specific impedance matching function during vocalization.

In the Mapungubwe National Park (RSA), Parker and Bernard (2018: 56, 57) recorded a *Rhinolophus* species with a F_{char} = 100.72 ± 0.52 kHz, F_{max}: 100.93 ± 0.77 kHz, F_{min}: 91.34 ± 6.08 kHz, F_{knee}: 100.72 ± 0.52 kHz, duration: 34.89 ± 14.42 msec, with 8.32 ± 3.39 calls/sec. This type of call was also recorded by Taylor *et al.* (2013b: 14) from the Soutpansberg area, and probably is produced by an undescribed species.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the following diurnal avian predators: African fish eagle (*Haliaeetus vocifer* (Daudin, 1800)), Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) [on either *landeri* or *fumigatus* or *hildebrandti*].

PARASITES:
BACTERIA
Bartonellae
Kamani *et al.* (2014: 628) tested 12 Nigerian "*Rhinolophus*" sp. and found at least 8 of them testing positive for *Bartonella* DNA.

HAEMOSPORIDA
Schaer *et al.* (2015: 381) found *Nycteria* sp. parasites in *Rhinolophus* sp. 1 from South Sudan. The same bat species was also infected by *Nycteria* cf. *gabonensis*. Landau *et al.* (2012: 142) and Perkins and Schaer (2016: Suppl.) also reported *Nycteria krampitzi* Rosin, Landau and Hugot, 1978 from the Republic of Congo and Gabon.

Wünschmann *et al.* (2010: 178) refer to Boulard (1975), who reported the first case of renal coccidiosis in a bat (on *H. caffer* and *Rhinolophus* sp.) from Sierra Leone and the Congo and caused by *Klossiella killicki*.

Garnham (1973: 236) refers to Anciaux de Faveaux for a *Polychromophilus ? murinus* from "Africa".

HEMIPTERA
Cimicidae: Haeselbarth *et al.* (1966: 10) records that only three males of *Loxaspis setipes* Ferris and Usinger, 1957 are known from unknown *Rhinolophus*, from Lukolela, Congo.

DIPTERA
Streblidae: *Brachytarsina africana* (Walker, 1849) is a typical ectoparasite of the genus *Rhinolophus* in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100). *Ascodipteron brevior* Maa, 1965 from Sudan (Haeselbarth *et al.*, 1966: 106). *Ascodipteron lophotes* Monticelli, 1898 from Yemen (Haeselbarth *et al.*, 1966: 106). *Raymondia alulata* Speiser, 1908 (Shapiro *et al.*, 2016: 253). *Raymondia aspera* Maa, 1968 (Shapiro *et al.*, 2016: 253). *Raymondia boquieni* Vermeil, 1965 from Congo and the DRC (Shapiro *et al.*, 2016: 254). *Raymondia huberi huberi* Frauenfeld, 1855 (Shapiro *et al.*, 2016: 254). *Raymondia intermedia* Jobling, 1936 (Shapiro *et al.*, 2016: 255). *Raymondia seminuda* Jobling, 1954 (Shapiro *et al.*, 2016: 255). *Raymondia setiloba* (Jobling, 1954) (Shapiro *et al.*, 2016: 256). *Raymondia waterstoni* Jobling, 1931 (Shapiro *et al.*, 2016: 256). *Raymondia* sp. B (Shapiro *et al.*, 2016: 257).

Nycteribiidae: *Nycteribia integra* Theodor and Moscona, 1954 common in Egypt (Haeselbarth *et al.*, 1966: 109). *Nycteribia ovalis* Theodor, 1957 from Tanzania (Haeselbarth *et al.*, 1966: 110). *Nycteribia tecta* Theodor, 1957 (Haeselbarth *et al.*, 1966: 110). *Dipseliopoda biannulate* (Oldroyd, 1953) from the Sudan (Haeselbarth *et al.*, 1966: 116). Kamani *et al.* (2014: 628) reported the presence of *Cyclopodia greeffi* Karsch, 1884 on bats from Nigeria.

SIPHONAPTERA
Ischnopsyllidae: Members of the genus *Rhinolophopsylla* Oudemans, 1909 are known to be parasites of *Miniopterus* and *Rhinolophus* (Haeselbarth *et al.*, 1966: 191).

ACARI
Myobiidae: Fain (1994: 1280) indicates that only two endemic genera are found on *Rhinolophus* species: *Neomyobia* with 13 species and three subspecies, and *Rhinomyobia* with one species. Another genus/species - *Calcarmyobia rhinolophi* - was described from *Rhinolophus lobatus*, but this probably should be from *Miniopterus natalensis arenarius* (Uchikawa, 1985a: 15).

VIRUSES:
Adenoviridae
These viruses were found by Waruhiu *et al.* (2017) in bats from Kenya.

Coronaviridae
Tao *et al.* (2017: 3) found 28.9 % (13 out of 45) of the Kenyan *Rhinolophus* sp. Specimens they tested to be positive for CoV. Tao and Tong (2019: 1) report the complete genomic sequence of a strain of betacoronavirus (BtKY72/*Rhinolophus* sp./Kenya/2007 - BtKY72).

Paramyxoviridae
1 out of nine tested *Rhinolophus* sp. from Cameroon was found to test positive for *Paramyxovirus* sequences by Mortlock *et al.* (2015: 1841).

Rhabdoviridae
Lyssavirus - Rabies related viruses

Horton *et al.* (2014: Table S1) tested 16 Kenyan *Rhinolophus* sp. specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

†***Rhinolophus maghrebensis*** Gunnell, Eiting, and Geraads, 2011

*2011. *Rhinolophus maghrebensis* Gunnell, Eiting, and Geraads, N. Jb. Geol. Paläont. Abh., 260 (1): 56, figs 3A, 7A. Publication date: January 2011. Type locality: Morocco: Ahl al Oughlam [ca. 33 35 N 07 30 W] [Goto Description]. Holotype: INSAP AaO 4655: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Right maxilla with P4-M3. Paratype: INSAP AaO 4673: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Left dentary p4-m3. - Etymology: Name taken from *Maghreb* ("countries of the setting sun"), the Arabic name for north-western African countries (Morocco, Algeria, Tunisia) (see Gunnell *et al.*, 2011: 56). (Current Combination)

2013. *Rhinolophus maghrebiensis:* Stoetzel, Palaeog., Palaeoclim., Palaeoecol., 392: 373. Publication date: 29 September 2013. (Lapsus)

TAXONOMY:
Gunnell *et al.* (2011: 56) describe it as a large species of the *Rhinolophus ferrumequinum* phenotypic group - larger than extant African *Rhinolophus* species *R. alticolus, R. blasii, R. euryale, R. denti, R. landeri, R. mehelyi, R. hipposideros*, and *R. simulator*, smaller than *R. hildebrandtii*.

†***Rhinolophus mellali*** Lavocat, 1961

*1961. *Rhinolophus ferrumequinum mellali* Lavocat, Notes Mém. Serv. Mines Carte geol. Maroc, 155: xxx. Type locality: Morocco: Beni Mellal. - Comments: The holotype consists of a left mandibular fragment with I, C, P_2-M_1 (Marandat, 1994: 60).

? *Rhinolophus mellali:* (Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Early late Miocene.

GENERAL DISTRIBUTION:
Northern Africa (Gunnell *et al.*, 2011: 70).

Rhinolophus adami Aellen and Brosset, 1968

*1968. *Rhinolophus adami* Aellen and Brosset, Rev. suisse Zool., 75 (14): 443. Type locality: Congo: Kouilou [ca. 04 00 N 12 00 E] [Goto Description]. Holotype: MNHN ZM-MO-1968-408: ad ♀, alcoholic (skull not removed). Collected by: Jean-Paul Adam; collection date: 9 January 1967; original number: 12/8G. 3 paratypes see Aellen and Brosset (1968: 443). Paratype: MHNG 1129.084: skull only. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of J.-P. Adam, the collector of the type specimen. (Current Combination)

TAXONOMY:
Kock *et al.* (2000) place it in the *adami* species group, followed by Csorba *et al.* (2003: xvi, 4 - 5) and Simmons (2005: 351). Species group reviewed by Kock *et al.* (2000). See Csorba *et al.* (2003: 5) for taxonomic background.

COMMON NAMES:
Czech: vrápenec Adamův. English: Adam's Horseshoe Bat, Congo Horseshoe Bat. French: Rhinolophe du Congo. German: Adams Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Jacobs *et al.*, 2008x; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008x; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004ab; IUCN, 2004). 1996 - DD (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are currently unknown. It is possible that it is threatened by cave disturbance, however, this needs to be confirmed (Jacobs *et al.*, 2008x; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008x) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Further studies are needed into the distribution, abundance, natural history, and threats to this species.

GENERAL DISTRIBUTION:
Rhinolophus adami is known only from the type series collected in Kimanika cave, Kouilou, in the Republic of Congo.

Native: Congo (Aellen and Brosset, 1968; Csorba *et al.*, 2003: 5; Simmons, 2005:351).

DETAILED MORPHOLOGY:
Baculum - See Csorba *et al.* (2003: 4).

POPULATION:
Structure and Density - It is known only from ten specimens held in the Paris and Geneva museums (Aellen and Brosset, 1968), and may be naturally rare, however, this requires confirmation (Jacobs *et al.*, 2008x; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008x; IUCN, 2009).

PARASITES:
Adam and Landau (1973a: 5) report on the presence of a protozoan parasite of the genus *Polychromophilus* (Haemoproteidae) in *R. adami* from the Republic of Congo. About 50 % of the specimens they examined were found to be infected. Gametocytes were found year-round. The bats were also infested (in low numbers) by the nycteribiid flies *Penicillidia fulvida* Bigot, 1885 and *Nycteribia schmidlii scotti* Falcoz, 1923, of which the prior was a major carrier of *Polychromophilus* sporozoites.

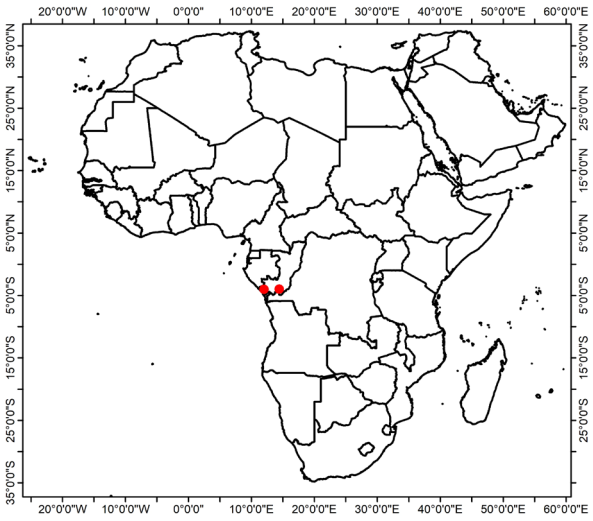


Figure 73. Distribution of *Rhinolophus adami*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo.

Rhinolophus alcyone Temminck, 1853

*1853. *Rhinolophus alcyone* Temminck, Esquisses zoologiques sur la Côte de Guiné. 1e partie, les Mammifères., 80. Type locality: Ghana: Boutry River [=Butre river] [ca. 04 49 N 01 55 W] [Goto Description]. Holotype: RMNH MAM.35892:. Allen (1939a: 73) notes: 'Type in Leiden Mus., but description has not "one single word of any value for identifying the species or determining its affinities" - K. Andersen'. - Comments: Allen (1939a: 73), Kock (1969a: 121), Grubb *et al.* (1998: 77) mention 1852 as year of publication. - Etymology: alcyone: "[=Alkuone] mythological name for the kingfisher" and this is sometimes written as "Halcyon". Alkuone herself is the "daughter of Aiolos, who threw herself in the sea, where her husband Keüks (or Ceyx) was drowned. Thetis changed her in a kingfisher and her husband in a seagull". (Current Combination)

TAXONOMY:
Forms part of the *landeri* species group (Csorba *et al.*, 2003: 55 - 57; Simmons, 2005: 351). See Csorba *et al.* (2003: 56) for remarks on taxonomy.

COMMON NAMES:
Czech: vrápenec Alcyone. English: Halcyon Horseshoe Bat. French: Rhinolophe Alcyon, Rhinolophe d'Halcyon. German: Temmincks Hufeisennase, Rothen Kamnase, Halcyon Rundblattnase. Spanish (Castillian): Murciélago de Herradura

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008y; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008y; IUCN, 2009). 2004 -LC ver 3.1 (2001) (Jacobs *et al.*, 2004y; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
This widespread species is threatened in parts of its range by habitat loss, largely resulting from logging and conversion of land to agricultural use. In some areas the species is hunted for food, although it is unclear whether this represents a major threat (Jacobs *et al.*, 2008y; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008y) [in IUCN (2009)] reported that it is not known if the species is present in any protected areas. Further studies are needed into the taxonomy and distribution of this species.

GENERAL DISTRIBUTION:
Rhinolophus alcyone ranges through much of West and Central Africa. It has been recorded from Senegal in the west through to Togo, and then from Nigeria to southern Sudan and western Uganda, with patchy records from the Congo basin (although it likely occurs throughout the Congo). It ranges as far south as central Democratic Republic of the Congo.

The record of this species from Gabon needs to be reexamined as it may represent a misidentified specimen of *Rhinolophus sylvestris* (Dowsett *et al.*, 1991).

Amori *et al.* (2016: 219) pointed out that a number of localities, originally situated in Togo, are currently in Ghana.

Native: Bioko, Burkina Faso (Kangoyé *et al.*, 2012: 6025; 2015a: 610); Cameroon; Central African Republic (Lunde *et al.*, 2001: 537); Congo (Dowsett *et al.*, 1991: 259); Congo (The Democratic Republic of the) (Monadjem *et al.*, 2010d: 555); Côte d'Ivoire; Equatorial Guinea; Gabon (?); Ghana; Guinea (Fahr and Ebigbo, 2003: 128); Guinea-Bissau (Rainho and Ranco, 2001: 47); Kenya; Liberia (Monadjem and Fahr, 2007: 50); Nigeria; Senegal; Sierra Leone; Sudan; Togo (?); Uganda.
Presence uncertain: Gabon.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Young (1975: 76) indicates that two distinct colour phases can be found: rufous (orange) and grey.

ECHOLOCATION:
In Guinea, Fahr and Ebigbo (2003) reported the frequency of the CF-component at 67.4 kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) and Lim (2007).
Karyotype - Unknown.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - This species is easily found in colonies of up to 20 animals (Jacobs *et al.*, 2008y; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008y; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Csorba *et al.* (2003: 57) refer to Kingdon (1984), who indicated that three females from western Uganda were pregnant in mid-June, whereas a fourth one was lactating. One birth was reported in September.

PARASITES:
HAEMOSPORIDA
Schaer *et al.* (2013a: 17416; 2015: 381) report the presence of hemosporidian parasites of the genus *Nycteria* in one investigated bat from Côte d'Ivoire. In the DRC, Karadjian *et al.* (2016: 9835) found *R. alcyone* specimens infected with *Nycteria gabonensis* Rosin, Landay & Hugot 1978.

DIPTERA
Streblidae: *Raymondia allisoni* Theodor, 1968 from Ghana (Shapiro *et al.*, 2016: 253).

Nycteribiidae: *Nycteribia inopinata* Theodor, 1957 from Ebolowa, Cameroon (Haeselbarth *et al.*, 1966: 109).

VIRUSES:
Hepadnaviridiae
Hepatitis B virus (HBV)
Drexler *et al.* (2013c: 16152) report on one *R. alcyone* on 16 examined specimens from Gabon that was positive for horseshoe bat HBV (HBHBV).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that none of the 15 specimens they examined from Gabon tested positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

Rhabdoviridae
Lyssavirus - Rabies related viruses
2006 in Nigeria, Dzikwi *et al.* (2010: 269) tested 43 brains by direct fluorescent antibody (DFA) and mouse inoculation test (MIT) which tested negative for lyssavirus antigens.
Lagos bat virus (LBV) - In 2006, 2 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), none

tested positive for neutralizing anitibodies (Dzikwi *et al.*, 2010: 269).
Mokola virus (MOKV) - In 2006, 2 individuals from Nigeria were serum tested by a modified rapid fluorescent focus inhibition test (RFFIT), none tested positive for neutralizing anitibodies (Dzikwi *et al.*, 2010: 269).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Nigeria, Senegal, Sierra Leone, Uganda.

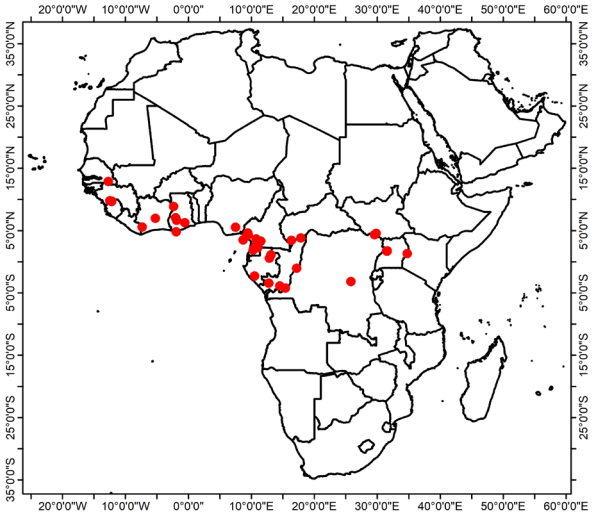


Figure 74. Distribution of *Rhinolophus alcyone*

Rhinolophus blasii Peters, 1867

1857. *Rhinolophus clivosus:* Blasius, Säugethiere Deutschlands, 33, figs 10, 11. Type locality: Italy: "Italy". - Comments: Preoccupied by *clivosus* Cretzschmar, 1828 (see Corbet and Hill, 1992: 100 and Pavlinov *et al.*, 1995: 81).

*1867. *Rhinolophus blasii* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 17 (for 1866). Publication date: 1867. Type locality: Italy: "Italy". Holotype: ZMB 557: ♂, alcoholic (skull not removed). Collected by: Johan Heinrich Blasius. See Turni and Kock (2008). - Comments: Type locality originally SE Europe, but restricted to Italy by Ellerman *et al.* (1953: 59), and Trieste (see Turni and Kock (2008). - Etymology: In honour of the German naturalist Johann Heinrich Blasius (1809 - 1870) (see Kozhurina, 2002: 14). (Current Combination)

1904. *Rhinolophus empusa* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 14 (83): 378. Publication date: 1 Novmber 1904. Type locality: Malawi: Zomba [15 23 S 35 19 E,, 800 - 900 m] [Goto Description]. Holotype: BMNH 1893.7.9.33: ad ♀. Collected by: Alexander ("Alex") Whyte (F.Z.S); collection date: January 1893. - Comments: Considered a valid subspecies by Ansell and Dowsett (1988: 33), Taylor (1998: 37).

1905. *Rhinolophus andreinii* Senna, Arch. Zool. ital., 2: 256, pl. 16, f. 1; pl. 18, f. 7 - 16. Publication date: 30 September 1905. Type locality: Eritrea: Adi Ugri [14 53 N 38 49 E, 1 900 m].

1910. *Rhinolophus blasiusi* Trouessart, Fauna des Mammifères d'Europe, 9.

1910. *Rhinolophus brockmani* Thomas, Ann. Mag. nat. Hist., ser. 8, 5 (26): 192. Publication date: 1 February 1910. Type locality: Somalia: Upper Sheikh [4 500 ft] [Goto Description]. Holotype: BMNH 1909.12.17.4: ad ♀. Collected by: Dr. Ralph Evelyn Drake-Brockman; collection date: 13 November 1909; original number: 237. Thomas (1910a: 193) mentions two specimens. - Etymology: In honour of Dr. R.E. Drake-Browkman, the collector of the type specimen.

? *Rhinolophus blasii andreinii:* (Name Combination)

? *Rhinolophus blasii empusa:* (Name Combination)

TAXONOMY:
Includes *brockmani*; see Koopman (1975: 383). Replacement for *clivosus* Blasius, 1857, which was preoccupied (see Ansell and Dowsett, 1988: 33). Part of the *landeri* species group (Csorba *et al.*, 2003: 57 - 59; Simmons (2005: 351 - 352). See Csorba *et al.* (2003: 58 - 59) for remarks on taxonomy.

Herkt *et al.* (2017: Appendix S9) indicate that three subspecies are recognized in continental Africa which are relatively isolated geographically: *blasii* in Northwest Africa, *andreinii* in Ethiopia and *empusa* in southern Africa. No genetic tests have been performed yet to check the validity of these taxa. The analyses carried out by Herkt *et al.* (2017), however, indicatte substantial ecological niche differences as well as major geographic gaps in suitable habitat areas between them.

COMMON NAMES:
Afrikaans: Spitssaalneusvlermuis. Albanian: Lakuriq nate hundëpatkua i Blasius-it. Arabian: Khaffash. Armenian: Բլազիի կամ, միջերկրածովային պայտաքիթ. Azerbaijani: Blazius nalburunu. Basque: Blasius ferra-saguzar. Belarusian: Падкаванос Блазіўса. Bosnian: Blazijev potkovasti š iš miš. Breton: Frigribell Blasius. Bulgarian: Средиземноморски подковонос. Castilian: Murciélago de herradura de Blasius, Rinolofo de Blasius, Murciélago dalmata de herradura. Catalan: Ratpenat de ferradura de Blasius. Croatian: Blazijev potkovnjak. Czech: Vrápenec Blasiů v, vrapenec pahrbeč ní. Danish: Blasius' hestekonæse. Dutch: Blasius' hoefijzerneus, Blasius-hoefijzerneus. English: Peters's Horseshoe Bat, Blasius's Horseshoe Bat, Peak-saddle Horseshoe Bat. Estonian: Hele-sagarnina. Finnish: Vaaleaherkko. French: Rhinolophe de Blasius, Rhinolophe à selle pointue. Frisian: Blasius' hoefizernoas. Galician: Morcego de ferradura de Blasius. Georgian: ბლაზის ცხვირნალა. German: Blasius-Hufeisennase. Greek: Μεσορινόλοφος, Ρινόλοφος του Blasius. Hebrew: parsaf matzuy, Parsaf Matsui. Hungarian: Csúcsosnyergű patkósdenevér. Irish Gaelic: Crú-ialtóg Blasius. Italian: Rinolofo di Blàsius, Ferro di cavallo di Blàsius. Latvian: Blā zija pakavdegunis. Lithuanian: Blazijaus pasagnosis. Luxembourgish: Blasius-Huffeisennues. Macedonian: Бласиев потковичар [= Blasiev Potkovichar]. Maltese: Rinolofu ta' Blasius. Montenegrin: Sredozemni potkovič ar. Norwegian: Balkanhesteskonese. Polish: Podkowiec Blasiusa. Portuguese: Morcego-de-ferradura de Blasius, Morcego ferradura de nariz de sela. Rhaeto-Romance: Rinolof da Blasius. Romanian: Liliacul cu potcoavă a lui Blasius, Liliacul-lui-Blasius. Russian: Подковонос средиземноморский. Serbian: Јужни потковичар [= Juž ni potkovič ar]. Scottish Gaelic: Crudh-ialtag Blasii. Slovak: Podkovár Blasiov. Slovenian: Blasijev podkovnjak. Swedish: Balkanhästskonäsa. Turkish: Blasius Nalburunlu Yarasa. Ukrainian: Підковик (Підковоніс) Блазіуса. Welsh: Ystlum pedol Blasius.

CONSERVATION STATUS:
Global - Assessed as Least Concern (LC ver 3.1 (2001)). Widespread, although patchily distributed. There are some large colonies and the global population is likely to considerably exceed 10,000. Although the population is declining in some areas (e.g. western Balkans), it is stable in others (Jacobs *et al.*, 2008ag; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008ag; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Jacobs *et al.*, 2004x; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT D1 ver 3.1 (2001) (Jacobs *et al.*, 2016b). 2004 - VU D2 ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
Threats to the species include loss of Mediterranean woodlands, disturbance and loss of underground habitats, and destruction of roost sites (Kryštufek, 1999). In a number of range states the species is disturbed by tourist visits to caves and by use of the caves as shelters for livestock (Jacobs *et al.*, 2008ag; IUCN, 2009).

The most important risk factors related to climatic change were identified by Sherwin *et al.* (2012: 174) as being their roosting in caves/trees, the aerial feeding style and its long-distance dispersal. Bilgin *et al.* (2012: 434) predict that *R. blasii* will have a major range contraction as a result of climatic change.

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ag) [in IUCN (2009)] reported that *Rhinolophus blasii* is protected by national legislation in some range states. There are international legal obligations for the protection of this species through the Bonn Convention (Eurobats) and Bern Convention in areas to which these apply. It is included in Annex II (and Annex IV) of the EU Habitats and Species Directive, and hence requires specific conservation measures in some range states, including the designation of Special Areas for Conservation. It occurs in some protected areas. Taxonomic research is needed to clarify the status of the African populations. Monitoring and protection of caves is also required.

GENERAL DISTRIBUTION:
Rhinolophus blasii has a large range in the Palaearctic and the Afrotropics, throughout which it is widely but patchily distributed. Its range extends marginally into the Indomalayan region.

In Africa, it occurs from northeastern South Africa and the Democratic Republic of Congo, through south Malawi, to East African, Ethiopia and Somalia, and in North Africa. Follow Taylor (2000) for southern African distribution. In North African it is only present in Morocco and Algeria (it may occur in Tunisia but there are no confirmed records yet, and likewise for Egypt). Altitude range is from sea level to 1,400 m.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 602,154 km^2. In South Africa, its distribution is strongly associated with the amount of precipitation in the warmest quarter of the year (Babiker Salata, 2012: 49).

In Asia, it has a patchy distribution extending from Turkey in the west to Pakistan in the east, and from the Caucasus in the north to Yemen in the south (Simmons, 2005). It was confirmed in Georgia in 2006 (Z. Nagy *pers. obs.*). In Europe, it is extinct in northeastern Italy and has not been recorded in Slovenia during the last 50 years (Kryštufek, 2001). Also recorded from western Anatolia and from the Levant (Syria, Lebanon, Jordan, Palestine and Israel). It is now restricted to the Balkan peninsula and to some Mediterranean islands including Crete and Cyprus. There are no recent records in Romania and northern Bulgaria despite intensive work by Christian Dietz (Z. Nagy *pers. comm.,* 2006). Past records from this area are disputed: no specimen has been found in museums in Romania, and the presence of *R. euryale* in the same area might have caused confusion (Z. Nagy *pers. comm.,* 2006).

It occurs from sea level to 2,215 m in Yemen.

Native: Afghanistan; Albania; Algeria; Armenia; Austria; Azerbaijan; Bosnia and Herzegovina; Botswana; Bulgaria; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 555); Croatia; Cyprus; Eritrea; Ethiopia; Greece (Kriti); Iran, Islamic Republic of; Israel; Italy; Jordan; Libyan Arab Jamahiriya; Malawi (Ansell, 1978; Happold *et al.*, 1988; Happold and Happold, 1997b: 818; Monadjem *et al.*, 2010d: 555); Montenegro; Morocco (Benda *et al.*, 2010a: 157; El Ibrahimi and Rguibi Idrissi, 2015: 359); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 555; Monadjem *et al.*, 2010c: 377); Oman; Pakistan; Palestinian Territory, occupied; Serbia; Somalia; South Africa (Monadjem *et al.*, 2010d: 555); Swaziland (Monadjem, 2005: 5; Monadjem *et al.*, 2010d: 555); Syrian Arab Republic; Tanzania; Tunisia (Aellen and Strinati, 1970; Cockrum, 1996; Dalhoumi *et al.*, 2011; 2014: 53); Turkey; Turkmenistan; Yemen; Yugoslavia; Zambia (Ansell, 1969; Ansell, 1978; Monadjem *et al.*, 2010d: 555); Zimbabwe (Monadjem *et al.*, 2010d: 555).
Possibly extinct: Slovenia.

DETAILED MORPHOLOGY:
Baculum - See Csorba *et al.* (2003: 4).

In their study on take-off performance, Gardiner *et al.* (2014: 1059) determined a wing beat frequency of 12.96 ± 0.27 Hz.

FUNCTIONAL MORPHOLOGY:
In a study of flight-initiating jumps, Gardiner and Nudds (2011: 2187) found that the ground gleaning *R. blasii* did not outperform the fast-flying hawker (*Miniopterus schreibersii*) nor the trawling (*Myotis capaccinii*), although it spends a major part of its time foraging on the ground.

ECHOLOCATION:
Jacobs *et al.* (2007a) reported for individuals from South Africa a peak frequency of 86.6 (± 0.7) kHz (detector type not reported), while Monadjem *et al.* (2007a), using an Anabat detector, reported the same peak frequency albeit a different standard deviation (± 0.23) for an individual from Swaziland. Also from Swaziland, Monadjem *et al.* (2017c: 179) reported F_{min}: 79.4 ± 1.86 (77.9 - 81.5) kHz, F_{knee}: 86.3 ± 0.24 (86.1 - 86.6) kHz, F_c: 86.2 ± 0.21 (86.0 - 86.4) kHz, duration: 20.8 ± 0.72 (19.9 - 21.3) msec. Monadjem *et al.* (2010c: 377) reported for Mozambique that peak echolocation frequencies ranged between 93.2 - 95.4 kHz (ANABAT, Petterson D240x).

Jones and Siemers (2010: 449 - 450) indicated that females emit pulses with a higher frequency than males, and that juveniles emit lower frequencies than adults.

Papadatou *et al.* (2008b: 132) report the following data for 37 Greek specimens: F_{start}: 90.3 ± 4.85 kHz, F_{end}: 78.1 ± 4.48 kHz, F_{peak}: 94.0 ± 0.92 kHz, bandwidth: 4.0 ± 1.65 kHz, duration 44.1 ± 12.14 msec and interpulse interval: 71.8 ± 23.10 msec.

The following data for 10 Iranian calls were reported by Benda *et al.* (2012a: 182): F_{start}: 94.0 ± 0.1 (94.2 - 94.4) kHz, F_{end}: 92.0 ± 0.1 (91.8 - 92.1) kHz, F_{peak}: 93.1 ± 0.1 (93.0 - 93.3) kHz, duration: 48.6 ± 9.4 (40.1 - 68.3) msec and interpulse interval: 109.3 ± 5.6 (103.1 - 117.1) msec.

Walters *et al.* (2012: suppl.) report the following figures for 26 calls (4 sequences) from bats from Algeria and Greece: duration: 44.90 ± 8.52 msec, F_{max}: 95.51 ± 1.34 kHz, F_{min}: 80.58 ± 3.52 kHz, bandwidth: 14.93 ± 3.82 kHz, F_{peak}: 95.41 ± 1.33 kHz.

Disca *et al.* (2014: 226) indicate that in Morocco the type of call is FM-FC-FM, with F_{peak}: 96.7 ± 0.3 kHz and duration: 20.7 ± 4.9 msec.

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotype - Đulic (1967) reported 2*n* = 58, FN = 60, BA = 4, a submetacentric X and an acrocentric Y for specimens from Croatia. Qumsiyeh *et al.* (1986) and Rautenbach (1986) also reported 2*n* = 58, FN = 60, BA = 4, but differed in the X chromosome being reported in the respective publications as metacentric and submetacentric, and the Y chromosome as acrocentric and metacentric. Arslan and Zima (2014: 9) report that the autosomal complement consists of two medium-size bi-armed pairs and 26 acrocentric pairs, with one of the acrocentrics having a secondary constriction.

Protein / allozyme - Unknown.

HABITS:
Siemers and Ivanova (2004: 470) report that *R. blasii* uses aerial and foliage-gleaning in flight, as well as ground-gleaning (including landing) to detect and capture their prey.

DIET:
In northern Algeria, Ahmim and Moali (2013: 46) found that *R. blasii* droppings contained 96.87 % Insecta and 3.13 % Chilopoda. The most frequent insect preys were Diptera (37.50 %), specifically Chironomidae/Ceratopogonidae (9.38 %), Culicidae, Anisopodidae and Sphaeroceridae (6.25 %). Trichoptera also were frequently present (15.63 %), followed by Lepidoptera and Hemiptera (both 12.50 %).

Gardiner *et al.* (2014: 1058) assessed its foraging strategy as "low altitude slow aerial hawking", sometimes with gleaning.

POPULATION:
Structure and Density - Africa: Not very common. Asia: This species has a widespread distribution and the populations in Pakistan and Afghanistan seem to be stable and doing well (Molur *et al.*, 2002). Europe: A rare or infrequent species, probably the rarest horseshoe bat in Europe (Kryštufek, 1999). Summer colonies of ca. 20 - 30 are typical, although up to 400 females may be found in a single colony. In winter, it congregates in mixed-species clusters with other *Rhinolophus* species (up to 2,000 animals in Serbia). There are large colonies in Serbia, Bulgaria and Greece. It is suspected to be declining because of loss of Mediterranean woodlands and cave disturbance, and is considered vulnerable in many range states (e.g., the western Balkans); however, the populations in the eastern Balkans are stable (Mediterranean Workshop, 2007) (Jacobs *et al.*, 2008ag; IUCN, 2009).
Trend - 2008 - Decreasing (Jacobs *et al.*, 2008ag; IUCN, 2009). *R. blasii* populations within the Asia Minor and Levant region are predicted to have a declining population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

PARASITES:
Ševcík *et al.* (2012: 35) report on the presence of the bat flies *Phthiridium biarticulatum* Hermann, 1804 (Nycteribiidae) and *Brachytarsina flavipennis* Macquart, 1851 (Streblidae) on bats from Cyprus. The same parasites were found by Benda *et al.* (2010b: 243) in Jordan. *B. flavipennis* was also reported from Iran by Benda *et al.* (2012a: 255). Benda *et al.* (2010b) also refer to previous records of *Penicillidia conspicua* Speiser, 1901 and *P. dufourii* (Westwood, 1835) from Palestine, *Phthiridium integrum* (Theodor and Moscona, 1954) and *Penicillidia fulvida* (Bigot, 1885) from Yemen (all Nycteribiidae); a streblid *Ascodipteron africanum rhinolophi* Jobling, 1958 from Yemen; and an ischnopsillid *Rhinolophopsylla unipectinata* (Taschenberg, 1880) from Yemen.

Nycteridocoptes eyndhoveni Fain, 1959 (Acari: Sarcoptidae) was reported from "*R. blasii empusa*" from Tanganika Moba, DCR by Fain (1959a: 341).

Streblidae: *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100). *Raymondia alulata* Speiser, 1908 (Shapiro *et al.*, 2016: 253). *Raymondia hardyi* Fiedler, 1954 (Shapiro *et al.*, 2016: 254). *Raymondia waterstoni* Jobling, 1931 (Haeselbarth *et al.*, 1966: 104). *Ascodipteron lophotes* Monticelli, 1898 (Haeselbarth *et al.*, 1966: 106, but Maa (1965) suggests that these records need verification).

Nycteribiidae: *Nycteribia integra* Theodor and Moscona, 1954 (Haeselbarth *et al.*, 1966: 109). *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114).

Bendjeddou *et al.* (2017: 15) reported the following ectoparasites from Algerian bats: Nycteribiidae: *Nycteribia (Nycteribia) latreillii* (Leach, 1817), *Penicillidia (Penicillidia) dufourii* Westwood, 1835 and *Phthiridium biarticulatum* Hermann, 1804; Streblidae: *Brachytarsina (Brachytarsina) flavipennis* Macquart, 1851 and Arachnida: *Eyndhovenia euryalis* (G. Canestrini, 1885).

VIRUSES:
Coronaviridae - Coronaviruses
Luis *et al.* (2013: suppl.) mention the presence of BatCoV BB98-15 and a SARS coronavirus-related virus.

Alphacoronavirus
Kohl and Kurth (2014: 3112) reported this virus from German bats.
Betacoronavirus

Reported from bats from Bulgaria and Germany by Kohl and Kurth (2014: 3112).

Polyomaviridae
Carr *et al.* (2017) reported two new virsuses from *R. blasii* from Zambia: *Rhinolophus blasii polyomavirus 1* and *Rhinolophus blasii polyomavirus 2*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Congo (Democratic Republic of the), Eritrea, Ethiopia, Italy, Malawi, Morocco, Mozambique, Somalia, South Africa, Swaziland, Tanzania, Tunisia, Zambia, Zimbabwe.

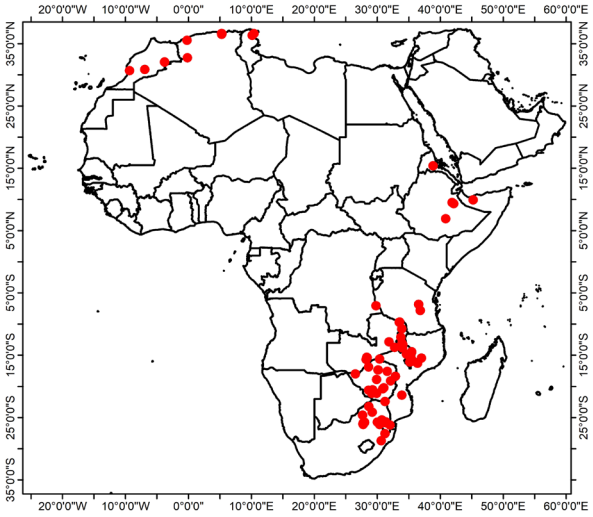


Figure 75. Distribution of *Rhinolophus blasii*

Rhinolophus capensis Lichtenstein, 1823

*1823. *Rhinolophus capensis* Lichtenstein, Verzeichniss der Doubletten des Zool. Mus. K. Univ. Berlin, 4. Type locality: South Africa: Cape province: Cape of Good Hope [ca. 33 56 S 18 28 E]. Lectotype: ZMB 377: juv, skin and skull. Collected by: Krebs; collection date: 1822. Skull damaged. Lectotype designated by Turni and Kock (2008: 32). - Comments: Turni and Kock (2008: 32) also indicate that originally there were two additional specimens, which might have been sold to an unknown collection. Furthermore, Turni and Kock (2008: 32) mention that ZMB 376 and 378, which were longtime considered syntypes of *capensis*, were re-identified by Karl Koopman as belonging to *Rhinolophus clivosus* Cretzschmar, 1828. - Etymology: Referring to Cape of Good Hope or the Cape province, from where the type specimen was obtained. (Current Combination)

1860. *Rhinolophus auritus* Sundevall, Kongl. Svenska Vet.-Akad. Hand., ser. 2, 2: no 10, p. 13, footnote. Type locality: South Africa: Southern Cape province: Cape of Good Hope, near Knysna: Belvedere [ca. 33 53 S 22 59 E]. Holotype: NRM ♂. Collection date: 3 April 1854. Victorin; Grill 1859; Mam. Ex. No. 1907: see Andersen (1904c: 456).

TAXONOMY:
Part of the *capensis* species group (Csorba *et al.*, 2003: 7 - 8; Simmons, 2005: 352). See Csorba *et al.* (2003: 8) for remarks on taxonomy. Reviewed by Stoffberg (2008).

COMMON NAMES:
Afrikaans: Kaapse saalneusvlermuis, Kaapse Vlermuis. Czech: vrápenec jihoafrický. English: Cape Horseshoe Bat, Southern Africa horseshoe bat. French: Rhinolophe d'Afrique du Sud, Rhinolophe du Cap. German: Kap-Hufeisennase, Capischen Kamnase, Russbraunen Kamnase. Portuguese: Morcego ferradura de cabo.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
De Graaf (1960) identified material as *R* cf. *capensis* from the Late Pliocene, at Makapansgat, South Africa. Avery and Avery (2011: 16) reported Holocene remains from Blinkklipkop, Powerhouse Cave, Wonderwerk (Northern Cape province, South Africa), as well as Pleistocene remains from the latter locality.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population (there are many records of this species from coastal caves), and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008z; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008z; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Jacobs *et al.*, 2004w; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Jacobs *et al.*, 2016c). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
The species is threatened in parts of its range by disturbance of cave roosts (often by recreational and tourism activities), and the conversion of suitable foraging habitat to agricultural use (Jacobs *et al.*, 2008z; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008z) [in IUCN (2009)] reported this species as present in some protected areas. There is a need to identify and protect important roost sites for this species. Further studies are needed into the distribution of this species.

GENERAL DISTRIBUTION:
Rhinolophus capensis is restricted to the coastal belt of the Northern Cape, the Western Cape and the Eastern Cape of South Africa, as far east along the coast as the vicinity of East London (Csorba *et al.*, 2003: 8; Stoffberg, 2008: 2). Odendaal *et al.* (2014: 4) indicate that the geographic range of *R. capensis* is determined by two environmental gradients that influence the regional rainfall patterns. First, there is the increasing aridity towards the north and secondly a seasonality shift from west to east, whereby the rains are dominant during the winter in the west, then becoming aseasonal and finally being dominant during the summer in the extreme east.

Simmons (2005: 352) follows Ansell and Dowsett (1988: 33) and Koopman (1993a: 164), who list South Africa, Zimbabwe and Mozambique, but does indicate doubt about its occurrence outside of South Africa. Koopman (1993a: 164) states that the records from Zambia and Malawi are erroneous. Griffin (1999: 32), however, suspects its occurrence in Namibia. In the RSA, the species' distribution is best predicted by biome: desert, Albany thicket, fynbos and grassland (Babiker Salata, 2012: 50, 118).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 277,925 km^2 (or 4 % of the total surface of the area).

Native: South Africa (Eastern Cape Province, Northern Cape Province, Western Cape Province) (Ellerman *et al.*, 1953; Maree and Grant, 1997; Csorba *et al.*, 2003: 8; Monadjem *et al.*, 2010d: 556).
Presence uncertain: Namibia.

FUNCTIONAL MORPHOLOGY:
Jacobs *et al.* (2007a), at De Hoop, South Africa, found *R. capensis* to have a lower mean wing loading and aspect ratio than *R. clivosus*, but no differences in their mean shape indices.

SEXUAL DIMORPHISM:
At De Hoop, South Africa, Jacobs *et al.* (2007a) found females were heavier than males, but there were no differences in forearm length, or wingspan.

ECHOLOCATION:
Jacobs *et al.* (2007a) reported a peak frequency of 83.9 (± 1.2) kHz for individuals from South Africa.

Odendaal and Jacobs (2009: 62) found some sort of local dialects in the echolocation calls for South African *R. capensis*: 84.60 ± 0.82 kHz at De Hoop, 85.84 ± 0.73 kHz at Table Farm, and 80.66 ± 0.50 kHz at Steenkampskraal, which is probably the result of interactions with other *Rhinolophus* species: *R. swinnyi* at Steenkampskraal, and *R. darlingi* at Table Farm, as well as with *R. clivosus*. Bastian and Jacobs (2013: 18) and Odendaal *et al.* (2013: 112) indicate that the peak frequency ranges from 75.7 kHz at the western end of the species' coastal distribution in South Africa to 85 - 86.5 kHz at the eastern end. This increase seems to be linked with the mean annual rainfall (Odendaal *et al.*, 2013). Bastian and Jacobs (2013: 18) also found that the 85 kHz specimens were able to discriminate between 85 kHz calls from conspecifics and calls from *R. damarensis*, which also peaks at 85 kHz. The 75 kHz specimens were unable to make that discrimination.

Odendaal and Jacobs (2010b: 240) reported that there was no relation between body size and peak frequency across populations. However, nasal chamber length was found to be the best predictor on peak frequency. They also found that in each population, the females were larger than the males and produced calls with higher frequencies, and therefore suggest that there might be a potential social role for the peak frequency.

When flying with conspecifics, Fawcett *et al.* (2013: 49) found that the terminal FM sweep became longer and wider in bandwidth than when flying alone. Fawcett *et al.* (2015: 693), furthermore, found that *R. capensis* produced longer frequency-modulated downward sweeps at the end of their call when they flew together with bats from the same species or with *Miniopterus natalensis* than when they flew alone. Additionally, when they were flying with *R. clivosus* (a larger high-duty cycle bat), its calls were shorter than when flying alone or with other *R. capensis* individuals.

Bastian and Jacobs (2015) investigated the ability for *R. capensis* to discriminate their own calls from those of allopatric (*R. damarensis*) and sympatric (*R. clivosus*) congeners. The bats had no

problems with the calls from *R. clivosus*, but the calls from *R. damarensis* could only be discriminated by one of the test groups.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach (1986) reported 2*n* = 58, FN = 60, BA = 4, and the X and Y chromosomes as submetacentric. Erasmus and Rautenbach (1984: 94) mention 52 acrocentric and four bi-armed autosomal chromosomes, resulting in 60 autosomal arms.

Protein / allozyme - see Maree and Grant (1997).

HABITAT:
Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *R. capensis* activity was not significantly, nor positively influenced by size of wetland, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body. *R. capensis* preferentially flew near trees, orchards surrounding wetlands and over these wetlands (Sirami *et al.*, 2013: 35).

HABITS:
Jacobs *et al.* (2007a) at De Hoop, South Africa found that the average esitmated flying height above ground 1.00 ± 0.77 m, *n*= 11. At the same locality, Thomas and Jacobs (2013: 129) found that Lepidoptera eating bats (e.g. *R. capensis* and *Nycteris thebaica*) emerged earlier than bats feeding on Diptera (e.g. *Tadarida aegyptiaca*).

DIET:
Jacobs *et al.* (2007a) at De Hoop, South Africa, found that the diet mainly comprised Lepidoptera and Coleoptera with lesser amounts of Neuroptera, Hemiptera and Diptera. The mean size of measurable prey taken by *R. capensis* was smaller than that taken by *R. clivosus*, although the range of prey sizes taken by the two species overlapped (Jacobs *et al.*, 2007a).

PREDATORS:
Avery *et al.* (2005: 1054) found this species in pellets from *Tyto alba* in South Africa.

POPULATION:
Structure and Density - *Rhinolophus capensis* can be found in colonies consisting of thousands of individuals (Taylor, 2000; Skinner and Chimimba, 2005). Skinner and Chimimba (2005) state that 'they are abundant in the Western Cape and the Eastern Cape, where there are many records from coastal caves' (Jacobs *et al.*, 2008z; IUCN, 2009).
Trend - 2008 - Decreasing (Jacobs *et al.*, 2008z; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Bojarski and Bernard (1992) [in Anthony (2000: 16)] report that immunocytochemical indices of gonadotropic function rise significantly during the spermatogenic period, coincident with high plasma testosterone levels.

Bernard (1985: 129) and Martin and Bernard (2000: 36) mention that spermatogenesis starts in spring (October in South Africa) and ends after early winter (May) although sperm remain in the caudae epididymides through winter (May to September). Copulation and ovulation occur in August to September, at the end of winter hibernation. Parturition occurs in November and December after a gestation period of three to four months (see also Bernard, 1984; Krutzsch, 2000).

Bernard (1985: 134) indicates that females do not become reproductively mature in their first year, and that males would only be able to mate in their second year.

PARASITES:
Streblidae: *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100).
Nycteribiidae: *Nycteribia schmidlii* Schiner, 1853 (Haeselbarth *et al.*, 1966: 108).

SIPHONAPTERA
Ischnopsyllidae: *Rhinolophopsylla ashworthi* (Waterson, 1913) known only from a few specimens from the Cape Province (King William's Town, Willowmore and Oudtshoorn), South Africa (Haeselbarth *et al.*, 1966: 191). *Rhinolophopsylla capensis* Jordan and Rothschild, 1921 (Haeselbarth *et al.*, 1966: 191).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Namibia, South Africa.

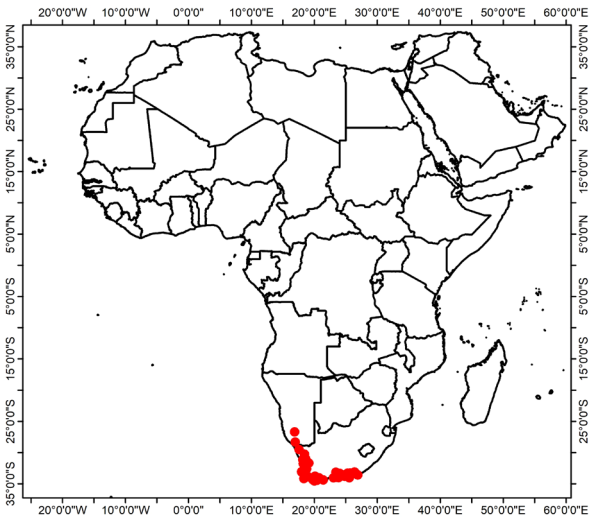


Figure 76. Distribution of *Rhinolophus capensis*

Rhinolophus clivosus Cretzschmar, 1828

*1828. *Rhinolophus clivosus* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 47, pl. 18. Type locality: Saudi Arabia: Red Sea Coast: Al Muwaylih [=Mohila] [ca. 27 49 N 35 30 E] [Goto Description]. Paratype: SMF 12311: skin only. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Lectotype: SMF 4371: mounted skin (skull not removed). Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1826. Old catalog: II.F.4.a; see Mertens (1925: 20). - Comments: Allen (1939a: 74) mentions "1826" (as mentioned on the title page) as year of publication of Cretzschmar's work, other authors mention it as "1827", "1828", "1830-1831". - Etymology: From the masculine Latin adjective *clivósus*, meaning "characterized by slopes, steep", referring to a seemingly unreliable distinctive character of the noseleaf "*Rhinolophus apparato olfactorio externo clivis gradatim elatis non dissimili*" (Cretzschmar 1828) (see Lanza *et al.* (2015: 80). (Current Combination)

1829. *Rhinolophus Geoffroyii* A. Smith, Zool. Journ., 4 (16): 433. Publication date: May 1829. Type locality: South Africa: "South Africa" [Goto Description]. - Comments: Roberts (1951: 61) nominated Cape Town as type locality; see Meester *et al.* (1986: 38). Allen (1939a: 75) mentioned *geoffroyii* as a separate species. Meester *et al.* (1986: 38) follow Ellerman *et al.* (1953: 57) in considering *geoffroyii* as unidentifiable.

1861. *Rhinolophus acrotis* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 4, 10. Publication date: 1861. Type locality: Eritrea: Kérén [ca. 15 45 N 38 20 E] [Goto Description]. Holotype: SMNS 986a: ad ♂, alcoholic (skull not removed). Collected by: Martin Theodor von Heuglin; collection date: 1862. Paratype: SMNS 986b: juv ♂, alcoholic (skull not removed). Collected by: Martin Theodor von Heuglin; collection date: 1862. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 293) mention this specimen as a possible paratype, although they do indicate that Heuglin based his description on one single specimen (probably SMNH 986a). They also indicate that this specimen was marked as "Cotype" by Krauss. - Etymology: From the two neuter Greek substantives "*ἄκρον*" (akron), meaning "extremity" and "*οὖς*", meaning "ear" (see Lanza *et al.*, 2015: 80).

1904. *Rhinolophus Andersoni* Thomas, Ann. Mag. nat. Hist., ser. 7, 14 (80): 156. Publication date: 1 August 1904. Type locality: Egypt: Eastern desert of Egypt [ca. 22 N 35 E] [Goto Description]. Holotype: BMNH 1904.11.4.2: imm ♂. Collected by: Arthur M. MacKilligan; collection date: 3 August 1903; original number: 26. - Comments: Kock (1969a: 113) mentions: "Eastern Desert, im Gebiet des Wadi Alagi, 22 N 35 E, Sudan".

1904. *Rhinolophus augur* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 14 (83): 380. Publication date: 1 November 1904. Type locality: South Africa: Northern Cape province: [formerly Bechuanaland]: Kuruman [26 28 S 22 27 E, 4 000 ft] [Goto Description]. Holotype: BMNH 1904.10.1.1: ad ♂, skin and skull. Collected by: Mr. R.B. Woosnam; collection date: 19 April 1904; original number: 26.

1904. *Rhinolophus augur zambesiensis* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 14 (83): 383. Publication date: 1 November 1904. Type locality: Malawi: Fort Hill [=Chitipa] [09 42 S 33 16 E, 1 300 m] [Goto Description]. Holotype: BMNH 1897.10.1.18: ad ♂, skin and skull. Collected by: Alexander ("Alex") Whyte (F.Z.S); collection date: July 1896; original number: 136. Presented/Donated by: Sir Harry Hamilton Johnston. - Comments: Considered a synonym of *zuluensis* by Ansell and Dowsett (1988: 32).

1904. *Rhinolophus augur zuluensis* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 14 (83): 383. Publication date: 1 November 1904. Type locality: South Africa: KwaZulu-Natal: 20 mi [=32 km] NW Eshowe: Jususie valley [=Insuzi valley] [28 53 S 31 03 E, 1 000 ft] [Goto Description]. Holotype: BMNH 1904.5.1.8: ad ♀, skin and skull. Collected by: Captain Claude Henry Baxter Grant; collection date: 17 November 1903; original number: 602. Presented/Donated by: C.D. Rudd Esq. - Comments: Considered a valid subspecies by Ansell and Dowsett (1988: 32), Taylor (1998: 35).

1905. *Rhinolophus acrotis brachygnatus* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 15 (85): 73. Publication date: 1 January 1905. Type locality: Egypt: Giza province: Giza [30 01 N 31 13 E] [Goto Description]. Holotype: BMNH 1892.9.9.7: ad ♂, alcoholic (skull not removed). Collected by: Dr. John Anderson; collection date: 16 December 1891. See Qumsiyeh

(1985: 35). Paratype: [Unknown] imm ♀, alcoholic (skull not removed). See Qumsiyeh (1985: 35).

1916. *Rhinolophus keniensis* Hollister, Smiths. Misc. Coll., 66 (1) (2406): 2. Publication date: 10 February 1916. Type locality: Kenya: W side Mount Kenya [ca. 00 10 S 37 19 E, 7 000 ft] [Goto Description]. Holotype: USNM 166352: ad ♂, skull and alcoholic. Collected by: Edmund Heller; collection date: 27 August 1909; original number: 1154. Fisher and Ludwig (2015: 54) indicate that the Field Catalog mentions that this specimen was collected at the Base Camp on the West side of Mount Kenya.

1932. *Rhinolophus geoffroyi zuluensis:* Ortlepp, 18th Report of the Director of Veterinary Sciences and Animal Industry. Union of South Africa. (Name Combination)

1934. *Rhinolophus acrotis schwarzi* Heim de Balsac, Bull. Mus. natn. Hist. nat., Paris, sér. 2, 7: 483. Publication date: November 1934. Type locality: Algeria: Sahara, Tassai des Azdjers: Djanet [24 34 N 09 30 E] [Goto Description]. Holotype: MNHN ♀, alcoholic (skull not removed). Collected by: La Mission Augiéras Draper. Holotype: MNHN ZM-MO-2006-246: ♀, skull and alcoholic. Collected by: Dr. Henry Foley; collection date: 1934. Paratype: MNHN ZM-MO-2006-247: ♀, skull only. Collected by: Dr. Henry Foley; collection date: 1934. Paratype: MNHN ZM-MO-2006-248: ♀, skull only. Collected by: Dr. Henry Foley; collection date: 1934.

1959. *Rhinolophus ferrum-equinum keniensis:* Harrison, Occ. Pap. Nat. Mus. S. Rhod., 23B: 228.. (Name Combination)

1980. *Rhinolophus ferrumequinum keniensis:* Blackwell, Mycologia, 72 (1): 145. (Name Combination)

1993. *angur:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 164. (Lapsus)

? *Rhinolophus clivosus acrotis:* (Name Combination)

? *Rhinolophus clivosus augur:* (Name Combination)

? *Rhinolophus clivosus brachygnathus:* (Name Combination)

? *Rhinolophus clivosus clivosus:* (Name Combination)

? *Rhinolophus clivosus keniensis:* (Name Combination)

? *Rhinolophus clivosus zuluensis:* (Name Combination)

? *Rhinolophus ferrum-equinum zuluensis:* (Name Combination)

? *Rhinolophus geoffroyi augur:* (Name Combination)

? *Rhinolophus geoffroyi geoffroyi:* (Name Combination)

? *Rhinolophus geoffroyi:* (Name Combination, Alternate Spelling)

TAXONOMY:



Figure 77. *Rhinolophus clivosus*.

ferrumequinum species group (Csorba *et al.*, 2003: 35 - 39; Simmons, 2005: 353). See Csorba *et al.* (2003: 36 - 37) for review of taxonomy.

Roberts (1919: 112) points out that *geoffroyii* Smith, 1829 antedates *augur* Andersen, 1904, and later (Roberts, 1951) regards *augur* as a subspecies of *geoffroyii*. Allen (1939a) follows Roberts in regarding *geoffroyii* as the prior name, but Ellerman *et al.* (1953) reject this, pointing out that the description does not identify *geoffroyii* and that the type is apparently lost, and therefore propose that the name be discarded as unidentifiable. The next available name would be *Rhinolophus augur* Andersen, 1904.

Stoffberg *et al.* (2012: 1) indicate that southern African representatives of *R. clivosus* s.l. are as distinct from more northern African samples as they are from *R. ferrumequinum*. In southern Africa, they (p. 5) distinguish five geographic groups: Western Cape clade, Knysna region clade, Northern Cape clade, a predominantly KwaZulu-Natal/Mpumalanga mixed group and a Mpumalanga/Limpopo Province clade. About 3.7 Mya, these groups were separated from more northern groups (Kenya, Tanzania and Mozambique) and all of these were separated from the Egyptian populations at about 4.26 Mya. Stoffberg *et al.* (2012: 2; fig. 1) show the distribution area for four subspecies: *geoffroyi* in the Western Cape province and the coastal part of the Northern Cape province; *zuluensis* in the

Eastern Cape province, KwaZulu-Natal province, Mpumalange province, southern Limpopo province and Swaziland and Lesotho; *augur* in eastern Northern Cape province and central Botswana; and *zambesiensis* in Mozambique, Zambia, Zimbabwe and the extreme southeastern DRC. On the other hand, Benda and Vallo (2012: 83) suggest that all populations occurring in the savanna belt from the Cape to Kenya belong to one taxon (subspecies): *augur*. Unfortunately, neither Stoffberg *et al.* (2012) nor Benda and Vallo (2012) provide any information on the validiy of the name "*geoffroyii*". Therefore, pending further investigation in the taxonomy of this complex, we retain the usage of the name *R. clivosus*.

COMMON NAMES:
Afrikaans: Geoffroy se saalneusvlermuis, Geoffroy-saalneusvlermuis, Geoffroyse vlermuis. Arabian: Khafash abu hadweh arabi, Khaffash. Chinese: 佐氏菊头蝠. Czech: vrápenec pouštní, wrápenec pahrbečný, vrapenec pahrbeční. Dutch: Geoffroy's hoefijzerneus. English: Arabian Horseshoe Bat, Cretzschmar's Horseshoe bat, Geoffroy's Horseshoe Bat. French: Rhinolophe de Cretzschmar, Rhinolophe de Geoffroy. German: Geoffroys Hufeisennase. Hebrew: Parsaf HaNegev. Italian: Rinòlofo di Cretzschrnar, Fèrro di cavàllo di Cretzschmar. Portuguese: Morcego ferradura gigante.

ETYMOLOGY OF COMMON NAME:
Colloquial name after E. Geoffroy Saint-Hilaire, who collected bats in Egypt during the early part of the nineteenth century (see Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
R. clivosus has been recovered from both the upper Pleistocene and very late Holocene at Border Cave and is possibly present in the late Holocene at Nkupe, South Africa (Avery, 1991: 6). Avery and Avery (2011: 17) report additional Holocene (Blinkklipkop and Wonderwerk), and Pleistocene (Wonderwerk) remains from the Northern Cape province (South Africa).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough globally to qualify for listing in a more threatened category (Kock *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Kock *et al.*, 2008a; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004an; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).
Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Jacobs *et al.*, 2016d). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
Although there are generally considered to be no major threats to the species as a whole, some populations are locally threatened by disturbance of their roosting sites, and indirect poisoning resulting from the use of insecticides, pesticides and similar chemicals (Kock *et al.*, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Kock *et al.* (2008a) [in IUCN (2009)] reported that in view of the species wide range it seems likely that it is present in several protected areas. All bats, including *Rhinolophus clivosus*, are protected by national legislation in Jordan (Amr *pers. comm.*, 2004). Bats of the genus *Rhinolophus* are generally susceptible to indirect poisoning through the local use of insecticides; there is a need to evaluate the impact of this threat on populations (especially in southwest Asia), and to investigate alternative methods of insect control (Kock *pers. comm.*, 2004).

GENERAL DISTRIBUTION:
Rhinolophus clivosus is widespread in North, East and southern Africa, and also in parts of southwest Asia, including western and southeastern areas of the Arabian Peninsula. In North Africa it has been recorded from Algeria, Libya and Egypt; in East Africa, it ranges from Sudan in the north, through all East African countries to Malawi in the south; in southern Africa, it is present in Mozambique and Zambia in the north, ranging southwards into South Africa, Namibia and southern Angola. In addition, there are a number of records from southern and eastern parts of the Democratic Republic of the Congo. In southwest Asia, it ranges from Israel, Jordan and the Sinai Peninsula of Egypt in the north, through the western and southeastern part of the Arabian Peninsula of Saudi Arabia, Yemen and Oman, with a few additional records of the species from central regions of the Arabian Peninsula.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,120,944 km^2.

In South Africa, its distributoin is strongly associated with annual precipitation (Babiker Salata, 2012: 49).

ZMB has two specimens from the Central African Republic, that seem to be outliers.

Native: Afghanistan; Algeria; Angola; Burundi; Cameroon; Chad; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 556); Djibouti (Pearch *et al.*, 2001: 397); Egypt; Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 133); Israel; Jordan; Kenya (Lavrenchenko *et al.*, 2004b: 133); Lesotho (Lynch, 1994: 190; Monadjem *et al.*, 2010d: 556); Liberia; Libyan Arab Jamahiriya; Malawi (Happold *et al.*, 1988; Happold and Happold, 1997b: 818; Monadjem *et al.*, 2010d: 556); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 556; Monadjem *et al.*, 2010c: 377); Namibia (Cotterill, 2004a: 261); Oman; Rwanda; Saudi Arabia; Somalia; South Africa (Monadjem *et al.*, 2010d: 556); Sudan; Swaziland (Monadjem, 2005: 5; Monadjem *et al.*, 2010d: 557); Tanzania (Stanley and Goodman, 2011: 41); Turkmenistan; Uganda (Kityo and Kerbis, 1996: 63); Yemen; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 557); Zimbabwe (Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 557).
Presence uncertain: Palestinian Territory, Occupied.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
For 5 specimens from the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following wing parameters: Fa: 53.4 ± 1.5 mm, Wing area: 175.9 ± 5.8 cm^2, Wing span: 33.8 ± 1.1 cm, Wing loading: 9.2 ± 0.8 N/m^2, and aspect ratio: 6.5 ± 0.3.

DETAILED MORPHOLOGY:
Baculum - See Thomas (1997) and Csorba *et al.* (2003: 36).

Jacobs *et al.* (2013b: 76) found that *R. clivosus* has a smaller nasal capsule volume than predicted from its size.

FUNCTIONAL MORPHOLOGY:
Jacobs *et al.* (2007a), at De Hoop, South Africa, found *R. clivosus* to have a higher mean wing loading and aspect ratio than *R. capensis*, but no differences in their mean shape indices.

SEXUAL DIMORPHISM:
At De Hoop, South Africa, Jacobs *et al.* (2007a) found that females were heavier than males, but there were no differences in forearm length, or wingspan.

ECHOLOCATION:
Finger *et al.* (2017: 144) found that echolocation signals enables *R. clivosus* to distinguish the sex of the caller (probably linked with the initial and terminal FM components of the signal) and even its indentity (probably linked with resting frequency). Raw *et al.* (2018: 1) furthermore found that *R. clivosus* could discriminate readily between species using echolocation pulses with discrete frequencies. To discriminate between species with overlapping frequencies, additional parameters such as sweep rate of the FM and duty cycle were used.

For individuals in South Africa, Taylor (1999b), using a Pettersson D980 detector at a locality in Dundee, reported a maximum frequency of 94.3 (± 0.2) kHz, while Jacobs *et al.* (2007a) (detector type and locality not reported) reported a peak frequency of 92.1 (± 0.7) kHz. Monadjem *et al.* (2007a), using an Anabat detector at several different localities in Swaziland, reported a maximum frequency of 91.9 (± 0.65) kHz. From the same country, Monadjem *et al.* (2017c: 179) reported F_{min}: 75.7 ± 3.15 (70.4 - 80.3) kHz, F_{knee}: 91.5 ± 0.70 (90.0 - 92.3) kHz, F_c: 91.3 ± 1.06 (88.9 - 92.5) kHz and duration: 32.9 ± 5.35 (23.3 - 40.1) msec. Taylor (2000) indicates a constant frequency component of 94 kHz. Monadjem *et al.* (2010c: 378) reported from Mozambique that the peak echolocation frequencies ranged between 79.8 - 81.0 kHz (ANABAT, Petterson D240x).

From Algeria Forest Station (RSA), Schoeman and Jacobs (2002: 157) reported the type of calls to be high duty echolocation dominated by constant frequency calls, with a F_{peak}: 92.7 ± 0.5 kHz.

Monadjem *et al.* (2007a) also reported sexual dimorphism in the call with females emitting a higher frequency call than males (females 92.5 (± 0.04) kHz, males 91.6 (± 0.61) kHz).

Taylor *et al.* (2013b: 19) recorded the following parameters for 10 calls from Soutpansberg, South Africa: F_{max}: 92.1 ± 0.51 (91.5 - 92.8) kHz, F_{min}: 86.7 ± 3.21 (89.6 - 90.9) kHz, F_{knee}: 90.3 ± 0.42 (89.6 - 90.9) kHz, F_{char}: 90.7 ± 0.40 (90.1 - 91.4) kHz, duration: 14.3 ± 3.63 (8.6 - 19.4) msec.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg area (RSA): F_{min}: 79 - 90 kHz, F_{char}: 90 - 91 kHz, F_{knee}: 91 - 91 kHz, Slope: 280 - 606 OPS, duration: 9 - 19 msec.

Jacobs (2016: 133) and Jacobs *et al.* (2017b: 3) indicated that the call frequency of about 92 kHz in South Africa is much higher than expected for an animal of that size (which would be something around 66 kHz). They found that climatic factors, especially temperature, play an important role.

Eisenring *et al.* (2016: SI 2) reported the following for 28 calls from the Aberdares Range in Kenya: PF: 84.9 ± 5.0 (66.9 - 88.3), HF: 86.8 ± 4.3 (69.7 - 89.7), LF: 68.4 ± 6.4 (56.4 - 81.8), DT: 0.4 ± 0.2 (0.0 - 0.6), DF: 18.4 ± 7.3 (4.9 - 32.5), IPI: 0.7 ± 0.7 (0.1 - 3.8).

In Jordan, Benda *et al.* (2010b: 204) recorded the following parameters for 10 calls: F_{start}: 73.1 ± 1.9 (71.5 - 77.0) kHz, F_{end}: 73.8 ± 2.3 (70.0 - 77.0) kHz, F_{peak}: 84.4 ± 0.4 (83.5 - 85.0) kHz, Pulse duration: 48.0 ± 4.8 (43.0 - 59.0) msec, and Inter-pulse interval: 39.6 ± 12.9 (27.0 - 59.0) msec.

From Israel, Hackett *et al.* (2016: 223) reported 66 calls with these values: Pulse duration: 54.48 ± 11.22 msec, F_{start}: 78.92 ± 5.18 (69.3 - 88.8) kHz, F_{end}: 78.81 ± 5.26 (68.3 - 88.8) kHz, F_{peak}: 85.18 ± 0.57 (83.4 - 88.8) kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotype - Both Đulic and Mutere (1974) and Rautenbach *et al.* (1993) reported 2*n* = 58. However, Đulic and Mutere (1974) reported FN = 62, BA = 6, a large acrocentric X chromosome, and a small acrocentric Y chromosome, whereas Rautenbach *et al.* (1993) reported FN = 60, BA = 4, and submetacentric X and Y chromosomes. Richards *et al.* (2016d: 187, 192) mentioned 2*n* = 58 and FN = 60, with primarily acrocentric chromosomes and two small metacentric pairs. Erasmus and Rautenbach (1984: 94) mention 50 acrocentric and six bi-armed autosomal chromosomes, resulting in 62 autosomal arms.

Protein / allozyme - Unknown.

HABITAT:
Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *R. clivosus* activity was not significantly, nor positively influenced by size of wetland, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body. *R. clivosus* preferentially near trees, orchards surrounding wetlands and over these wetlands (Sirami *et al.*, 2013: 35).

HABITS:
Jacobs *et al.* (2007a) at De Hoop, South Africa found that the average esitmated flying height above ground 0.84 ± 0.20 m, *n*= 6. At the same locality, Thomas and Jacobs (2013: 124) found that *R. clivosus* emerged earlier than the other species in the area (in order of emergence): *Miniopterus natalensis, Rhinolophus capensis, Nycteris thebaica, Myotis tricolor, Neoromicia capensis* and *Tadarida aegyptiaca*.

Petersen *et al.* (2019: 439) studied the behaviour and social calls of captive bats and found four acoustically distinct call types: 1) cascading/rising frequency-modulated (FM) calls, 2) oscillatory FM calls, 3) noisy screech calls and 4) whistle calls. These call types showed only weak associations with specific behaviours, situational categories or functional contexts.

ROOST:
Avery *et al.* (1990: 7) indicate that cool and moist caves or cave-like structures are used as daytime roosts. Taylor *et al.* (1999: 70) reported a roost containing 20 animals in the Shongweni Dam tunnel (RSA).

DIET:
From the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following prey groups based on 46 faecal pellets from 5 bats (in volume percent): Lepidoptera (62.6 ± 30.8), Coleoptera (29.4 ± 24.8), Hemiptera (2.0 ± 4.5), Hymenoptera (1.4 ± 3.1), and unknown (4.6 ± 6.4).

Jacobs *et al.* (2007a) at De Hoop, South Africa, found that the diet mainly consisted of Lepidoptera and Coleoptera with lesser amounts of Neuroptera, Hemiptera and Diptera. The mean size of measurable prey taken by *R. clivosus* was larger than that taken by *R. capensis*, although the range of prey sizes taken by the two species overlapped (Jacobs *et al.*, 2007a).

PREDATORS:
Avery *et al.* (2005: 1054) found this species to be present in pellets from the barn olw (*Tyto alba*) in South Africa.

Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - *Rhinolophus clivosus* is common in some parts of its range, including South Africa, but is uncommon to rare in other areas, such as in Zimbabwe. In Swaziland, three separate populations contained over a thousand individuals, while in Jordan forty individuals were observed at a single location (Amr, 2000). Although the population appears to be stable in many regions, in Jordan the population is in decline and this bat may be declining throughout its range in the Arabian Peninsula (Amr *pers. comm.*) (Kock *et al.*, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Kock *et al.*, 2008a; IUCN, 2009). *R. clivosus* populations within the Asia Minor and Levant region have an unknown population trend, under predictive climate change scenarios (Bilgin *et al.*, 2012: 433).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 116) indicates that spermatogenesis occurs in late spring/summer/early fall. Copulation occurs in fall

and is followed by sperm storage in the female until arousal and conception in the following spring.

Stanley and Goodman (2011: 41) reported on four females collected in East Usambara (Tanzania), of which two (collected on 17 August 1992) had small teats and two (collected in the first half of August 1991 and 1993) had large, non-lactating teats. Six males collected in the first half of August included three animals with scrotal testes and three with abdominal testes. Four males collected between July and September 1991 to 1993 in West Usambara had scrotal testes too.

PARASITES:
Hirst (1923: 989) mentions that Kolenati gave "*R. clivosus* [= *R. blasii*]" as host for the mite *Periglischrus interruptus* Kolenati, but that he corrected this later to *R. euryale*. Kolenati gave a new name to a mite from a *R. clivosus* specimen from Egypt: *Periglischrus glutinimargo*.
From Jordan, Benda *et al.* (2010b: 229) reported the presence of a bat fly: *Phthiridium biarticulatum* Hermann, 1804 (Nycteribiidae) and a flea *Rhinolophopsylla unipectinata unipectinata* (Taschenberg, 1880) (Ischnopsyllidae). Additionally, they also mention literature date for *Phthiridium integrum* from Saudi Arabia and Yemen, *Ascodipteron africanum rhinolophi* Jobling, 1958 (Streblidae) from Yemen, and five mites from Yemen: *Trombicula knighti* Radford, 1954, *T. filamentosa* Radford, 1953, *T. brevitarsa* Radford, 1952, *Brennanella longispina* Radford, 1953, and *Labidocarpus nasicolus* Lawrence, 1938.

ACARI
Sarcoptidae: Fain (1959a: 340) mentions a paratype of *Nycteridocoptes eyndhoveni* Fain, 1959, collected from a *R. clivosus zuluensis* from Lubudi, DRC. Fain (1959c: 237) reported *Psorergates (Psorergatoides) rhinolophi* Fain from *R. clivosus zuluensis* from Uvira, Kivu, DRC.
Trombiculidae: *Trombicula (Grandjeana) reticulata* (Vercammen-Grandjean & Nadchatram, 1963) collected from "*R. geoffroyi zuluensis*" [= *R. clivosus zuluensis*] from South Africa (Vercammen-Grandjean and Nadchatram, 1963; Stekolnikov, 2018a: 136). Stekolnikov (2018a: 189) also mentioned *Willmannium natalense* (Lawrence, 1949).

DIPTERA:
Streblidae: *Ascodipteron lophotes* Monticelli, 1898 from Eritrea (Haeselbarth *et al.*, 1966: 106), South Africa (Haeselbarth *et al.*, 1966: 106), Yemen (Haeselbarth *et al.*, 1966: 106, host referred to as *R. acrotis*). *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100). *Nycteribosca africana* Walker, 1849 (Zumpt, 1950: 96 - on "*R. geoffroyi*". *Raymondia hardyi* Fiedler, 1954 from South Africa (Shapiro *et al.*, 2016: 254). *Raymondia intermedia* Jobling, 1936 (Shapiro *et al.*, 2016: 255). *Raymondia waterstoni* Jobling, 1931 (Zumpt, 1950: 96; Haeselbarth *et al.*, 1966: 104). *Brachytarsina (Brachytarsina) flavipennis* Macquart, 1851 and *Raymondia huberi* Frauenfeld, 1855 from Algeria (Bendjeddou *et al.*, 2017: 15).

Nycteribiidae: *Nycteribia schmidlii* Schiner, 1853 (Haeselbarth *et al.*, 1966: 108; Bendjeddou *et al.*, 2017: 15). *Nycteribia scissa scissa* Speiser, 1901 the nominate form found exclusively on *R. clivosus* from South Africa and Namibia (Haeselbarth *et al.*, 1966: 108). *Nycteribia ovalis* Theodor, 1957 from Pietermaritzburg, South Africa (Haeselbarth *et al.*, 1966: 110). *Penicillidia fulvida* (Bigot 1885) (Zumpt, 1950: 97 - on "*R. geoffroyi*"; Haeselbarth *et al.*, 1966: 114). *Nycteribia integra* Theodor and Moscona, 1954 (Haeselbarth *et al.*, 1966: 109, host referred to as *R. acrotis*). *Nycteribia scissa* Speiser, 1901 (Zumpt, 1950: 97 - on "*R. geoffroyi*")
.
Szentiványi *et al.* (2019: Suppl.) also mentions *Penicillidia fulvida* bat flies from Kenyan "*Rhinolophus ferrumequinum keniensis*" which were carrying *Arthrorhynchus nycteribiae* fungi.

Calliphoridae: Zumpt (1950: 88) reported a calyptrate larva of *Calliphora croceipalpis* Jaennicke, 1867, which was found in decomposing bats ("*Rhinolophus geoffroyi*") on the bottom of the Sterkfontein caves (RSA). Other magots developed into an unidentified Borboridae and a Phoridae.

SIPHONAPTERA
Ischnopsyllidae: *Rhinolophopsylla ashworthi* (Waterston, 1913) known only from a few specimens from the Cape Province (King William's Town, Willowmore and Oudtshoorn) (Haeselbarth *et al.*, 1966: 191). *Rhinolophopsylla capensis* Jordan and Rothschild, 1921 (Zumpt, 1950: 97 - on "*R. geoffroyi*"; Haeselbarth *et al.*, 1966: 191, Beaucournu and Kock, 1996).

ACARI
Spinturnicidae: *Spinturnix viduus* and *Periglischrus africanus* were described by Zumpt (1950: 92, 93) from "*Rhinolophus geoffroyi*" from the Sterkfontein caves (RSA).
Ixodidae: ?*Ixodes simplex* Neumann, 1906 (see Zumpt, 1950: 96); *Ixodes pilosus howardi* Neumann (on "*Rhinolophus augur*", see Howard, 1908: 168).
Trombiculidae: *Trombicula natalensis* Lawrence, 1949 (see Zumpt, 1950: 96).

Listrophoridae: *Alabidocarpus nasicolus* Lawrence, 1938 (see Zumpt, 1950: 96).

VIRUSES:
Bunyaviridae
Phlebovirus
Rift Valley Fever Virus (RVFV) - Oelofsen and Van der Ryst (1999) tested 40 individuals from eight localities in the Free State Province, South Africa for RVFV antigen using an enzyme linked immunosorbet assay (ELISA), none tested positive.

Coronaviridae
Anthony *et al.* (2017b: Suppl.) mention the following alpha-coronaviruses: Predict_CoV_70, Human_CoV_229E, Predict_CoV_65, and the beta-coronavirus: Predict_CoV_43.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies: Oelofsen and Smith (1993) tested 85 individual brains, from 14 localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

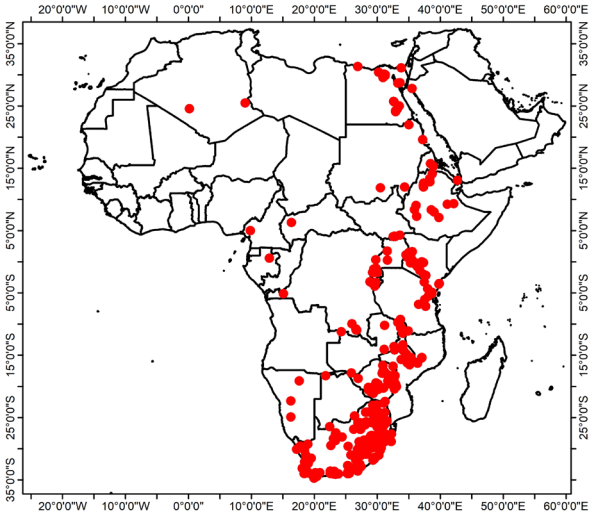


Figure 78. Distribution of *Rhinolophus clivosus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Botswana, Burundi, Cameroon, Central African Republic, Congo (Democratic Republic of the), Egypt, Eritrea, Ethiopia, Gabon, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, Saudi Arabia, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

Rhinolophus cohenae Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012

*2012. *Rhinolophus cohenae* Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, PLoS ONE, 7(9): 16. Publication date: 12 September 2012. Type locality: South Africa: Mpumalanga: Barberton: Mountainland Nature Reserve [25 43 08 S 31 15 58 E, 690m] [Goto Description]. Holotype: DNSM 8626: ad ♂, skull and alcoholic. Collected by: Lientjie Cohen (Mpumalanga Park). Presented/Donated by: ?: Collector Unknown. Baculum prepared. Skull and mandible in good condition (Taylor *et al.*, 2012c: 16). Paratype: DNSM 11620: ad ♂, skull and alcoholic. Collected by: Dr Samantha Stoffberg and Lientjie Cohen; collection date: 27 September 2009. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 11918: ad ♂, skull and alcoholic. Collected by: Dr Samantha Stoffberg and Lientjie Cohen; collection date: 27 September 2009. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 11919: ad ♂, skull and alcoholic. Collected by: Dr Samantha Stoffberg and Lientjie Cohen; collection date: 27 September 2009. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 7886: ad ♂, skull and alcoholic. Collected by: Lientjie Cohen (Mpumalanga Park); collection date: 27 September 2004. Presented/Donated by: ?: Collector Unknown. - Etymology: Recognition of Lientjie Cohen who collected the type specimen and contributed significantly to the conservation of bats in South Africa, particularly in Mpumalanga Province. The species name combines the surname Cohen and genitive singular case-ending "ae" indicative of feminine gender (Taylor *et al.*, 2012c: 17). - ZooBank: D0E1C9DD-7D36-4C01-AE0D-60AD474960A0. (Current Combination)

TAXONOMY:



Figure 79. *Rhinolophus cohenae* from Mpumalanga, South Africa.

Based on mitochondrial and nuclear DNA sequences and morphological and morphometric data, Taylor *et al.* (2012c) found that the *Rhinolophus hildebrandtii* group includes more species than previously recognized.

COMMON NAMES:
English: Cohen's Horseshoe Bat. German: Cohens Hufeisennase.

CONSERVATION STATUS:
Global - not assessed.

Assessment History
Global - not assessed.

Regional -
South Africa: 2016 - VU C2a(ii), D2 ver 3.1 (2001) (Cohen *et al.*, 2016).

GENERAL DISTRIBUTION:
Known only from three closely-spaced localities in Mpumalanga Province of South Africa in the vicinity of Nelspruit Taylor *et al.* (2012c: 17).

Accurate delimitation of this species' range is subject to further collecting and reappraisal of existing museum material, previously refered to as *R. hildebrandtii*.

Native: South Africa (Taylor *et al.*, 2012c: 17).

ECHOLOCATION:
Lowest recorded peak frequency 33.0 kHz in the holotype; mean 32.86 ± 0.24 kHz, n= 7 in type series Taylor *et al.* (2012c: 16).

PARASITES:
DIPTERA:
Streblidae: *Raymondia hardyi* Fiedler, 1954 from South Africa (Shapiro *et al.*, 2016: 254; based on a record by Theodor (1968), who mentioned "*R. hildebrandtii*" as host).

ZOOBANK:
D0E1C9DD-7D36-4C01-AE0D-60AD474960A0

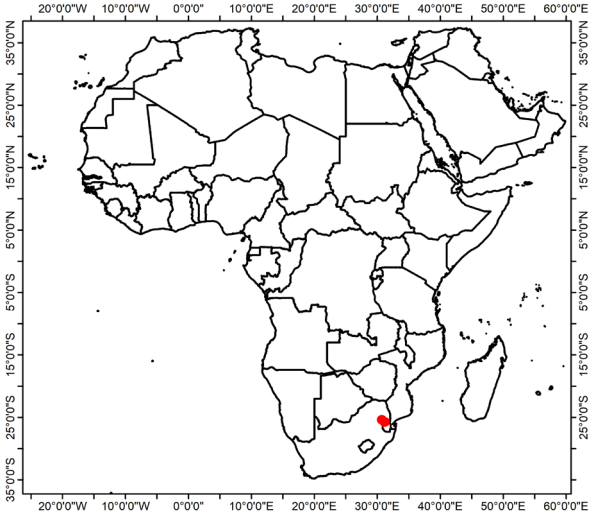


Figure 80. Distribution of *Rhinolophus cohenae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
South Africa.

Rhinolophus damarensis Roberts, 1946

*1946. *Rhinolophus darlingi damarensis* Roberts, Ann. Transv. Mus., 20 (4): 303. Type locality: Namibia: Damaraland: Okahandja district: Oserikari [Goto Description]. Holotype: TM 9474: ad ♀, skin and skull. Collected by: Austin Roberts; collection date: 10 August 1941. Note: Caught in bedroom at night.
? *Rhinolophus damarensis:* (Name Combination, Current Combination)

TAXONOMY:
Jacobs *et al.* (2013a: 12) showed that *R. darlingi* (*sensu lato*) was polyphyletic comprising two non-sister lineages (*R. darlingi* (*sensu stricto*) and *R. damarensis*), with disjunct distributions in southern Africa, which diverged about 9.7 Mya. They further showed that despite the genetic divergence between the two lineages (*R. darlingi* (*sensu stricto*) and *R. damarensis*) echolocation frequencies as well as skull and post-cranial morphology, apart from bacula, were highly convergent.

Two lineages which within the *R. damarensis* clade can be seen: a northern (where the type of *damarensis* falls) and a southern linage, which diverged about 5 Mya (Jacobs *et al.*, 2013a: 12).

R. damarensis is embedded in the *fumigatus* clade that includes *R. darlingi*, *R. fumigatus*, *R. eloquens* and *R. hildebrandtii* (Jacobs *et al.* (2013a: 12).

Based on DNA sequencing, morphometrics, and echolocation data, Jacobs *et al.* (2013a) concluded that the western population of *R. darlingi* represents a separate species, which was separated from the eastern population some 9.7 Mya.

COMMON NAMES:
German: Damara-Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) [as part of *R. darlingi*] in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008aa; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [as part of *R. darlingi*] (Jacobs *et al.*, 2008aa; IUCN, 2009). 2004 - LC ver 3.1 (2001) [as part of *R. darlingi*] (Jacobs *et al.*, 2004v); IUCN, 2004). 1996 - LR/lc [as part of *R. darlingi*] (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Jacobs *et al.*, 2016i). 2004 - NT ver 3.1 (2001) [as part of *R. darlingi*] (Friedmann and Daly, 2004).

ECHOLOCATION:
In South Africa, Maluleke *et al.* (2017: 7347) studied the variation in echolocation calls along a latitudinal gradient between 16 and 32° S. They observed resting frequencies of 85.43 ± 1.3 kHz and average call duration of 31.14 ± 5.9 msec, with a slight sexual dimorphism: in females the frequencies varied between 84.4 ± 0.7 kHz and 87.6 ± 1.1 kHz in the different localities, and in males between 84.4 kHz ± 0.9 to 86.9 ± 1.1 kHz. The only factor they found to be responsible for the divergence in resting frequency was annual mean temperature.

MOLECULAR BIOLOGY:
DNA - Jacobs *et al.* (2013a: 12) sequenced the Cytochrome *b* gene from the type specimen of *R. d. damarensis* Roberts, 1924 (TM 9474) (Genbank Nr- KF683224), which grouped distinctly from the eastern populations now referred to as *R. darlingi* (*sensu stricto*). Two lineages which within the *R. damarensis* clade can be seen a northern (where the type of *damarensis* falls, and a southern linage.

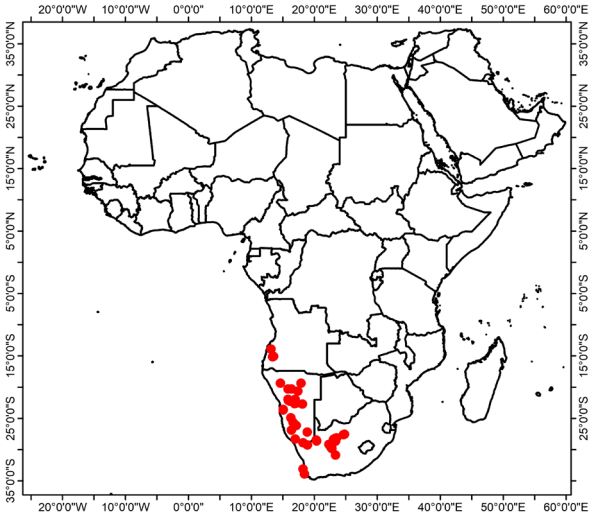


Figure 81. Distribution of *Rhinolophus damarensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Namibia, South Africa.

Rhinolophus darlingi K. Andersen, 1905

*1905. *Rhinolophus Darlingi* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 15 (85): 70. Publication date: 1 January 1905. Type locality: Zimbabwe: Mashonaland: Mazoe [17 30 S 31 03 E, 4 000 ft] [Goto Description]. Holotype: BMNH 1895.8.27.1: ad, skin only. Collected by: J.ff. Darling Esq. Collection date: 13 June 1895; original number: 35. Paratype: BMNH [a]:. Paratype: BMNH [b]:. Paratype: BMNH [c]:. Paratype: BMNH [d]:. Paratype: BMNH [e]:. - Etymology: In honour of J. ff. Darling, a mining engineer, who first collected this species in Mazoe, Zimbabwe, in the early part of the twentieth century (see Smithers, 1983: 126; Taylor, 2005). (Current Combination)

1924. *Rhinolophus darlingi barbertonensis* Roberts, Ann. Transv. Mus., 10: 59. Publication date: 31 January 1924. Type locality: South Africa: SE Transvaal province: Barberton district: Louw's creek [Goto Description]. Holotype: TM 2476: ad ♀, skin and skull. Collected by: Austin Roberts; collection date: 14 March 1920. Note: Caught in old mine drive.

2016. *Rhinolophus darling:* Hoffmaster and Vonk, Behav. Sci., 6 (25): 1. Publication date: 20 November 2016. (Lapsus)

? *Rhinolophus darlingi darlingi:* (Name Combination)

? *Rhinolophus darlingi:* (Current Spelling)

TAXONOMY:
Jacobs *et al.* (2013a: 12) showed that *R. darlingi* (*sensu lato*) was polyphyletic, comprising two non-sister lineages (*R. darlingi* (*sensu stricto*) and *R. damarensis*), with disjunct distributions in southern Africa, which diverged about 9.7 Mya. They further showed that despite the genetic divergence between the two lineages (*R. darlingi* (*sensu stricto*) and *R. damarensis*) echolocation frequencies as well as skull and post-cranial morphology, except for the bacula, were highly convergent.

R. darlingi is embedded in the *fumigatus* clade (Csorba *et al.*, 2003: 39 - 40; Simmons (2005: 354) that includes – *R. damarensis*, *R. fumigatus*, *R. eloquens* and *R. hildebrandtii* (Jacobs *et al.* (2013a: 12).

R. darlingi includes *R. d. barbertonensis* Roberts, 1924.

COMMON NAMES:
Afrikaans: Darling se saalneusvlermuis, Darling-saalneusvlermuis. Czech: vrápenec Darlingův. English: Darling's Horseshoe Bat. French: Fer-à-Cheval de Darling, Rhinolophe de Darling. German: Darlings Hufeisennase. Portuguese: Morcego ferradura de Darling.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
R. darlingi is represented intermittently in the upper Pleistocene and in the very late Holocene at Border Cave (Avery, 1991: 6).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008aa; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008aa; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004v); IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Jacobs *et al.*, 2016j). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
Jacobs *et al.* (2008aa) [in IUCN (2009)] reported that there appear to be no major threats to this species as a whole.

CONSERVATION ACTIONS:
This species is present within several protected areas. Further taxonomic studies are needed for populations recorded outside of southern Africa. No direct conservation measures are currently needed for the species (Jacobs *et al.*, 2008aa; IUCN, 2009).

GENERAL DISTRIBUTION:
Rhinolophus darlingi is largely distributed in southern Africa with some additional records outside of this area. Skinner and Chimimba (2005) report that it has been recorded from Namibia and northeastern Botswana; that it is widely distributed in Zimbabwe; in South Africa, where its distribution is best predicted by geology (Babiker Salata, 2012: 50), it is known from Limpopo Province, eastern Mpumalanga, northern Gauteng, in parts of the Eastern Cape and the Northern Cape, and from KwaZulu-Natal. In much of eastern Mozambique; and in the lowveld and Lubombo regions of Swaziland. It is unclear if the species is present in Lesotho. Outside of southern Africa, it has been recorded from Benguela in Angola, Banagi in Tanzania, and possibly from Nigeria suggesting a wider distribution than is currently known (Skinner and Chimimba, 2005). Herkt *et al.* (2017: Appendix S9), however, found that there are substantial differences in terms of occupied ecological niches between the populations from southern Africa and those from Nigeria, which support the statement in IUCN (2013) that they may represent a separate species.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,217,047 km^2.

CAS has 5 specimens from the Pyramids of Giza, Egypt, which may be possible misidentifications as these seem to be well outside of the distribution range of the species.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 557); Botswana (Monadjem *et al.*, 2010d: 557); Burundi; Congo (The Democratic Republic of the); Kenya; Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 557); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 557); Namibia (Monadjem *et al.*, 2010d: 557); South Africa (Monadjem *et al.*, 2010d: 557); Swaziland (Monadjem *et al.*, 2010d: 558); Tanzania; Zambia (Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 558); Zimbabwe (Monadjem *et al.*, 2010d: 558).
Presence uncertain: Lesotho; Nigeria.

ECHOLOCATION:
Jacobs *et al.* (2007a) reported a peak frequency of 88.1 (± 2.0) kHz for individuals from South Africa (detector type not reported). For individuals from Swaziland Taylor (1999b) using a Petterssen D980 at Mlawula reported a maximum frequency of 86.2 (± 0.1) kHz, while Monadjem *et al.* (2007a) using an Anabat detector at a number of localities reported a maximum frequency of 85.8 (± 0.36) kHz. Taylor (2000) reported a constant frequency component of 86 kHz. Monadjem *et al.* (2017c: 179) registered the following parameters: F_{min}: 74.3 ± 4.28 (70.8 - 79.1) kHz, F_{knee}: 85.7 ± 0.46 (85.2 - 86.1) kHz, F_c: 85.6 ± 0.38 (85.2 - 85.8) kHz and duration: 26.5 ± 3.74 (22.6 - 30.0) msec. They also indicated that the maximum detection distance was 2 m.

One call from Waterberg, South Africa had the following parameters: Fmax: 87.4 kHz, Fmin: 84.2 kHz, Fknee: 85.6 kHz, Fchar: 85.1 kHz, duration: 28.0 msec (Taylor *et al.*, 2013b: 19). These authors also reported an additional four calls from Swaziland: Fmax: 85.8 ± 0.25 (85.5 - 86.0) kHz, Fmin: 74.5 ± 4.54 (72.3 - 76.1) kHz, Fknee: 84.8 ± 0.52 (84.1 - 85.2) kHz, Fchar: 85.2 ± 0.54 (84.5 - 85.6) kHz, duration: 17.8 ± 3.39 (13.3 - 21.5) msec.

Jacobs (2016: 119) indicates that the second harmonic of this bat coincides with the fourth harmonic of *R. hildebrandtii*, which possibly might illustrate "harmonic hopping".

MOLECULAR BIOLOGY:
DNA - Jacobs *et al.* (2013a: 12) sequenced the Cytochrome *b* gene from the type specimen of *R. d. barbetonensis* Roberts 1924 (TM 2476) (Genbank Nr- KF683217), which grouped with specimens collected from the type locality of the type of *R. darlingi* (Mazoe, Zimbabwe).
Karyotype - Both Peterson and Nagorsen (1975) and Rautenbach (1986) reported, for specimens from Zimbabwe and South Africa respectively, 2*n* = 58, FN = 60, BA = 4, and subtelocentric X and Y chromosomes.
Erasmus and Rautenbach (1984: 94) mention 52 acrocentric and four bi-armed autosomal chromosomes, resulting in 60 autosomal arms.

Protein / allozyme - Unknown.

POPULATION:
Structure and Density - *Rhinolophus darlingi* is a locally common species that, while usually found in small numbers, can be represented by hundreds of bats in a colony (Skinner and Chimimba, 2005) (Jacobs *et al.*, 2008aa; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008aa; IUCN, 2009).

POSTNATAL DEVELOPMENT:
Hoffmaster and Vonk (2016: 1) refer to Carter and Wilkinson (2013), who suggest that *R. darlingi* mothers, cooperating to keep all of the offspring warm, increase the probability of their own offspring's survival.

PARASITES:
Streblidae: *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100).
Nycteribiidae: *Nycteribia scissa rhodesiensis* Theodor, 1957 from Zimbabwe and Malawi (Haeselbarth *et al.*, 1966: 108). *Nycteribia tecta* Theodor,1957 from Zimbabwe and South Africa, but Haeselbarth *et al.* (1966: 110) suggests these may represent a distinct subspecies.

SIPHONAPTERA
Pulicidae: *Echidnophaga aethiops* Jordan and Rothschild, 1906 locality not mentioned (Haeselbarth *et al.*, 1966: 135).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV: Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in one individual from Limpopo Province, South Africa, none were tested positive (0/1).

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies: Oelofsen and Smith (1993) tested five individuals from three localities using "Trousse Platelia Rage" ELISA kit (Diagnostic Pasteur), none tested positive for antibodies to rabies virus glycoprotein G. Oelofsen and Smith (1993) tested five individual brains, from three localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

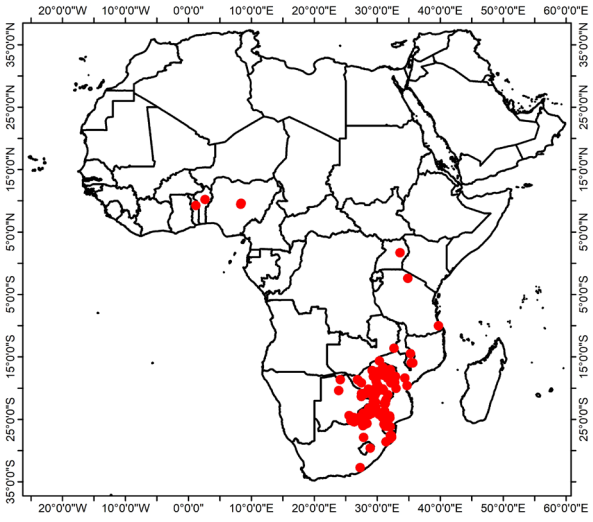


Figure 82. Distribution of *Rhinolophus darlingi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Kenya, Lesotho, Malawi, Mozambique, Namibia, Nigeria, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Rhinolophus deckenii Peters, 1868

*1868. *Rhinolophus Deckenii* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 705 (for 1867). Type locality: Tanzania: Zanzibar coast (mainland opposite Zanzibar) [Goto Description]. Holotype: ZMB 3269: ad ♀, alcoholic (skull missing). Collected by: Baron Karl Klaus von der Decken; collection date: undated. - Etymology: In honour of baron Karl Klaus Von der Decken (1833 - 1865), collector of the type specimen. (Current Combination)
? *Rhinolophus deckeni:* (Alternate Spelling)
? *Rhinolophus deckenii:* (Current Spelling)

TAXONOMY:
Treated as a subspecies of *clivosus* by Hayman and Hill (1971: 23); but see Koopman (1975: 386). *ferrumequinum* species group (Csorba *et al.*, 2003: 41 - 42; Simmons, 2005: 354). See Csorba *et al.* (2003: 41) for remarks on taxonomy.

COMMON NAMES:
Chinese: 德氏菊头蝠. Czech: vrápenec východoafrický. English: Decken's Horseshoe Bat, Eastern Africa horseshoe bat. French: Fer-à-Cheval d'Afrique orientale, Rhinolophe de Decken, Rhinolophe d'Afrique orientale. German: Deckens Hufeisennase. Italian: Rinòlofo di Dècken, Fèrro di cavàllo di Dècken.

CONSERVATION STATUS:
Global - Listed as Near Threatened (NT ver 3.1 (2001)) because this species is probably in significant decline (but probably at a rate of less than, though close to, 30 % over ten years) because of deforestation through much of its range, thus making the species close to qualifying for Vulnerable A2c (Jacobs *et al.*, 2008ab; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Jacobs *et al.*, 2008ab; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004p; IUCN, 2004). 1996 - DD (Baillie and Groombridge, 1996).

MAJOR THREATS:
Jacobs *et al.* (2008ab) [in IUCN (2009)] reported that this species is presumably threatened by the logging and conversion of forest land to agricultural use, especially in coastal areas.

CONSERVATION ACTIONS:
There appear to be no direct conservation measures in place. It has been recorded from some National Parks and Forest Reserves in Tanzania. There is a need to maintain areas of suitable forest habitat for this species. Further research is needed into the species taxonomy, biology and overall natural history (Jacobs *et al.*, 2008ab; IUCN, 2009).

GENERAL DISTRIBUTION:
Rhinolophus deckenii, a little-known East African species has been recorded from Uganda, Kenya, and Tanzania (including the islands of Pemba, and Unguja [=Zanzibar] [see O'Brien, 2011: 286]). It has recently been found in Mozambique.

Native: Kenya; Mozambique (Monadjem *et al.*, 2010d: 558; Monadjem *et al.*, 2010c: 378); Tanzania (including the islands of Zanzibar and Pemba) (Stanley and Goodman, 2011: 42); Uganda.

ECHOLOCATION:
Monadjem *et al.* (2010c: 378) reported from Mozambique that the peak echolocation frequency of a single male was recorded at 72 kHz (ANABAT).

POPULATION:
Structure and density - Small colonies of less than 20 individuals. It is reported to be locally common in some areas, such as the Manga Forest Reserve, Tanzania (Doggart *et al.*, 1999b) (Jacobs *et al.*, 2008ab; IUCN, 2009).
Trend - 2008 - Decreasing (Jacobs *et al.*, 2008ab; IUCN, 2009).

PARASITES:
Streblidae: *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100).
Nycteribiidae: *Nycteribia tecta* Theodor 1957 from Kenya, Uganda, Tanzania and the Sudan (Haeselbarth *et al.*, 1966: 110).

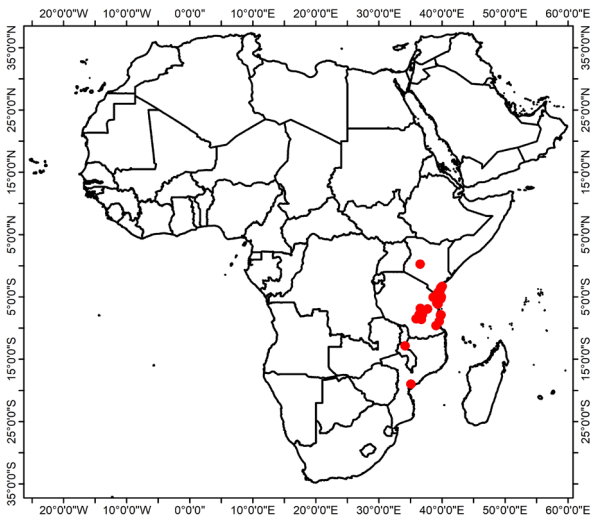


Figure 83. Distribution of *Rhinolophus deckenii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Kenya, Malawi, Mozambique, Tanzania.

Rhinolophus denti Thomas, 1904

*1904. *Rhinolophus Denti* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (77): 386. Publication date: 1 May 1904. Type locality: South Africa: Northern Cape province: [formerly Bechuanaland]: Kuruman [26 28 S 22 27 E, 1 300 m] [Goto Description]. Holotype: BMNH 1904.4.8.2: ♂. Collected by: Captain R.E. Dent; collection date: 24 January 1904; original number: 7. - Etymology: In honour of R.E. Dent (Smithers, 1983: 130; Skinner and Smithers, 1990; Taylor (2005), the collector of the type specimen. (Current Combination)

1960. *Rhinolophus denti knorri* Eisentraut, Stuttg. Beitr. Naturk., 39: 3. Publication date: 1 June 1960. Type locality: Guinea: 12 km W Kolenté, Salung Plateau: Nyembaro [ca. 10 05 N 12 30 W] [Goto Description]. Holotype: SMNS 6111: ad ♂, skin and skull. Collected by: Hans Knorr; collection date: 27 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 293) mention the locality for this specimen as "Salung-Plateau near Nyembaro-Nerebili, 10 km western of Kolenté, 400 m, Guinea". Paratype: SMNS 6112: ad ♀, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Paratype: SMNS 6112a: ad ♀, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Paratype: ZFMK 1959.0174: ♂, skin and skull. Collected by: Hans Knorr; collection date: 15 November 1956; original number: 90. See Hutterer and Peters (2010: 11). Paratype: ZFMK 1959.0175: ♂, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. See Hutterer (1984: 30), Hutterer and Peters (2010: 11).. - Comments: Considered a valid subspecies by Grubb *et al.* (1998: 78). Type specimen in the SMNS.

? *Rhinolophus denti denti:* (Name Combination)

? *Rhinolophus denti:* (Current Spelling)

TAXONOMY:



Figure 84. A female *Rhinolophus denti* (TM 48035) caught at Taung, North-West Province, South Africa.

Placed within the *capensis*-group (Csorba *et al.*, 2003: 9 - 10; Simmons, 2005: 354). Possibly includes *R. swinnyi* (see Roberts, 1914; Csorba *et al.*, 2003: 9 - 10). Two subspecies are currently recognised, besides the nominate form described from the Northern Cape Province of South Africa (and including Namibia, Botswana and Zimbabwe), also *R. d. knorri* Eisentraut, 1960 from Guinea (and including Ghana) (Csorba *et al.*, 2003: 9 - 10; Simmons, 2005: 354). *R. d. knorri* is slightly smaller than the nominate form especially in the length of tibia and ear (Csorba *et al.*, 2003: 9 - 10). See Csorba *et al.* (2003: 9 - 10) for further remarks on taxonomy.

COMMON NAMES:
Afrikaans: Dent se saalneusvlermuis, Dent-saalneusvlermuis, Dentse Vlermuis. Czech: vrápenec Dentův. English: Dent's Horseshoe Bat. French: Rhinolophe de Dent. German: Dents Hufeisennase. Portuguese: Morcego ferradura de Dent.

SIMILAR SPECIES:
R. swinnyi (Shortridge, 1934; Roberts, 1914; 1946: 304). Shortridge (1934) was incorrect though, in indicating that Hewitt (1913) described a new subspecies of *R. denti*, from Pirie in the Eastern Cape province of South Africa, when it was actually *R. swinnyi piriensis* (Hewitt, 1913: 402).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery and Avery (2011: 16) indicate that material from the eastern part of the Northern Cape province in South Africa, that was previously assigned to *R. capensis* should probably be assigned to *R. denti*.

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008ak; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008ak; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004ak; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT D1 ver 3.1 (2001) (Schoeman *et al.*, 2016a). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
Jacobs *et al.* (2008ak) [in IUCN (2009)] reported there appear to be no major threats to this species. It might be locally threatened in parts of its range by disturbance to roosting caves.

CONSERVATION ACTIONS:
There appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further studies are needed into the distribution of this species (particularly in West and Central Africa) (Jacobs *et al.*, 2008ak; IUCN, 2009).

GENERAL DISTRIBUTION:
Rhinolophus denti is widely, but patchily, recorded in West and southern Africa. It ranges from southeastern Senegal, through northern parts of West Africa to northeastern Ghana; in Central Africa it appears to have only been recorded from eastern Congo and southern Angola; in southern Africa, it is present in Namibia, northwestern and southwestern Botswana and northern parts of South Africa, where the species' distribution is linked with land use/land cover (Babiker Salata, 2012: 50).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 781,091 km^2.

A record from Gambia is doubtful according to Kock *et al.* (2002: 85), since it is possibly of an adolescent *R. landeri*, as is the record from Côte d'Ivoire (Csorba *et al.*, 2003: 10) that is also apparently a *R. landeri* (see Simmons, 2005: 354). Records have been reported from Zimbabwe (Smithers and Wilson, 1979: 57; Fenton and Bell, 1981). However, Smithers (1983) later indicated three records from northeastern Zimbabwe in Smithers and Wilson (1979) and Csorba *et al.* (2003: 10) are misidentifications.

Herkt *et al.* (2017: Appendix S9) found that there are major differences between the occupied ecological niches for *denti* from southwestern Africa and *knorri* from West Africa.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 558); Botswana (Smithers, 1971; Csorba *et al.*, 2003: 10; Monadjem *et al.*, 2010d: 558); Ghana (Csorba *et al.*, 2003: 10); Guinea (Csorba *et al.*, 2003: 10); Guinea-Bissau (Rainho and Ranco, 2001: 48; Simmons, 2005: 354); Mozambique (Smithers and Lobão Tello, 1976; Csorba *et al.*, 2003: 10; Smithers and Lobão Tello, 1976); Namibia (Ellerman *et al.*, 1953; Kock and Howell, 1988; Csorba *et al.*, 2003: 10; Monadjem *et al.*, 2010d: 558); Senegal; South Africa (Northern Cape Province (Ellerman *et al.*, 1953; Herselman and Norton, 1985; Rautenbach, 1986; Monadjem *et al.*, 2010d: 558; Csorba *et al.*, 2003: 10), North West Province (James, 1986; Csorba *et al.*, 2003: 10), Free State Province (Watson, 1998; Monadjem *et al.*, 2010d: 558)).

Bates *et al.* (2013: 338) reject the presence of *R. denti* in the Republic of Congo.

GEOGRAPHIC VARIATION:
See "Taxonomy" section.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Smithers (1983), Skinner and Smithers (1990), Taylor (2000), Csorba *et al.* (2003: 9 - 10), Taylor (2005).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Smithers (1983), Skinner and Smithers (1990), Taylor (2000), Csorba *et al.* (2003: 9 - 10), Taylor (2005).

DETAILED MORPHOLOGY:
Baculum - Unknown
Of the skull, teeth and noseleaves see Csorba *et al.* (2003: 9 - 10).

SEXUAL DIMORPHISM:
Five mensural characters (forearm length, fourth metacarpal length, width across the upper canines, rostral width, and length of the mandibular toothrow) showed significant variation between the sexes in an analysis of specimens from Koegelbeen Cave in the Northern Cape Province of South Africa (Rautenbach, 1986).

ECHOLOCATION:
For individuals at Sengwa in Zimbabwe Jacobs (1996) and Fenton and Bell (1981) reported a maximum frequency of 110 kHz. Jacobs *et al.* (2007a) reported a similar peak frequency of 110.9 (± 1.7) kHz for individuals in South Africa.

Jacobs (2016: 119) indicates that the second harmonic of this bat coincides with the fourth harmonic of *R. capensis*, which possibly might illustrate "harmonic hopping".

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Peterson and Nagorsen (1975) reported the diploid number as 2*n* = 58, aFN = 62, BA = 6, X = ST, Y =?, based on specimens from Zimbabwe. These results were supported by Rautenbach (1986) who also reported the Y chromosome to be metacentric. Karyologically identical to *R. swinnyi* (Csorba *et al.* (2003: 9 - 10).
Protein / allozyme - Unknown.

HABITAT:
Found in relatively arid regions (Csorba *et al.*, 2003: 9 - 10). Even the most south easterly record in Africa comes from the drier south-western part of the Free State Province of South Africa (Watson, 1998).

HABITS:
In north western Namibia a specimen shot by Shortridge (1934: 52) at "Rua Cana Falls" had a slow fluttering *Kerivoula*-like flight, and several other individuals were observed "circling low among trees and bushes near the Cunene River on bright moonlight nights". Found roosting at Drotsky's Cave in Namibia throughout the year (Smithers, 1983; Skinner and Smithers, 1990; Taylor, 2005).

ROOST:
Shortridge (1934: 52) records finding a single individual, at Louisvale in the Northern Cape Province of South Africa, inside a low water culvert occupied by a small colony of *Nycteris*. Shortridge, 1934: 52) also records finding two individuals "hanging from the thatched roof inside a small native house at Kaoko-Otavi" in the north western part of Namibia. Also found in caves (Smithers, 1983; Skinner and Smithers, 1990; Taylor, 2005). At Drotsky's Cave in Namibia the bats were "clinging to the sides of stalactites…hanging freely from the sides in open clusters", and were found in semi-dark 90 m from the cave entrance and in total darkness deep in the cave (Smithers, 1983; Skinner and Smithers, 1990; Taylor, 2005). Notes on an index card for specimens in the Transvaal Museum, from a cave near Warrenton in the Northern Cape Province of South Africa, indicate the cave was wet with water on the floor and dripping from stalactites, and that the bats congregated in separate groups. James (1986: 218) recorded a single individual at a disused quarry near Buxton in the North West Province, roosting on the ceiling of a "ruined mine structure which formed a 2 x 2 x 20 m cement, semi-dark room in a hillside".
Weber and Fahr (2006: 4) indicate that, in Guinea, *R. denti* largely or exclusively depends on the availability of caves as day roosts.

MIGRATION:
May not migrate as *R. denti* has been found roosting at Drotsky's Cave in Namibia throughout the year (Smithers, 1983; Skinner and Smithers, 1990; Taylor, 2005).

DIET:
Insectivorous (Smithers, 1983; Skinner and Smithers, 1990; Taylor, 2000; 2005).

POPULATION:
Structure - The species is known from fewer than 100 in colonies in West Africa, and fewer than 200 colonies in southern Africa (Jacobs *et al.*, 2008ak; IUCN, 2009).
Density - "Sparsely distributed", with no records of large colonies (Shortridge, 1934:52). At Drotsky's Cave in Namibia the bats were observed "clinging to the sides of stalactites in dozens" (Smithers, 1983; Skinner and Smithers, 1990; Taylor, 2005). Herselman and Norton (1985: 92) indicated that this species had not been collected from the Northern Cape province in the "last half century"

and could be considered as "extremely rare, possibly extinct, in the Cape Province". Yet, specimens in the Transvaal Museum, collected from the Northern Cape Province of South Africa between 1983 and 1988, indicate that at three different visits; 12, 71 and 15 specimens were taken from Koegelbeen Cave, 12 specimens were taken on a single date from a cave near Warrenton, and 11 specimens were taken on a single date from a locality near Postmasberg.
Trend - 2008 - Unkown (Jacobs *et al.*, 2008ak; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Notes on an index card for specimens in the Transvaal Museum, from a cave near Warrenton in the Northern Cape Province of South Africa, indicate that on 14th of June 1983 the bats were in torpor.

PARASITES:
Brennan *et al.* (2015: 145) found no antibodies against *Pseudogymnoascus destructans* (White-nose syndrome) in blood samples from bats from Botswana.

VIRUSES:
Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that two out of three examined South African *R. denti* specimens tested positive for *Paramyxovirus* sequences.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies: Oelofsen and Smith (1993) tested 12 individuals from three localities using "Trousse Platelia Rage" ELISA kit (Diagnostic Pasteur), none tested positive for antibodies to rabies virus glycoprotein G. Oelofsen and Smith (1993) tested 15 individual brains, from two localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

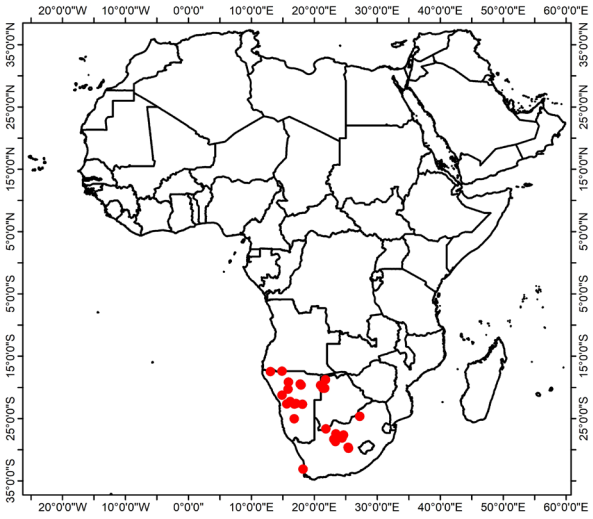


Figure 85. Distribution of *Rhinolophus denti*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Botswana, Namibia, South Africa.

Rhinolophus eloquens K. Andersen, 1905

*1905. *Rhinolophus Hildebrandti eloquens* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 15 (85): 74. Publication date: 1 January 1905. Type locality: Uganda: Entebbe [00 04 N 32 28 E, 3 800 ft] [Goto Description]. Holotype: BMNH 1899.8.4.4: ad, skin only. Collected by: Sir Frederic John Jackson. See Andersen (1905a: 75). Topotype: ROM 68683: ad ♀, alcoholic (skull not removed). Collected by: Theo Simpson Jones; collection date: 4 July 1963. Presented/Donated by: ?: Collector Unknown. - Etymology: From the Latin masculine adjective *èloquens*. Andersen (1905a) provides no etymological information; however, it is possible that this *Rhinolophus* is "eloquent" from a phylogenetic and zoogeographical point of view, as Andersen (1905a: 75) writes that "The present form is of great interest from phylogenetic no less than from a zoogeographical point of view" (see Lanza *et al.*, 2015: 93).
1922. *Rhinolophus hildebrandti perauritus* de Beaux, Atti Soc. ital. Sci. nat., 61: 22. Publication date: February 1922. Type locality: Somalia: Territory of the Rahanuin [Goto Description].
2016. *Rhinolophus eloquensis:* Amori, Segniagbeto, Decher, Assou, Gippoliti and Luiselli, Zoosystema, 38 (2): 219. Publication date: 24 June 2016. (Lapsus)
? *Rhinolophus aethiops eloquens:* (Name Combination)
? *Rhinolophus eloquens eloquens:* (Name Combination)
? *Rhinolophus eloquens:* (Name Combination, Current Combination)
? *Rhinolophus fumigatus eloquens:* (Name Combination)

TAXONOMY:
Included as subspecies in *aethiops* by Kock (1969a: 121). Includes *perauritus*; see Koopman (1975: 389). *fumigatus* species group (Csorba *et al.*, 2003: 47 - 48; Simmons, 2005: 354). See Csorba *et al.* (2003: 48) for remarks on taxonomy.

COMMON NAMES:
Chinese: 乌干达菊头蝠. Czech: vrápenec ugandský. English: Eloquent Horseshoe Bat. French: Rhinolophe éloquent. German: Andersens Hufeisennase. Italian: Rinòlofo eloquènte, Fèrro di cavàllo eloquènte.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008ac; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008ac; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004u; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
Rhinolophus eloquens is threatened by the general conversion of its habitat to agricultural use (Jacobs *et al.*, 2008ac; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ac) [in IUCN (2009)] reported there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research needed into the distribution, natural history and threats to this bat.

GENERAL DISTRIBUTION:
Rhinolophus eloquens is endemic to Central and Eastern Africa. It has been recorded from southern Sudan, eastern Democratic Republic of the Congo, Rwanda, Uganda, Kenya, Somalia and the islands of Pemba, Unguja [=Zanzibar], and Mafia in Tanzania (see O'Brien, 2011: 286).

Native: Congo, (Democratic Republic of) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 558); Ethiopia (Lavrenchenko *et al.*, 2004b: 147); Kenya; Rwanda; Somalia; Sudan; Tanzania (United Republic of); Uganda.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Jacobs *et al.*, 2008ac; IUCN, 2009). Trend - 2008 - Unknown (Jacobs *et al.*, 2008ac; IUCN, 2009).

PARASITES:
HEMIPTERA:
Polyctenidae: *Androctenes horvathi* Jordan 1912 recorded from Kenya and Sudan (Haeselbarth *et al.*, 1966: 17).

DIPTERA:
Streblidae: *Brachytarsina africana* (Walker, 1849) has a wide distribution in subsaharan Africa (Haeselbarth *et al.*, 1966: 100). Jobling (1954) as mentions *Raymondia intermedia* Jobling, 1936 as possible parasite of *R. eloquens* (see also Shapiro *et al.*, 2016: 255). *Raymondia seminuda* Jobling, 1954 (Shapiro *et al.*, 2016: 255).
Nycteribiidae: *Nycteribia hoogstraali* Theodor, 1957 from the Torit district in the Sudan (Zumpt 1966: 109). *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114).

ACARI:
Trombiculidae: Stekolnikov (2018a: 50) reported the presence of *Whartonia oweni* Vercammen-Grandjean and Brennan, 1957.

VIRUSES:
Filoviridae - Filoviruses
Marburgvirus
Kuzmin *et al.* (2010b: 353) detected MARV RNA in 3.6 % of the examined *R. eloquens* in the DRC.
Luis *et al.* (2013: suppl.) report the presence of Lake Victoria marburg virus.

Rhabdoviridae
Vesiculovirus
Mount Elgon bat virus is reported by Luis *et al.* (2013: suppl.) although they remark that the bat might have been a *R. hildebrandti*.

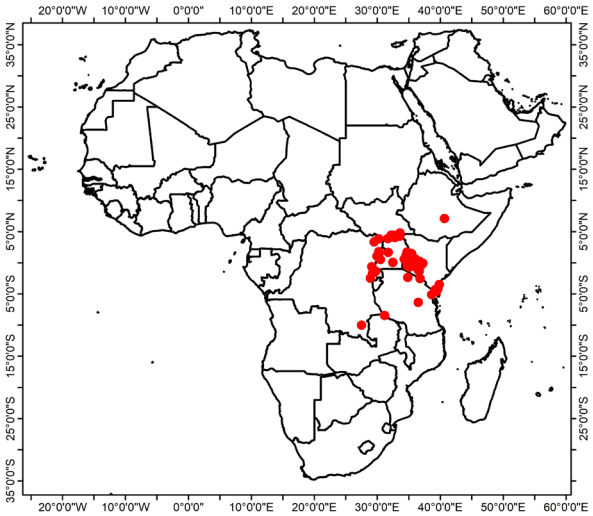


Figure 86. Distribution of *Rhinolophus eloquens*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, Uganda.

Rhinolophus euryale Blasius, 1853

*1853. *Rhinolophus euryale* Blasius, Arch. Naturgesch. Berlin, 19 (1): 49, 52, 54. Publication date: 1853. Type locality: Italy: Milan. - Etymology: Referring to "*Euryale*", one of the Gorgons (see Palmer, 1904: 279). (Current Combination)
1867. *Rhinolophus algirus* Loche, Exploration scientifique de l'Algerie pendant les années 1840, 1841, 1842. Mammifères, Cheiroptères, 83. Publication date: 1867. Type locality: Algeria: "Jardin Marengo". - Comments: Allen (1939a: 74) states that this name is not certainly identifiable, but may possible prove to supersede *barbarus* if the types can be found. Ellerman and Morrison-Scott (1951: 120) include it with a question mark in the synonymy of *R. euryale barbarus*.
1896. *Hipposiderus euryale:* Thomas, Ann. Mus. civ. Stor. nat. Genova, (2) 17 (37): 105. (Name Combination)
1904. *E[uryalus] atlanticus* K. Andersen and Matschie, Sber. Ges. naturf. Freunde Berlin, 77. Type locality: France: Indre-et-Loire: St. Paterna. Holotype: ZMB 12963: ♂, alcoholic (skull not removed). Collected by: Nitsche; collection date: 6 April 1893; original number: (formerly ZMB 6705). See Turni and Kock (2008: 28). Paratype: MNHN ZM-MO-1879-2030: alcoholic (skull not removed). Collected by: The Lataste collection. See Rode (1941: 238).
1904. *E[uryalus] Cabreræ* K. Andersen and Matschie, Sber. Ges. naturf. Freunde Berlin, 78. Type locality: Spain: Madrid: Alcata de Henares [40 25 N 03 43 W]. Holotype: ZMB 12964: ♀, alcoholic (skull not removed). Original number: ex. Museum Madrid. See Turni and Kock (2008: 28). - Comments: Mentioned as *cabrerai* by Trouessart, 1910 (see Cabrera, 1914: 83).
1970. *R[hinolophus] euryole:* Rushton, Ann. Génét. Sél. anim., 2 (4): 463. (Lapsus)
1970. *Rhinolophus euroyle:* Rushton, Ann. Génét. Sél. anim., 2 (4): 466. (Lapsus)

TAXONOMY:
Revised by DeBlase (1972). Gaisler (2001: 68) does not recognises subspecies. *euryale* species group (Csorba *et al.*, 2003: 14 - 16; Simmons, 2005: 354 - 355). See Csorba *et al.* (2003: 16) for remarks on taxonomy.

COMMON NAMES:
Albanian: Lakuriq nate hundëpatkua i Mesdheut. Arabian: Khaffash. Armenian: Հարավային պայտաքիթ. Azerbaijani: Cə nub nalburunu. Basque: Ferra-saguzar mediterraneo. Belarusian: Падкаванос міжземнаморскі. Bosnian: Mediteranski potkovasti š iš miš. Breton: Frigribell greizdouarel. Bulgarian: Южен подковонос. Castilian: Murciélago mediterráneo de herradura, Rinolofo mediterraneao de herradura, Murciélago de herradura mediterráneo. Catalan: Ratpenat de ferradura mediterrani, Rat penat mediterrani de ferradura, Ratapinyada mediterrània de ferradura. Croatian: Už ni potkovnjak. Czech: Vrápenec již ní, Vrápenec stř edozemský. Danish: Middelhavehestekonæse. Dutch: Paarse hoefijzerneus. English: Mediterranean Horseshoe Bat. Estonian: Vahemere sagarnina. Finnish: Välimerenherkko. French: Rhinolophe euryale. Frisian: Pearse hoefizernoas. Galician: Morcego de ferradura mediterráneo, Morcego mediterráneo de ferradura. Georgian: სამხრეთული ცხვირნალა. German: Mittelmeerhufeisennase, Mittelmeer-Hufeisennase, Gleichsatteligen Kammnase. Greek: Μεσορινόλοφος. Hebrew: Parsaf Bahir. Hungarian: Kereknyergű patkósdenevér, Kereknyergû patkósorrú denevér, Rinolophos i mesogiaki. Italian: Rinolofo mediterraneo, Rinolofo Eurìale, Ferro di cavallo Eurìale, ferro di cavallo mediterraneo. Irish Gaelic: Crú-ialtóg Mheánmhuirí. Latvian: Vidusjuras pakavdegunis. Lithuanian: Pietinis pasagnosis. Luxembourgish: Mëttelmier-Huffeisennues. Macedonian: Медитерански потковичар, Juzhen Potkovichar. Maltese: Rinolofu tal-Mediterran. Montenegrin: Južni potkovičar. Norwegian: Middelhavshesteskonese. Polish: Podkowiec ś ródziemnomorski. Portuguese: Morcego-de-ferradura-mediterrânico. Rhaeto-Romance: Rinolof mediterran. Romanian: Liliacul mediteranean cu potcoavă, Liliac-sudic. Russian: Подковонос южный, Южный подковонос [= Yuzhnyj podkovonos]. Serbian: Средоземни потковичар [= Sredozemni potkovičar]. Scottish Gaelic: Crudh-ialtag Meadhan-thìreach. Slovak: Podkovár južný. Slovenian: Južni podkovnjak. Swedish: Medelhavshästskonäsa. Turkish: Akdeniz Nalburunlu Yarasası. Ukrainian: Підковик (iідковоніс) південний. Welsh: Ystlum pedol Môr y Canoldir.

SIMILAR SPECIES:
Puechmaille and Teeling (2013: 252) point out that visual identification of hibernating bats might be problematic in the case of *R. euryale* and *R. mehelyi*, as bat they originally identified as *R.*

mehelyi turned out to belong to the other species after using non-invasive genetic tests on the animals' droppings.

CONSERVATION STATUS:
Global - Many range states have reported that populations have declined, and colonies have disappeared over the last 27 years (=3 generations). It is inferred that overall population decline has approached 30 % over that period (although the population is now stable and or even increasing in some areas, e.g. France), so the species is assessed as Near Threatened (approaching A2c) (NT ver 3.1 (2001)) (Hutson *et al.*, 2008o; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Hutson *et al.*, 2008o; IUCN, 2009). 1996 - VU A2c ver 2.3 (1994).

MAJOR THREATS:
Threats include loss of foraging habitat, and disturbance and loss of underground habitats. On a landscape scale, fragmentation and loss of linear elements such as hedgerows and riparian vegetation is a problem because such elements are used as landscape references for commuting. The species' strong dependence upon caves for roosting makes it particularly sensitive to cave disturbance, such as that from caving or tourism. Tourist disturbance of caves affects the species in several range states. The use of organochlorine pesticides is believed to have contributed to the earlier dramatic decline of the species in France (Brosset *et al.*, 1988). In North Africa, threats include habitat loss due to agriculture (livestock) and human disturbance (Hutson *et al.*, 2008o; IUCN, 2009).

Aerial hawking, water stress, and its small distribution range are believed to be the most important risk factors for this species linked with climatic change (Sherwin *et al.* (2012: 174).

CONSERVATION ACTIONS:
Hutson *et al.* (2008o) [in IUCN (2009)] reported *Rhinolophus euryale* is protected by national legislation in most range states. There are also international legal obligations for protection of this species through the Bonn Convention (Eurobats) and Bern Convention, where these apply. It is included in Annex II (and IV) of EU Habitats and Species Directive, and hence requires special measures for conservation including designation of Special Areas for Conservation. There is some habitat protection through Natura 2000, and some roosts are already protected by national legislation). The species is directly or indirectly benefiting from EU LIFEfunded projects in France, Spain and Italy. No specific measures are in place in North Africa.

GENERAL DISTRIBUTION:
Rhinolophus euryale is a western Palaearctic species, occurring in southern Europe, north-west Africa (known range extends across northern Morocco, Algeria, and Tunisia), and the Near East. There is only a single record from Cyprus, but this is regarded by most authors to be *R. mehelyi*. It is widely distributed over its range, and is found from sea level to 1,000 m.

Native: Abkhasia; Albania; Algeria (Csorba *et al.*, 2003: 16); Andorra; Armenia; Azerbaijan; Bosnia and Herzegovina; Bulgaria; Croatia; France (Corse) (Csorba *et al.*, 2003: 16); Georgia; Gibraltar; Greece (East Aegean Is.); Holy See (Vatican City State); Hungary; Iran (Csorba *et al.*, 2003: 16), Islamic Republic of; Iraq; Israel (Csorba *et al.*, 2003: 16); Italy (Sardegna, Sicilia); Jordan; Lebanon [see Horácek *et al.* (2008: 55)] (Csorba *et al.*, 2003: 16); Macedonia, the former Yugoslav Republic of; Monaco; Montenegro; Morocco (Csorba *et al.*, 2003: 16; El Ibrahimi and Rguibi Idrissi, 2015: 359); Palestinian Territory, Occupied; Portugal (Csorba *et al.*, 2003: 16); Romania; Russian Federation; San Marino; Serbia; Slovakia; Slovenia; Spain; Syrian Arab Republic (Csorba *et al.*, 2003: 16); Tunisia (Csorba *et al.*, 2003: 16; Dalhoumi *et al.*, 2016b: 867); Turkey (Csorba *et al.*, 2003: 16).
Regionally extinct: Switzerland.
Presence uncertain: Cyprus [see Benda *et al.* (2007: 71)]; Egypt; Turkmenistan.

DETAILED MORPHOLOGY:
Baculum - See Csorba *et al.* (2003: 15).

In their study on take-off performance, Gardiner *et al.* (2014: 1059) determined a wing beat frequency of 11.48 ± 0.50 Hz.

ECHOLOCATION:
The data for 38 animals from Greece were the following: F_{start}: 91.8 ± 5.00 kHz, F_{end}: 88.7 ± 3.49 kHz, F_{peak}: 104.8 ± 0.96 kHz, bandwidth: 3.5 ± 1.05 kHz, duration 53.8 ± 20.42 msec and interpulse interval: 84.5 ± 30.01 msec (Papadatou *et al.*, 2008b: 132).

Walters *et al.* (2012: suppl.) report the following figures for 26 calls (15 sequences) from French and Italian bats: duration: 35.23 ± 18.06 msec, F_{max}: 102.28 ± 1.20 kHz, F_{min}: 88.22 ± 4.30 kHz, bandwidth: 14.06 ± 3.69 kHz, F_{peak}: 101.68 ± 2.18 kHz.

Animals from Tunisia emitted sounds at 102.39 ± 1.01 kHz (105.0 - 106.5 kHz; Dalhoumi *et al.*, 2016b: 866).

Schuchmann *et al.* (2012: 161) found that both sexes were able to recognize the sex of conspecifics from their echolocation calls.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Both Bovey (1949) and Capanna and Manfredi Romanini (1971) reported 2*n* = 58, FN = 60. Rushton (1970: 463) also reported 2*n* = 58, FN=60, with two (sub)metacentric, 24 acrocentrics, and 2 minute pairs or acrocentric chromosomes. The X chromosome is reported as submetacentric and the Y chromosome as minute. Zima *et al.* (1992a) reported 2*n*=58, FN=60, BA=4, a submetacentric X chromosome and a metacentric Y chromosome for a specimen from Greece.

Capanna and Civitelli (1964a: 371) reported 2*n* = 58, including 24 acrocentric pairs, 2 metacentric pairs and two pairs of very small chromosomes. The X chromosome was reported as a large submetacentric and the Y as a very small one.

Protein / allozyme - Unknown.

HABITAT:
Russo *et al.* (2005: 327) and Goiti *et al.* (2008: 498 - 499) indicate that, in Spain, *R. euryale* always foraged in areas where there were trees, and never over open meadows, pastures, heath, gorse- or fern-covered areas (or any other open habitats). About 96 % of the bats they tagged, used hedgerows to forage in. The second most frequented habitat (90 %) was broad-leaved woodland, whereas isolated trees were visited between 1 and 12 %. Exotic tree plantations (e.g. *Eucalyptus* formed the least preferred habitat. Furthermore, the breeding colony size was found to be positively correlated with the availability of edges around breeding sites.

HABITS:
From the Iberian Peninsula, Goiti *et al.* (2006: 141) reported that during pre-breeding foraging occurred on average within 1.3 km, and at most 4.2 km from the roost. For lactating females, the average distance was 4.3 km, and a maximum distance from the roost of 9.2 km was observed. In the same period, males foraged closer (mean 1.9 km). During the post-lactation period, adults travelled a mean of 4.6 km, whereas juveniles flew on average only 2.6 km.

ROOST:
Based on data from Sardinia, Russo *et al.* (2014: 9) rule out that *R. euryale* and *R. mehelyi* compete for roosting sites.

DIET:
In northern Spain, Goiti *et al.* (2008: 496 - 497) examined 810 feces from 168 bats. These showed that the bat's diet included 10 prey categories, of which the Lepidoptera (moths) formed the staple diet (between 68 and 99 % of the diet). Moths are also the most important prey during lactation and post-lactation. Another important prey item, although very seasonal and especially prebreeding, was the beetle *Rhizotrogus* (Scarabaeidae). Other food items (in descending rank) included lacewings (Neuroptera, Chrysopidae and Hemerobiidae), craneflies (Diptera, Tipulidae), brachyceran flies, Psocoptera, and Hymenoptera. Diets were similar for adults and juveniles.

In the southwestern Iberian peninsula, Arrizabalaga-Escudero *et al.* (2018: Suppl.) identified the following food items from faecal samples of *R. euryale* (food items marked with an asterisk were also found in faecal samples of *R. mehelyi*): Coleoptera (Cerambycidae: *Arhopalus ferus* (Mulsant, 1839)*); Diptera (Tachinidae: unidentified*: *Phryno vetula* (Meigen, 1824); Muscidae: *Polietes lardarius* (Fabricius, 1781)); Lepidoptera (Crambidae: *Calamotropha paludella* (Hübner, 1824)*; *Metasia ophialis* (Treitschke, 1829); *Ostrinia nubilalis* (Hübner, 1796)*; Erebidae *Catocala nymphaea* (Esper, 1787); *Catocala nymphagoga* (Esper, 1787)*; *Lygephila lusoria* (Linnaeus, 1758); Gelechiidae: *Teleiopsis* sp.*; Geometridae: *Aplasta ononaria* (Füssli, 1783); *Camptogramma bilineata* (Linnaeus, 1758)*; *Ennomos quercaria* (Hübner, 1813)*; *Gymnoscelis rufifasciata* (Haworth, 1809); *Idaea ochrata/rufaria*; *Pachycnemia hippocastanaria* (Hübner, 1799)*; *Rhoptria asperaria* (Hübner, 1817)*; Noctuidae: *Acronicta rumicis* (Linnaeus, 1758); *Agrotis segetum/trux**; *Agrotis ipsilon* (Hufnagel, 1766)*; *Amphipyra tragopoginis* (Clerck, 1759); *Apamea monoglypha/sicula*; *Apamea arabs* Oberthur, 1881; *Autographa gamma/pulchrina**; *Calophasia platyptera* (Esper, [1788])*; *Cosmia trapezina* (Linnaeus, 1758); *Mythimna albipuncta* (Denis & Schiffermüller, 1775)*; *Mythimna loreyi/sicula**; *Peridroma saucia* (Hübner, 1808)*; *Polyphaenis sericata* (Esper, 1787)*; *Sesamia nonagrioides* (Lefèbvre, 1827)*; Nolidae: *Meganola strigula* (Denis & Schiffermüller, 1775); Praydidae: *Prays fraxinella* Bjerkander, 1784*; Pyralidae: *Ephestia mistralella* (Millière, 1874); *Pempelia palumbella* (Denis & Schiffermüller, 1775)*; *Phycita* sp.; Tortricidae: *Cnephasia* sp. 1*; *Cnephasia* sp. 2*); Neuroptera (Chrysopidae: *Chrysoperla* sp.*;

Cunctochrysa albolineata (Killington, 1935); *Pseudomallada flavifrons* (Brauer, 1851); Myrmeleontidae: *Distoleon tetragrammicus* (Fabricius, 1798)*); Orthoptera (Tettigoniidae: *Tessellana tessellata* (Charpentier 1825)). Of the 62 prey taxa, 32 (representing over 75 % of all food items) were consumed by both bat species.

Andreas *et al.* (2013) using faecal analysis of *R. euryale* from southern Slovakia, showed that this species mainly fed on medium-sized moths (25 - 40 mm) (%f = 60; %vol = 74) and the diet of *R. euryale* contained Neuroptera (Hemerobiidae) (%f = 2.2; %vol = 0.3), nematoceran Diptera (%f = 13.3; %vol = 9.1) and Trichoptera (%f = 6.7; %vol = 3.6). In the same area (and northern Hungaria), Miková *et al.* (2013: 848) investigated the relation between food and ambient temperature during winter.

Ahmim and Moali (2013: 175) examined droppings from northern Algeria, which contained mainly Insecta (96.19%) and Chilopoda (3.81%). Diptera accounted for 29.00 % (Culicidae: 14.29 %, Chironomidae/Ceratopogonidae: 7.14 %, and Tipulidae: 5.71 %. Lepidoptera were the second most important order and accounted for 19.08 %.

Laurent (1944a: 13) tried to (force) feed captive animals with mealworms (*Tenebrio molitor*), but these were rejected.

Gardiner *et al.* (2014: 1058) assessed its foraging strategy as "low altitude slow aerial hawking", with no observations of gleaning.

In Hungary, Maxinová *et al.* (2017a: 98) examined "non-consumptive faeces" (produced during hibernation after no feeding activity) and found these not to contain any insect DNA, but rather bat DNA as well as peptides belonging to other craniates and eukaryotes. They also found bacterial peptides and one Nematode. Furthermore, the high concentration of inorganic material suggest that drinking as well as direct sediment consumption occur inside the cave environment during the hibernation period. They conclude that winter arousals are primarily aimed at regulating the water balance. Maxinová *et al.* (2017b: 93) also found that the bat's digestive enzymes (amylase, chitobiase, endochitinase and glukosaminidase) remained active during the entire hibernation period.

POPULATION:
Structure and Density - According to Hutson *et al.* (2008o) [in IUCN (2009)], *R. euryale* is an infrequent species. Summer colonies number ca. 50 - 1,500 individuals (S. Aulagnier *pers. comm.,* 2007). Winter clusters typically number up to 2,000 animals. It occurs in large vulnerable colonies and is considered threatened in many range states. Large population declines have been reported in several European countries, including Spain (Palomo and Gisbert, 2002). In France, the population declined by ca. 70 % between 1940 and 1980, although subsequently the trend appears to have stabilised (Brosset *et al.*, 1988; S. Aulagnier *pers. comm.,* 2007). Apart from *R. blasii*, which may have gone extinct in the country, *R. euryale* is probably the rarest rhinolophid in Italy, and anecdotal evidence suggests that a number of colonies have declined in the past few decades (D. Russo *pers. comm.,* 2006). The species has a very small and declining population in Portugal (Rodrigues *et al.*, 2003; Cabral *et al.*, 2005). It is stable and common in the central and eastern Balkans (M. Paunovic *pers. comm.,* 2007).
There is little information on population trends outside Europe, although it is suspected that continuing declines have also occurred in at least parts of the non-European range. For example, in Iran the species is no longer found in caves which 30 years ago held 20,000 individuals of different species (M. Sharifi *pers. comm.,* 2005).
Trend - 2008 - Decreasing (Hutson *et al.*, 2008o; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 13 years, and Ibáñez *et al.* (2018: 80) recaptured a male bat in La Rioja (Spain) that was banded 21 years before.

REPRODUCTION AND ONTOGENY:
Tuttle and Stevenson (1982: 121) indicate that males need about 27 months to reach sexual maturity, whereas females need between 15 and 27 months.

Szekely *et al.* (2015: Suppl.) mention that both males and females become sexually mature after 821 days (= about 27 months). The gestation period takes 90 days, after which a young is born with a weight of 3.89 g (adult: 8.2 g).

POSTNATAL DEVELOPMENT:
In Iran, Eghbali *et al.* (2017: 276) found that the young's body mass increased linearly until day 23, when it attained 74.29 % of the mean mass of adult females. Its body mass increased (from 3.58 g at birth) by 0.36 g per day and its forearm length increased (from 20.10 mm at birth) by 1.41 mm/day. By day 70, the epiphysal gap was closed. The wing load decreased by 0.09 Nm^{-2}/ day until day 36, and subsequently increased again to a maximum of 6.56 ± 0.30 Nm^{-2} by day 80.

PARASITES:
Hirst (1923: 989) mentions that Kolenati described a mite (*Periglischrus interruptus*) from a bat, he originally identified as "*R. clivosus* [= *R. blasii*]", but that he corrected this later to *R. euryale*.

Ševcík *et al.* (2012: 35) report on the presence of the bat flies *Nycteribia schmidlii schmidlii* Schiner, 1853 and *Phthiridium biarticulatum* Hermann, 1804 on bats from Cyprus.

The bat flies *Brachytarsina flavipennis* Macquart, 1851 (Streblidae) and *Phthiridium biarticulatum* Hermann, 1804 (Nycteribiidae) were reported from Jordan by Benda *et al.* (2010b: 238). Benda *et al.* (2010b: 238) also refer to previous reports from Turkey mentioning the following parasites: *Nycteribia pedicularia* Latreille, 1805, *N. schmidlii* Schiner, 1853, *N. kolenatii* Theodor and Moscona, 1954, *N. vexata* Westwood, 1835, *Brachytarsina flavipennis* Macquart, 1851, and *Rhinolophopsylla u. unipectinata* (Taschenberg, 1880) and in Palestine *Penicillidia conspicua* Speiser, 1901 and *P. dufourii* (Westwood, 1835).

Bendjeddou *et al.* (2017: 15) reported the following ectoparasites from Algeria: Nycteribiidae: *Nycteribia (Nycteribia) pedicularia* Latreille, 1805, *Penicillidia (Penicillidia) dufourii* Westwood, 1835 and *Phthiridium biarticulatum* Hermann, 1804; and Siphonaptera: *Rhinolophopsylla unipectinata arabs* Jordan and Rothschild, 1921.

From Tunisia, Vermeil (1960: 738) reported the presence of the Nycteribiids *Nycteribia latreillii* Leach, 1817 and *Nycteribia vexata vexata* Westwood, 1835.

From non-specified areas, Haelewaters *et al.* (2018: 974) reported the Nycteribiid *Penicilidia conspicua* Speiser, 1901, which might be a host for the fungus *Arthrorhynchus nycteribiae* (Peyr.) Thaxt.

Malinicová *et al.* (2017: 211) investigated the gut microflora of Hungarian *R. euryale* during hibernation and found that the number of enterobacteria and enterococci decreased during hibernation and were restored at the end of hibernation.

VIRUSES:
Coronaviridae - Coronaviruses
Luis *et al.* (2013: suppl.) mention the presence of a SARS coronavirus-related virus.

Alphacoronavirus
Reported from Germany by Kohl and Kurth (2014: 3112).
Ar Gouilh *et al.* (2018: 90) reported the EPI 10 virus from an *R. euryale* from Morocco.

Betacoronavirus
Reported from Bulgaria and Germany by Kohl and Kurth (2014: 3112).

Orthomyxoviridae
Despite sampling and testing of 2 individuals of this species, no evidence of influenza A-like viruses (Orthomyxoviridae) were obtained (Fereidouni *et al.*, 2015).

Rhabdoviridae
Lyssavirus
Serra-Cobo *et al.* (2018: 2) found one out of 31 Algerian bats testing seropositive for European bat lyssavirus1 and none of the twelve Moroccan bats.

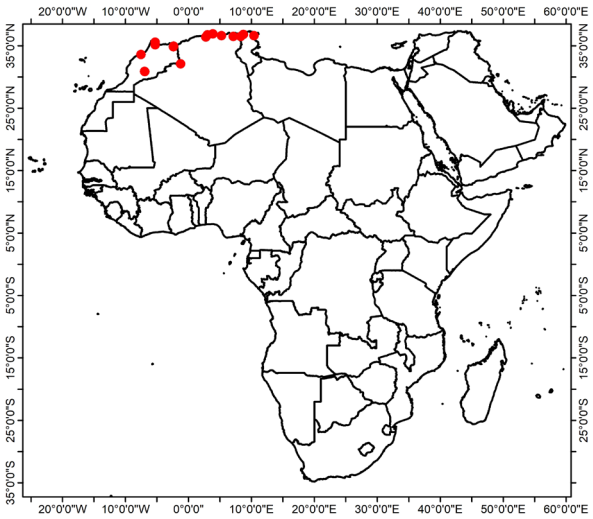


Figure 87. Distribution of *Rhinolophus euryale*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, Egypt, France, Morocco, Tunisia.

Rhinolophus ferrumequinum (Schreber, 1774)

*1774. *Vespertilio ferrum-equinum* Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, 1 (8): pl. 62, upper fig + 1 (9): 174. Publication date: 1774. Type locality: France: "France". - Etymology: From the Latin "*ferrum*" meaning iron and "*equus*" meaning horse.

1792. *Vespertilio ferrum-equinum major* Kerr, Animal Kingdom, 1 (1): xvii, 99. Type locality: France. - Comments: This might be an African form, but we lack further information.

1803. *major* E. Geoffroy Saint-Hilaire, Catalogue des Mammifères du Muséum national d'Histoire naturelle, Paris, ???. - Comments: This might be an African form, but we lack further information.
1961. *Rhinolophus ferrumequinum millali:* Lavocat, Notes Mém. Serv. Mines Carte geol. Maroc, 155: ?. Type locality: Morocco. - Comments: This is a fossil form from the Miocene-Pliocene. (Name Combination)
? *Rhinolophus ferrumequinum ferrumequinum:* (Name Combination)
? *Rhinolophus ferrumequinum:* (Name Combination, Current Combination)

TAXONOMY:
Taxonomic revisions by Felten *et al.* (1977), Strelkov *et al.* (1978), Kryštufek (1993) and Thomas (1997). Thomas (1997) recognized seven subspecies based on morphological characters (*R. f. ferrumequinum* in Europe and northwest Africa, *R. f. creticum* in Crete, *R. f. irani* in Iran, Iraq and Turkmenistan, *R. f. proximus* from Afghanistan and Pakistan to India, *R. f. tragatus* in north India and China, *R. f. korai* in Korea and *R. f. nippon* in Japan). *ferrumequinum* species group (Csorba *et al.*, 2003: 42 - 45; Simmons, 2005: 355). See Csorba *et al.*, 2003: 44 - 45) for further remarks on the taxonomy.

Based on cytochrome *b* analyses, Koh *et al.* (2014: 97) indicate that northern African populations form one clade with specimens from Europe and western Asia, which is different from three other clades: far-eastern Asia, eastern China and central China.

COMMON NAMES:
Albanian: Lakuriq nate hundëpatkua i madh. Arabian: Khafash abu hadwa kabir, Khaffash. Armenian: Մեծ պայտաքիթ. Azerbaijani: Böyük nalburun. Basque: Ferra-saguzar handi. Belarusian: Падкаванос вялікі. Bosnian: Veliki potkovasti šišmiš. Breton: Frigribell vras. Bulgarian: Голям подковонос. Castilian: Murciélago grande de herradura, Rinolofo grande de herradura. Catalan: Rat penat gran de ferradura, Ratapinyada gran de ferradura, Ratpenat de ferradura gran. Croatian: Veliki potkovnjak. Czech: Vrápenec velký, wrápenec podkowní, podkováček, podkováček, obecný, vrápenec podkovní, v. podkovníček, v. veliký, veliký vrápenec podkovní, vrápeník podkovní, vrápenec podkrovní. Danish: Stor hestekonæse. Dutch: Grote hoefijzerneus. English: Larger Horseshoe Bat, Greater Horseshoe Bat. Estonian: Suur-sagarnina. Finnish: Euroopanisoherkko. French: le grand rhinolophe fer à cheval, Grand rhinolophe, Grand Fer-à-Cheval. Frisian: Grutte hoefizernoas. Galician: Morcego de ferradura grande. Georgian: დიდი ცხვირნალა. German: Große Hufeisennase, Großhufeisennase, Hufeisennase. Greek: Τρανορινόλοφος. Hebrew: parsaf gadol. Hungarian: Nagy patkósdenevér nagy patkósorrú denevér, Rhinolophos i megali. Irish Gaelic: Crú-ialtóg mhór. Italian: Rinolofo maggiore, Ferro di Cavallo Maggiore. Latvian: Lielais pakavdegunis. Lithuanian: Didysis pasagnosis. Luxembourgish: Grouss Huffeisennues. Macedonian: Голем потковичар [= Golem Potkovichar]. Maltese: Rinolofu Kbir, Farfett il-Lejl tan-Nala kbir. Montenegrin: Veliki potkovičar. Norwegian: Storhesteskonese, Stor hesteskonese. Polish: Podkowiec duŻy. Portuguese: Morcego-de-ferradura-grande. Rhaeto-Romance: Rinolof grond, Nas fier-chaval grond. Romanian: Liliacul mare cu potcoavă, Liliac-mare-cupotcoavã. Russian: Подковонос большой, Болъшой подковонос [= Bolshoj podkovonos]. Serbian: Велики потковичар [= Veliki potkovič ar]. Scottish Gaelic: Crudh-ialtag mhòr. Slovak: Podkovár velký. Slovenian: Veliki podkovnjak, mali podkovnjak. Swedish: Större hästskonäsa. Turkish: Büyük Nalburunlu Yarasa. Ukrainian: Підковик (Підковоніс) великий. Welsh: Ystlum pedol mwyaf.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Lavocat (1961) described a new subspecies found in deposits of the Mio-Pliocene, at Beni Mellal. See Butler (1978).

CONSERVATION STATUS:
Global - This species has a large range. Although there have been marked and well-documented declines in some areas, the species remains widespread, abundant, and apparently stable in other areas. Assessed as Least Concern (LC ver 3.1 (2001)) (Aulagnier *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Aulagnier *et al.*, 2008a; IUCN, 2009). 2000 - LR/nt. 1996 - LR/nt ver 2.3 (1994).

MAJOR THREATS:
Aulagnier *et al.* (2008a) [in IUCN (2009)] reported the main threats are fragmentation and isolation of habitats, change of management regime of deciduous forests and agricultural areas, loss of insects due to pesticide use, and disturbance and loss of underground habitats and attics. In northwest Europe, habitat change is likely to have been amongst the major causes of declines, the conversion of woodland and small-field landscape

to large-scale agricultural land being particularly damaging. While declines elsewhere, particularly in eastern Europe, may currently not be so marked, the loss of cultural landscapes in those countries as they move towards western-style economies may have significant effects in the near future. The use of pesticides has been a recognized threat to the insect food, particularly where these have been directed against the larvae of favoured food items, such as melolonthid beetles, larvae of noctuid moths or crane-flies. Favoured prey may be affected secondarily by pesticide use, such as the loss of dung fauna from the use of persistent anti-parasitic drugs (avermectins) on cattle. Populations in caves and other underground habitats have suffered from increased disturbance (for example by tourist visits to caves). In buildings, colonies may be affected by human intolerance, renovation work or the application of pesticides, such as some of those used for the remedial treatment of timbers (Hutson *et al.*, 2001). In South Asia, this species is threatened by deforestation, generally resulting from logging operations and the conversion of land for agricultural and other uses. Disturbance to roosting sites is likely to be a potential threat to the populations of this species (Molur *et al.*, 2002).

Concerning climatic change, the most important risk factors identified by Sherwin *et al.* (2012: 174), are water stress, aerial hawking and long-distance dispersal.

CONSERVATION ACTIONS:
Aulagnier *et al.* (2008a) [in IUCN (2009)] reported *Rhinolophus ferrumequinum* has been the subject of widespread conservation activity, especially in Europe. Until recently, this has concentrated on roosts in buildings and caves. Many buildings used as roosts have management agreements and many underground sites have been protected. Nevertheless, sites continue to be lost or damaged. More recently, attention has turned to identifying more precisely the food and foraging requirements. A European meeting (Germany, May 1995) discussed the status and conservation needs for the species on a pan-European scale. The Bern Convention has commissioned a Europe-wide Species Action Plan under the Pan-European Biological and Landscape Diversity Strategy (Ransome and Hutson, 2000). It is protected by national legislation in some range states. There are international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention in parts of its range where these apply. It is included in Annex II (and IV) of the European Union Habitats Directive, and hence requires special measures for conservation including designation of Special Areas for Conservation. There is some habitat protection through Natura 2000 (some roosts are already protected by national legislation).

Flanders and Jones (2009: 894) point out that, in the U.K., management of broad-leaved woodland areas in close proximity (within 4 km) of transitional roosts (used in spring and autumn) should be enhanced.

There are no specific conservation measures in place for the species in North Africa or South Asia. Populations should be monitored to record changes in abundance and distribution (Molur *et al.*, 2002).

GENERAL DISTRIBUTION:
Rhinolophus ferrumequinum has a wide range in the Palaearctic, occuring from North Africa and southern Europe through south-west Asia, the Caucasus, Iran, Afghanistan, Pakistan and the Himalayas to south-eastern China, Korea, and Japan (Csorba *et al.*, 2003; Abe *et al.*, 2005). It usually occurs below 800 m asl, but can be found up to 3,000 m asl in the Caucasus depending on roost availability and humidity (K. Tsytsulina *pers. comm.,* 2005).

Native: Abkhasia; Afghanistan; Albania; Algeria; Andorra; Armenia; Austria; Azerbaijan; Bangladesh; Bhutan; Bosnia and Herzegovina; Bulgaria; China; Croatia; Cyprus; Czech Republic; France (Corse); Georgia; Germany; Gibraltar; Greece (Kriti); Hungary; India; Iran, Islamic Republic of; Iraq; Israel; Italy (Sardegna, Sicilia); Japan; Jordan; Kazakhstan; Korea, Democratic People's Republic of; Korea, Republic of; Kyrgyzstan; Lebanon; Liechtenstein; Luxembourg; Macedonia, the former Yugoslav Republic of; Moldova; Monaco; Montenegro; Morocco (El Ibrahimi and Rguibi Idrissi, 2015: 358); Nepal; Pakistan; Palestinian Territory, Occupied; Poland; Portugal; Romania; Russian Federation; San Marino; Saudi Arabia; Serbia; Slovakia; Slovenia; Spain (Baleares); Switzerland; Syrian Arab Republic; Tajikistan; Tunisia (Dalhoumi *et al.*, 2014: 53, 2016b: "3"); Turkey; Turkmenistan; Ukraine; United Kingdom; Uzbekistan.
Possibly extinct: Malta.
Regionally extinct: Belgium; Netherlands.

BIOGEOGRAPHY:
See Rossiter *et al.* (2007).

GEOGRAPHIC VARIATION:
Benda *et al.* (2014c: 16) mention that the Libyan *R. ferrumequinum* specimens are very small in size, and even the smallest within the Mediterranean range of this species, which led to their confusion with *R. clivosus*.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Lucati and López-Baucells (2016: Suppl.) refers to an albino specimen that was reported from "South Africa?" by Allen (1939b).

DETAILED MORPHOLOGY:
Baculum - See Csorba *et al.* (2003: 43).

Forman (1973) [in Scillitani *et al.* (2005: 302)] regards the stomach of this bat as primitive for the order and probably represents the ancestral condition of lower Eutheria, because it presents a number of features in common with Insectivora.

R. ferrumequinum is one of the few bat species, where the females can have a baubellum (*os clitoris*) (Lough-Stevens *et al.* (2017: 1078).

FUNCTIONAL MORPHOLOGY:
Kobayashi (2018: 69) found that the bat's *M. quadriceps femoris* has a short muscle belly attached to the proximal portion of the femur and that the insertional tendon of this muscle and its patellar ligament are very thin. These features indicate that *R. ferrumequinum* cannot exert a strong and long-distance extension of its knee joints, which results in the inability to crawl.

ECHOLOCATION:
Fukui *et al.* (2011: 1548) report that, in Japan, the detection range for *Rhinolophus ferrumequinum* calls is less than 5 metres.
Jones and Siemers (2010: 450) indicate that juveniles emit lower frequencies than adults, and Jones and Ransome (1993: 125) found that the young's resting constant-frequency (RF) values are at least partially determined by their mother's RF. Jones and Ransome (1993: 125) furthermore report that calls of *R. ferrumequinum* specimens aged between 1 and 28 years vary seasonally and over a lifetime in a predictable manner.

For 28 Greek specimens, Papadatou *et al.* (2008b: 132) report a start frequency of 66.5 ± 3.23 kHz, a terminating frequency of 64.9 ± 4.33 kHz, and a bandwidth of 3.9 ± 1.34 kHz. The duration of the call is 53.8 ± 10.50 msec, and the interpulse interval is 92.1 ± 24.94 msec.
Andrews *et al.* (2006: 199) analyzed 500 echolocation calls from UK bats, and found an average frequency of 83.8 ± 0.4 kHz and 21.0 ± 6.4 ms duration. Another set of 500 calls had an average frequency of 84.0 ± 0.5 kHz and a duration of 31.9 ± 9.5 ms. Social calls were emitted at frequencies between 15 and 29 kHz and their duration was between 4 and 49 ms (p. 201).
Walters *et al.* (2012: suppl.) report the following figures for 30 calls from bats from France, Switzerland and the UK: duration: 50.08 ± 13.52 msec, F_{max}: 81.66 ± 1.68 kHz, F_{min}: 70.29 ± 3.62 kHz, bandwidth: 11.37 ± 3.19 kHz, F_{peak}: 81.46 ± 1.65 kHz.
Dalhoumi *et al.* (2016b: 866) reported a long constant frequency part between 85 and 88 kHz for Tunisian animals.

From experiments in a flight tunnel, Koselj and Siemers (2013: 81) found that *R. ferrumequinum* bats can extract information from echolocation calls produced by conspecifics. This could facilitate sensory cooperation among echolocating bats.

In China, Sun *et al.* (2013: 1) found regional differences in the resting frequency of echolocation calls of *R. ferrumequinum* which were significantly correlated with geographic distance and mean annual temperature.

Besides the ultrasound calls used in echolocation, Andrews and Andrews (2003: 221) also report on twelve types of ultrasound social calls, which were in the range of 20 to 29 kHz and had a duration of 1 to 49 ms. Furthermore, there were also low frequency (audible) social calls (1 - 10 kHz).

For Morocco, Disca *et al.* (2014: 226) indicate that the type of call is FM-FC-FM, with F_{peak}: 84.6 ± 0.8 kHz and duration: 30.3 ± 7.6 msec.

MOLECULAR BIOLOGY:
DNA - See Rossiter *et al.* (2007).

Karyotype - Makino (1948), Capanna and Civitelli (1964a: 363), Rushton (1970: 463), Baker *et al.* (1974; 1975) and Qumsiyeh *et al.* (1986) all reported 2*n* = 58, FN = 60, a submetacentric X chromosome, and an acrocentric Y chromosome. Volleth and Eick (2012: 167) reported 2*n* = 58 and 28 as segment number. In Turkey, Arslan and Zima (2014: 7) found 2*n* = 58, FNa = 60-62, FN = 64-66, a metacentric X and an acro-/metacentric Y. The autosomal chromosomes consist of two medium-sized bi-armed pairs and 26 acrocentric pairs, but they indicate that one of the acrocentric pairs is considered by some other authors to be bi-armed, leading to the different FN and FNa values. Capanna and Civitelli (1964a: 371) mention 24 pairs of acrocentric chromosomes, 2 metacentric pairs, and 2 pairs of very small chromosomes; the X chromosome was reported as a large submetacentric and the Y as a very small one.

Protein / allozyme: Unknown.

HABITAT:
In the U.K., Flanders and Jones (2009: 891) reported that on an overal area of about 632 ha used by a colony of *R. ferrumequinum* specimens, 28.7 % consisted of pasture, 26.6 % of broad-

leaved woodland, 16.1 % of arable, 8.2 % of mixed woodland, 6.7 % urban, 5.8 % scrub, 4.3% grassland, 1.6 % heathland, 1.4 % water, and 0.7 % coniferous woodland. They also reported the following habitat preferences (high to low): pasture, broad-leaved woodland, mixed woodland, water, scrub, grassland, urban, coniferous woodland, heathland, and arable. Fukui *et al.* (2011: 1551) indicate that, in Japan, this species prefers natural forest gaps over artificially made gaps as in the latter debris is generally removed, leaving no tree branches for it to hang from while scanning for prey.

HABITS:
Park *et al.* (2000) [in Sherwin *et al.* (2012: 172)] found that *R. ferrumequinum* was longer active when the temperatures were higher than 10 °C, which they considered to be a thermal threshold for insect activity.

DIET:
Flanders and Jones (2009: 892) examined 1,580 bat droppings in the U.K. and found that Lepidoptera (moths) were the most abundant prey. In spring, *Melolontha melolontha* (May bugs), beetles of the genus *Geotrupes* (dor beetles), Trichoptera (caddis flies), Tipulidae (crane flies), Ichneumonidae (ichneumonid wasps), and Lepidoptera were contributing to the diet. In autumn, the two beetle species were replaced by representatives of the genus *Aphodius* (dung beetles), and additional to the other groups of insects, Diptera (mainly dung flies) were also part of the main prey types.

Andreas *et al.* (2013) using faecal analysis of *R. euryale* from southern Slovakia, showed that this species fed mainly on large moths (>40mm) (%f = 54; %vol = 89) and comprised also Coleoptera (%f = 19.5; %vol = 4.82), represented by Scarabaeidae, Elateridae and Curculionoidea.

In northern Algeria, Ahmim and Moali (2013: "2") found that *R. ferrumequinum* fed on three groups of arthropods: Insecta (95.31 % [Diptera: 34.56 % and Lepidoptera: 24.13 %]), Chilopoda (4.49 %) and Araneida (0.20 %). The largest groups within the Diptera were Culicidae (10.40 %), Chironomidae/Ceratopogonidae (10.94 %) and Tipulidae (4.28 %).

In Libya, Benda *et al.* (2014c: 19) examined faecal pellets and found one set to contain 84 % by volume larger moths, 9 % ants and 7 % beetles, whereas a second set contained only Lepidoptera with wingspans of ca. 40 mm.

POPULATION:
Structure and Density - *Rhinolophus ferrumequinum* is an infrequent species in most parts of its range, although in at least parts of southwest Asia and the Caucasus it is abundant and widespread (it is the most frequently reported species in Turkey: A. Karatas *pers. comm.,* 2005), with populations in Iran and Turkey considered to be stable (A. Karatas, M. Sharifi and K. Tsytsulina *pers. comm.,* 2005), although it may be decreasing in Russian parts of the Caucasus (S. Kruskop *pers. comm.,* 2005). Summer colonies of c. 30 - 200 individuals (up to 400 animals), and winter clusters of up to 500 animals are typical.
In Europe, the two most widespread *Rhinolophus* species, *R. ferrumequinum* and *R. hipposideros*, are of particular conservation concern and are the subject of considerable research and monitoring. *R. ferrumequinum* has shown marked declines in range in northwest Europe within the last 100 years (e.g. United Kingdom, Germany, Austria), and has gone extinct in some countries (eg. Belgium, Netherlands). However, there are signs of stabilisation and/or recovery in some northwest European countries (Hutson *et al.*, 2001). For example, in the UK the species declined massively in the past, but it is now stable at a low population level (around 5,000 individuals) (Ransome and Hutson, 2000). However, in Austria declines continue, with population reductions of 70 % in the last 10 years (from 100 to 30 breeding individuals: Spitzenberger (2002); F. Spitzenberger *pers. comm.,* 2006). In other parts of Europe, trends vary and are generally less well known: in Malta the species has gone extinct, in Portugal and Spain the trend is not known (although some colonies have disappeared in Spain) (Palomo and Gisbert, 2002; Cabral *et al.*, 2005), in Croatia the population is thought to be stable (N. Tvrtkovic *pers. comm.*), and in Romania the population has been slowly increasing since 1989 due to reduced use of pesticides and a return to traditional agriculture with colonies of up to 800 individuals. In Switzerland the species is very rare (3 maternity roosts with some 200 individuals), but the population trend appears stable (H. Kraettli *pers. comm.*, 2006). In its north African and south Asian range the population size and trends are unknown (Aulagnier *et al.*, 2008a; IUCN, 2009).
Trend - 2008 - Decreasing (Aulagnier *et al.*, 2008a; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 30.5 years.

ACTIVITY AND BEHAVIOUR:
In the U.K., Flanders and Jones (2009: 891) reported a maximum nightly foraging range of between 2.17 and 2.44 km, and the foraging area

averaged 148.1 ha. Fukui *et al.* (2011: 1551) [referring to Jones and Rayner (1989)] indicate that *R. ferrumequinum* is a "flycatcher" species, meaning that it hangs from tree branches while scanning for its prey.

Smotherman *et al.* (2016: 537) refer to Ma *et al.* (2006) in describing the song-like structure for this species as consisting of different syllable types in series.

REPRODUCTION AND ONTOGENY:
Tuttle and Stevenson (1982: 121) mention that males attain sexual maturity between 15 and 51 months, whereas this for females is between 15 and 39 months. Szekely *et al.* (2015: Suppl.) report 730 days (about 24 months) for both sexes. Gharaibeh (1997: 55) mentions lactating females and juveniles from the cave at Djebel Oust (Tunisia) on 29 July 1996. Benda *et al.* (2014c: 16) collected a pregnant female on 28 May at Nanatalah (Libya).
Kurta and Kunz (1987: 82) report that, at birth, the young weights about 29.3 % of the mother's body mass (5.8 versus 19.8 g), and that its forearm length is about 36.0 % of the mother's length (25.3 versus 70.3 mm).
The gestation period takes 80 days (with the young having a birth weight of 5.8 g - 25.4 % of the adult), and weaning occurs after 60 days (Szekely *et al.*, 2015: Suppl.).

MATING:
Fenton (1984) [in Keeley and Keeley (2004: 117)] reports the existence of copulatory plugs. For *R. ferrumequinum*, these plugs are formed from male secretions, and probably serve to prevent further insemination by other males, rather than preventing sperm leakage from the female's reproductive trace (in that case the plugs would probably be made by the females). However, Rossiter *et al.* (2000b) mention that these plugs can be ejected by the females, which would allow additional matings.

In Britain, Rossiter *et al.* (2000a: 545) found that mating was polygynous, but six females gave birth to young fathered by the same male in different years. This seems to indicate fidelity for either mating sites or individuals or from sperm competition. Females start visiting males for mating in autumn, so breeding partnerships are primarily determined by the female. Mating occurs in territory sites occupied by single males, which can be born both within and outside the female's own natal colony. Relatedness between parents, however, was no less than the average recorded for male/female pairs. Gene flow between colonies is likely to be primarily mediated by both female and male dispersal during the mating period rather than more permanent movements.

Liu *et al.* (2013a: 2179) describe the vocal communications during mating in China. They suggest these calls can serve as an indicator for the female bats to recognize the mating male in order to maintain mate fidelity as greater horseshoe bats are sexually segregated before mating.

PARASITES:
Beaucournu and Kock (1996) mentioned *Rhinolophopsylla unipectinata arabs* Jordan and Rothschild, 1921 on bats from Algeria.

In Europe Genov *et al.* (1992) reported the presence of the following Nematodes: *Molinostrongylus skrjabini* Skarbilovitch, 1934 and *M. alatus* (Ortlepp, 1932).

Ševcík *et al.* (2012: 35) report on the presence of the bat flies *Phthiridium biarticulatum* Hermann, 1804, *Phthiridium biarticulatum* Hermann, 1804, and *Brachytarsina flavipennis* Macquart, 1851 on bats from Crete and Cyprus. *Phthiridium biarticulatum* was also reported on *R. ferrumequinum* from Jordan by Benda *et al.* (2010b: 226), and from Algeria by Bendjeddou *et al.* (2013: 325). The latter authors also found *Brachytarsina flavipennis* and *Penicillidia dufouri* (Westwood, 1825) (Diptera: Nycteribiidae). Bendjeddou *et al.* (2017: 15) added two additional Nycteribiidae: *Nycteribia (Listropoda) schmidlii schmidlii* Schiner, 1853 and *Phthiridium biarticulatum* Hermann, 1804 and one Siphonaptera: *Rhinolophopsylla unipectinata arabs* Jordan and Rothschild, 1921.
Haelewaters *et al.* (2018: 794) also reported *Penicillidia conspicua* Speiser, 1901 and *P. fulvida*, Bigot, 1885, *Phthiridium biarticulatum* Hermann, 1804, which all might be hosts for the fungus *Arthrorhynchus nycteribiae*.

ACARI
Nycteribiidae: *Nycteribia kolenati* Theodor & Moscona, 1954 was reported by Haelewaters *et al.* (2017: 1) from *R. ferrumequinum* from Hungary. Vermeil (1960) reported two bat flies from Tunisian *R. ferrumequinum*: *Nycteribia biarticulata* Hermann, 1804 and *Nycteribosca kollari* Frauenfeld, 1855.
Trombiculidae: Stekolnikov (2018a: 186) mentioned *Sasatrombicula cherrata* (Taufflieb, 1960) from Oued Cherrat (Morocco).

VIRUSES:
In Italy, Balboni *et al.* (2010: 216) reported two *R. ferrumequinum* specimens, which tested positive for a fragment of RNA-dependent RNA

polymerase (RdRp) gene of viruses related to *Coronavirus*. Phylogenetic analysis showed a close correlation between one of these and SARS-related CoV belonging to the genus *Betacoronavirus* (see also de Jong *et al.*, 2011: 10).

Adenoviridae
Mastadenovirus
Kohl and Kurth (2014: 3111) report this virus from Hungary.

Astroviridae
Luis *et al.* (2013: suppl.) report on the presence of an unassigned astrovirus.

Bunyaviridae
Hantavirus
de Jong *et al.* (2011: 9), Luis *et al.* (2013: suppl.) report Hantaan virus occurring on this species, as well as an unassigned Issyk-kul virus (Keterah virus).

Coronaviridae - Coronaviruses
Luis *et al.* (2013: suppl.) mentions the presence of Coronavirus BatCoV BB98-15 and SARS coronavirus.

Alphacoronavirus
Kohl and Kurth (2014: 3112) report this virus to be present in German bats.
Betacoronavirus
This virus was reported from bats from Germany and Bulgaria by Kohl and Kurth (2014: 3112).

Flaviviridae
Flavivirus
Japanese encephalitis virus was reported by Luis *et al.* (2013: suppl.).

Orthomyxoviridae
Despite sampling and testing of 2 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

Papillomaviridae
Papillomavirus
This virus was reported from Spanish bats by Kohl and Kurth (2014: 3113).

Rhabdoviridae
Lyssavirus - Rabies related viruses
de Jong *et al.* (2011: 9) report the presence of European bat lyssavirus 2.
Serra-Cobo *et al.* (2018: 2) found one seropositive bat among the 47 tested for European bat lyssavirus 1 in Algeria and eight ouf of 67 tested in Morocco.
"Various European bat lyssaviruses" were reported by Kohl and Kurth (2014: 3114) from various European countries.

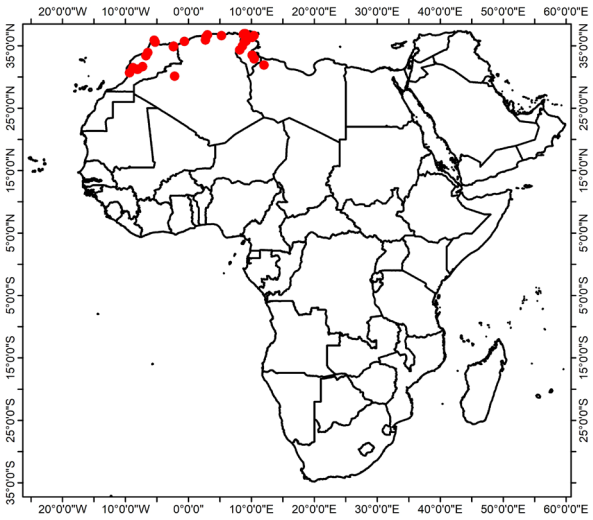


Figure 88. Distribution of *Rhinolophus ferrumequinum*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, Libya, Morocco, Tunisia.

Rhinolophus fumigatus Rüppell, 1842

*1842. *Rhinolophus fumigatus* Rüppell, Mus. Senckenberg., 3 (2): 132. Type locality: Ethiopia: Shoa province: Shoa province [ca. 09 00 N 39 00 E] [Goto Description]. Lectotype: SMF 4372: ad, mounted skin (skull not removed). Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1841. Presented/Donated by: Wilhem Peter Edward Simon Rüppell. See: 451). Mertens (1925: 20). Turni and Kock (2008) mention this specimen (old catalog SMF II.F.7.a) as Lectotype. Cotype: SMF II.F.7b:; collection date: 1841. Presented/Donated by: Wilhem Peter Edward Simon Rüppell. See Andersen (1904c: 451). - Etymology: From the passive Latin perfect participle *fumigàtus* meaning "smoked", referring to the fur colour of the species (see Lanza *et al.*, 2015: 96). (Current Combination)

1869. *Rhinolophus æthiops* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 637 (for 1868). Type locality: Namibia: Damaraland: Otjimbingue [22 15 S 16 10 E]. Syntype: ZMB 3295: ♂, skull and alcoholic. Collected by: Missionary Hahn. See Turni and Kock (2008). Syntype: ZMB 50073: ♀, alcoholic (skull not removed). Collected by: Missionary Hahn. Formerly

second specimen with number ZMB 3295; see Turni and Kock (2008: 30). - Comments: Turni and Kock (2008: 30) referring to Csorba *et al.* (2003: 50) mention that ZMB 3295 might possibly represent a species distinct from *fumigatus*.

1877. *Rhinolophus macrocephalus* Heuglin, Reise in Nordost Afrika, 2: 22. Publication date: 1877. Type locality: Ethiopia: Tigre province: As(s)am river: Adowa [14 10 N 38 54 E, 1 900 m]. Syntype: SMNS 1059: imm ♀, alcoholic (skull not removed). Collected by: Martin Theodor von Heuglin; collection date: 1862. See Andersen (1904c: 451), Dieterlen *et al.* (2013: 294). Syntype: SMNS 1059a: imm ♀. Collected by: Martin Theodor von Heuglin. Presented/Donated by: ?: Collector Unknown. Syntype: SMNS 1059b: ad ♂, alcoholic (skull not removed). Collected by: Martin Theodor von Heuglin; collection date: 1862. See Andersen (1904c: 451), Dieterlen *et al.* (2013 294).

1885. *Rhinolophus antinorii* Dobson, Ann. Mus. civ. Stor. nat. Genova, (2) 2: 16. Publication date: 22 May 1885. Type locality: Ethiopia: Shoa province: Daimbi.

1905. *Rhinolophus fumigatus exsul* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 15 (85): 74. Publication date: 1 January 1905. Type locality: Kenya: Kitui [01 22 S 38 01 E, 3 500 ft] [Goto Description]. Holotype: BMNH 1901.5.6.3: ad, skin only. Collected by: Mrs. Hildegarde Hinde; collection date: 3 January 1901; original number: 68. See Andersen (1905a: 74). - Comments: Considered a valid subspecies by Ansell and Dowsett (1988: 32).

1913. *Rhinolophus foxi* Thomas, Ann. Mag. nat. Hist., ser. 8, 11 (63): 314. Publication date: 1 March 1913. Type locality: Nigeria: Northern Nigeria, Bauchi plateau: Kabwir [09 24 N 09 34 E, 2 500 ft] [Goto Description]. Holotype: BMNH 1913.2.5.1: ad ♂. Collected by: Mr. J.C. Fox and The Cambridge University Mission; collection date: 14 November 1912; original number: 45. Presented/Donated by: Mr. J.C. Fox.

1914. *acrotis* G.M. Allen, Bull. Mus. comp. Zool., 58 (7): ???. - Comments: Preoccupied by *acrotis* Heuglin, 1861.

1917. *Rhinolophus abæ* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 428. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Aba [03 53 N 30 17 E] [Goto Description]. Holotype: AMNH 49113: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 15 December 1911; original number: 1756.

1939. *Rhinolophus aethiops diversus* Sanborn, Field Mus. Nat. Hist., Zool. Ser., 24 (5): 42. Publication date: 19 September 1939. Type locality: Senegal: Bakel [14 54 N 12 26 W] [Goto Description]. Holotype: BMNH 1919.7.7.2774: ad ♀, alcoholic (skull not removed). Collection date: 27 September 1887. Formerly in the Lataste collection (see: 42). - Comments: Considered a valid subspecies by Grubb *et al.* (1998: 77), but they also remark that it might be a subspecies of *aethiops*.

? *Rhinolophus abae:* (Alternate Spelling)

? *Rhinolophus aethiops:* (Alternate Spelling)

? *Rhinolophus fumigatus abae:* (Name Combination)

? *Rhinolophus fumigatus aethiops:* (Name Combination)

? *Rhinolophus fumigatus foxi:* (Name Combination)

? *Rhinolophus fumigatus fumigatus:* (Name Combination)

TAXONOMY:

Does not include *eloquens* or *perauritus*, but does include *aethiops*; see Koopman (1975: 389 - 390). *fumigatus* species group (Csorba *et al.*, 2003: 48 - 51; Simmons, 2005: 356). See Csorba *et al.* (2003: 49 - 50) for remarks on taxonomy, e.g. that *fumigatus* and *aethiops* are probably different species.

Jacobs *et al.* (2016g: 94) refer to Dool *et al.* (2016b), who found that *R. fumigatus* from the western part of Southern Africa seems to be a distinct but sister lineage to *R. fumigatus* from the eastern half of Africa.

COMMON NAMES:

Afrikaans: Rüppell se saalneusvlermuis, Rüppell-saalneusvlermuis. Chinese: 达马拉菊头蝠. Czech: vrápenec kouřový. English: Rüppell's Horseshoe Bat, Smoky Horseshoe Bat, Abyssinian Horseshoe Bat. French: Rhinolophe de Rüppell. German: Rüppells Hufeisennase, Rüppells Hufeisennase, Shoa Kamnase. Italian: Rinòlofo affumicàto, Fèrro di cavàllo affumicàto. Portuguese: Morcego ferradura da Damarlandia.

ETYMOLOGY OF COMMON NAME:

The colloquial name refers to the describer of the species (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008al; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008al; IUCN, 2009). 2004 - LC ver 3.1 (2001) (IUCN, 2004; Jacobs *et al.*, 2004aj). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Jacobs *et al.*, 2016k). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to *Rhinolophus fumigatus* as a whole (Jacobs *et al.*, 2008al; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008al) [in IUCN (2009)] reported that in view of the species wide range in East and southern Africa, it seems probable that it is present in several protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Rhinolophus fumigatus is widely, but patchily, recorded over much of sub-Saharan Africa. It ranges from Senegal and The Gambia in the east, through West and Central Africa to Ethiopia and Eritrea in the east, and from here through East and southern Africa as far south as Namibia and north-eastern South Africa.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,246,343 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 558; Taylor *et al.*, 2018b: 62); Benin (Capo-Chichi *et al.*, 2004: 162); Botswana (Cotterill, 2004a: 261); Burkina Faso (Kangoyé *et al.*, 2015a: 610); Burundi; Cameroon; Central African Republic; Chad; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 558); Côte d'Ivoire; Eritrea; Ethiopia; Gabon; Gambia; Ghana; Guinea; Kenya; Liberia; Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 558); Mali (Meinig, 2000: 105); Mauritania; Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 558; Monadjem *et al.*, 2010c: 378); Namibia (Monadjem *et al.*, 2010d: 559); Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa (Monadjem *et al.*, 2010d: 559); Sudan; Tanzania (Stanley and Goodman, 2011: 42); Togo; Uganda; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 559); Zimbabwe (Monadjem *et al.*, 2010d: 559).

SEXUAL DIMORPHISM:
Kangoyé *et al.* (2015a: 610) found no differences in body measurement of males and females from Burkina Faso, but the cranial measurements of the males were on average larger than those of the females.

ECHOLOCATION:
Jacobs *et al.* (2007a) reported a peak frequency of 53.8 (± 0.2) kHz for individuals South Africa. Monadjem *et al.* (2010c: 378) reported from Mozambique the peak echolocation frequencies of a single male was 54 kHz (ANABAT).

1 call of tye FM/CF/FM was recorded by Manga Mongombe (2012: 79) from Maroua (Cameroon) with the following parameters: F_{max}: 62.6 kHz, F_{min}: 61.6 kHz, F_{mean}: 61.9 kHz, F_{knee}: 61.7 kHZ, F_{char}: 61.6 kHz, and duration: 0.57 msec.

Kangoyé *et al.* (2015a: 610) reported that five males from Burkina Faso called at 54.2 ± 0.4 (53.4-54.4) kHz.

In Sierra Leone, a flying bat was recorded by Weber *et al.* (2019: 21) at 51.5 kHz.

For two calls from the Aberdares Range in Kenya, Eisenring *et al.* (2016: SI 2) gave the following values: PF: 57.9 ± 1.1 (57.2 - 58.7), HF: 106.7 ± 4.3 (103.7 - 109.8), LF: 54.3 ± 0.3 (54.0 - 54.5), DT: 0.0 ± 0.0 (0.0 - 0.1), DF: 52.5 ± 4.7 (49.2 - 55.8), IPI: 0.7 ± 0.1 (0.6 - 0.8).

For a bat from the Kalahari Desert, Adams and Kwiecinski (2018: 4) reported: F_{char}: 53.9 kHz, F_{max}: 54.4 kHz, F_{min}: 53.6 kHz, and duration: 40.1 msec.

Jacobs (2016: 119) indicates that the second harmonic of this bat coincides with the third harmonic of *R. hildebrandtii*, which possibly might illustrate "harmonic hopping".

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach (1986) reported 2*n* = 58, FN = 60, BA = 4, a subtelocentric X chromosome, and a metacentric Y. Koubínová *et al.* (2010b: 394) reported for Senegal similar results to Rautenbach (1986), but there were only two pairs of small meta- and submetacentric autosomes, and the remaining 26 pairs were acrocentric, a medium sized acrocentric (no. 15) had an achromatic gap near the centromere, while the X was a medium

sized subtelocentric, and the Y was dot-like. Koubínová (2013: 7) reported the karyotype as: 2*n* = 58, FNa = 60, FN = 64.
Protein / allozyme: Unknown.

ROOST:
Lelant and Chenaval (2011d: 13) report on a colony of over 1,000 animals inhabiting a very old Baobab tree (*Adansonia digitata*) in Fadgal, Senegal.

POPULATION:
Structure and Density - It is a locally common species that can be encountered as large colonies. Colonies in southern Africa tend to be smaller (Jacobs *et al.*, 2008al; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008al; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
A pregnant female was collected in August 1992 in the East Usambara Mountains (Tanzania) (Stanley and Goodman, 2011: 42).

PARASITES:
HAEMOSPORIDA
Lutz *et al.* (2016: 9) examined 5 *R. fumigatus* specimens from East Africa and found two of them infected with *Nycteria* sp. Rosskopf *et al.* (2018: Suppl.) mentioned the (same?) record from Malawi.

Fain (1959a: 340) mentions that one of the paratypes of *Nycteridocoptes eyndhoveni* Fain, 1959 (Acari: Sarcoptidae) was collected from a "*R. aethiops*" specimen Kambisa, Angola.

HEMIPTERA:
Polyctenidae: *Androctenes horvathi* Jordan, 1912 recorded from Transvaal, South Africa (Haeselbarth *et al.*, 1966: 17, host referred to as *R. eloquens*).

DIPTERA:
Streblidae: *Ascodipteron brevior* Maa, 1965, female cysts found at the base of the ears in Congo, Namibia and South Africa (Haeselbarth *et al.*, 1966: 106). *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100, host refered to as *R. eloquens*). *Raymondia intermedia* Jobling, 1936 (Shapiro *et al.*, 2016: 255).
Nycteribiidae: *Nycteribia scissa sudanica* Theodor, 1957 from Ethiopia, the Sudan and the Congo (Haeselbarth *et al.*, 1966: 108). *Penicillidia fulvida* (Bigot ,1885) (Haeselbarth *et al.*, 1966: 114, host referred to as *R. foxi*).

SIPHONAPTERA:
Ischnopsyllidae: *Rhinolophopsylla ectopa* (Jordan, 1937) was reported on "*R. aethiops*" from Kenya by Beaucournu and Kock (1996).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Rhinolophus fumigatus*: Coronaviruses and Paramyxoviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in 204 individuals from Oriental Province, DRC, one tested positive (1/204, 0.5 %).

UTILISATION:
Lelant and Chenaval (2012: 15) report on the use of *R. fumigatus* specimens in traditional medicine in Senegal.

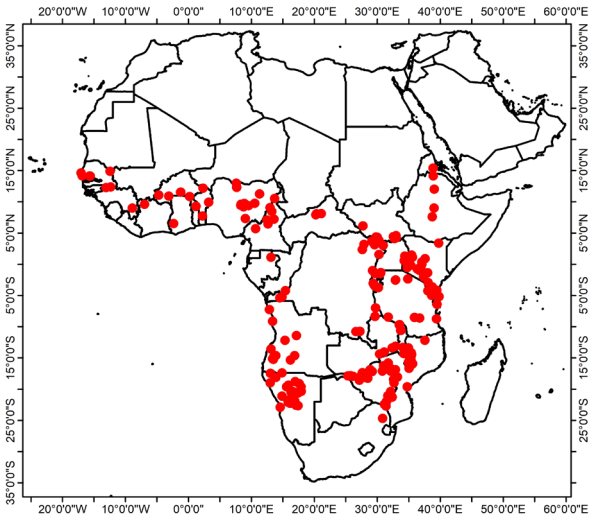


Figure 89. Distribution of *Rhinolophus fumigatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Malawi, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Rhinolophus gorongosae Taylor, MacDonald, Goodman, Kearney, Cotterill, Stoffberg, Monadjem, Schoeman, Guyton, Naskrecki and Richards, 2018

*2018. *Rhinolophus gorongosae* Taylor, MacDonald, Goodman, Kearney, Cotterill, Stoffberg, Monadjem, Schoeman, Guyton, Naskrecki and Richards, Zool. J. Linn. Soc., 184 (1): 1249, 1262, figs 6, 8, 9, 10, 12. Publication date: 24 April 2018. Type locality: Mozambique: Sofala province: Gorongosa National Park: Bunga Inselberg [18 35 56 S 34 20 35 E, 212 m] [Goto Description]. Holotype: DNSM 14820: ad ♂, skull and alcoholic. Collected by: Jennifer Anna Guyton; collection date: 25 April 2015; original number: JAG 196. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14815: ♀. Collected by: Jennifer Anna Guyton; collection date: 24-25 April 2015; original number: JAG 188. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14816: Collected by: Jennifer Anna Guyton; collection date: 24-25 April 2015. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14817: Collected by: Jennifer Anna Guyton; collection date: 24-25 April 2015. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14818: Collected by: Jennifer Anna Guyton; collection date: 24-25 April 2015. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14819: Collected by: Jennifer Anna Guyton; collection date: 24-25 April 2015. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14828: Collected by: Jennifer Anna Guyton; collection date: 2 May 2015. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14843: ♀. Collected by: Jennifer Anna Guyton; collection date: 5 November 2015; original number: JAG 228. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 14865: Collected by: Jennifer Anna Guyton; collection date: 22 July 2015. Presented/Donated by: ?: Collector Unknown. - Etymology: The name refers to the Gorongosa district (Mozambique) and the Gorongose National Park, where the type specimen was collected (Taylor *et al.* (2018a: 14).

COMMON NAMES:
English: Least horseshoe bat. German: Gorongosa-Hufeisennase.

GENERAL DISTRIBUTION:
This species has only been found in the Gorongosa National Park (Mozambique). Taylor *et al.* (2018a: 17) tentatively assigned a specimen from Mount Inago (Mozambique) to this species, but this specimen needs to be examined further.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Taylor *et al.* (2018a: 14) indicate that *R. gorongosae* is the smallest rhinolophid in the Ethiopian region, even smaller than *R. denti*.

ECHOLOCATION:
Taylor *et al.* (2018a: 17) report a peak echolocation CF of 106 (104 - 108) kHz.

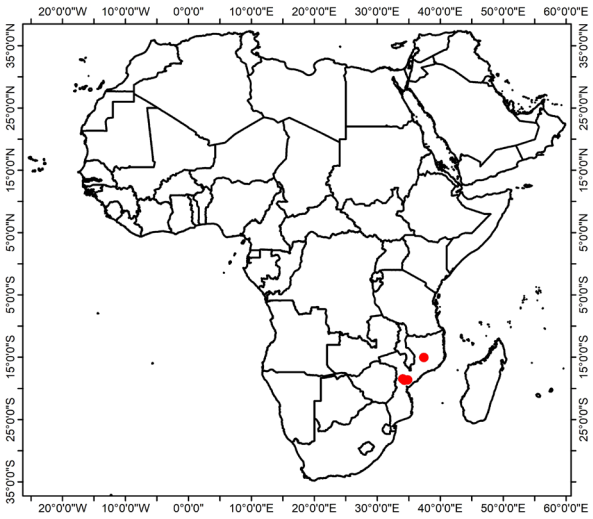


Figure 90. Distribution of *Rhinolophus gorongosae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Mozambique.

Rhinolophus guineensis Eisentraut, 1960

*1960. *Rhinolophus landeri guineensis* Eisentraut, Stuttg. Beitr. Naturk., 39: 1, fig. 1. Publication date: 1 June 1960. Type locality: Guinea: foot of Kelesi Plateau: Tahiré [ca. 10 05 N 12 30 W, 500 m] [Goto Description]. Holotype: SMNS 6103: ad ♂, skin and skull. Collected by: Hans Knorr; collection date: 5 October 1956. Presented/Donated by: ?: Collector Unknown. Paratype: SMNS 6104: ad, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) mention Salung Plateau near Nyembaro, 10 km W of Kolenté, Guinea as locality. Paratype: SMNS 6105: ad, skin and skull. Collected by: Hans Knorr; collection

date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) mention Salung Plateau near Nyembaro, 10 km W of Kolenté, Guinea as locality. Paratype: SMNS 6106: ad, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) mention Salung Plateau near Nyembaro, 10 km W of Kolenté, Guinea as locality. Paratype: SMNS 6107: ad, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) mention Salung Plateau near Nyembaro, 10 km W of Kolenté, Guinea as locality. Paratype: SMNS 6108: ad, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) mention Salung Plateau near Nyembaro, 10 km W of Kolenté, Guinea as locality. Paratype: SMNS 6109: ad, alcoholic (skull not removed). Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) mention Salung Plateau near Nyembaro, 10 km W of Kolenté, Guinea as locality. Paratype: SMNS 6113: ad, skin and skull. Collected by: Hans Knorr; collection date: 19 November 1956. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) mention Salung Plateau near Nyembaro, 10 km W of Kolenté, Guinea as locality. Paratype: ZFMK 1959.0176: ♀, skin and skull. Collected by: Hans Knorr; collection date: 5 October 1956; original number: 29. Presented/Donated by: ?: Collector Unknown. Paratype: ZFMK 1959.0177: ♂, skin and skull. Collected by: Hans Knorr; collection date: 23 November 1956; original number: 137. See Hutterer (1984: 30), Hutterer and Peters (2010: 11). - Etymology: Refers to country from which the type specimen was collected.

? *Rhinolophus guineensis:* (Name Combination, Current Combination)

TAXONOMY:
Meester *et al.* (1986) state that Rosevear (1965) and Kock (1969a) regard *guineensis* Eisentraut, 1960, from Guinea, as subspecifically distinct from *landeri*. Hayman and Hill (1971), on the other hand, consider it a synonym, while Böhme and Hutterer (1979), Csorba *et al.* (2003: 59 - 61) and Simmons (2005: 356) regard it as a distinct species, sympatric with *landeri* and somewhat larger.

COMMON NAMES:
Czech: vrápenec guinejský. English: Guinean Horseshoe Bat (Csorba *et al.*, 2003: 59 - 61; Simmons, 2005), Senegal Horseshoe Bat. French: Rhinolophe de Guinée, Rhinolophe du Sénégal. German: Guinea-Hufeisennase.

SIMILAR SPECIES:
See Csorba *et al.* (2003).

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU B2ab(ii,iii) ver 3.1 (2001)) because its area of occupancy is probably less than 2,000 km^2 (roosting caves), its distribution is severely fragmented, and there is continuing decline in the extent and quality of its forest and cave habitats (Fahr, 2008j; IUCN, 2009).

Assessment History -
2008 - VU B2ab(ii,iii) ver 3.1 (2001) (Fahr, 2008j; IUCN, 2009). 2004 - VU B2ab(iii) ver 3.1 (2001) (Fahr, 2004g; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
Major threats to *Rhinolophus guineensis* include deforestation resulting from logging operations, the conversion of land to agricultural use, and mining activities. There is also a limited threat of overhunting for the bushmeat trade (Fahr, 2008j; IUCN, 2009).

Sagot and Chaverri (2015: 1670) mention roost loss or disturbance, habitat degradation or loss, and hunting as major threats for this species.

CONSERVATION ACTIONS:
Fahr (2008j) [in IUCN (2009)] reported *Rhinolophus guineensis* has been recorded from the Mount Nimba World Heritage Site and the "Massif du Ziama" Biosphere Reserve, both in Guinea. It has also been recorded from a few state forests ("Forets Classees") in Guinea. There is a need to conserve remaining areas of suitable habitat for this species. Further studies are needed to better determine the species range.

GENERAL DISTRIBUTION:
Rhinolophus guineensis is a West African bat that has been patchily recorded from southern Senegal, Guinea, Sierra Leone, Liberia and Côte d'Ivoire. It is a highland species recorded at elevations of 1,400 m asl and over. It may be present in Gambia in remnant patches of forest (Grubb *et al.*, 1998).

Native: Côte d'Ivoire; Guinea (Denys *et al.*, 2013: 281; Decher *et al.*, 2016: 264); Liberia (Simmons, 2005); Senegal; Sierra Leone (Csorba *et al.*, 2003).
Presence uncertain: Gambia (Grubb *et al.*, 1998).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Csorba *et al.* (2003).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Csorba *et al.* (2003).

DETAILED MORPHOLOGY:
Baculum - Unknown
For a description of the crania, teeth, and noseleaves see Csorba *et al.* (2003).

ECHOLOCATION:
In Guinea, Fahr and Ebigbo (2003) reported the frequency of the CF-component at 85.3 - 85.4 kHz.

In Sierra Leone, one female called with a CF-component at 82.0 kHz (Weber *et al.*, 2019: 21).

HABITAT:
Monadjem *et al.* (2016y: 366) recorded this species from higher altitudes (above 900 m) in the Mount Nimba area.

See also Csorba *et al.* (2003).

HABITS:
See Csorba *et al.* (2003).

ROOST:
Weber and Fahr (2006: 4) indicate that *R. guineensis* largely or exclusively depends on the availability of caves as day roosts in Guinea.

POPULATION:
Structure and Density - *Rhinolophus guineensis* is possibly a rare species overall, although little information is available on the population abundance of this bat (Fahr, 2008j; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008j; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Weber *et al.* (2019: 21) recorded a pregnant female on 30 March in Sierra Leone.

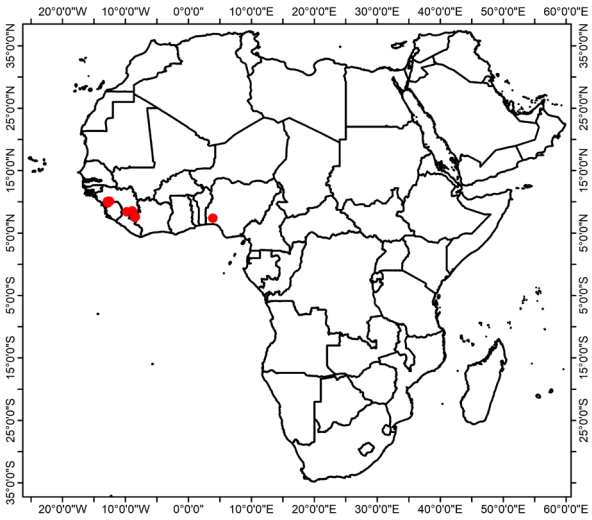


Figure 91. Distribution of *Rhinolophus guineensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Guinea, Liberia, Nigeria.

Rhinolophus hildebrandtii Peters, 1878

*1878. *Rhinolophus Hildebrandtii* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 195, pl. 1, fig. 1, 1a. Type locality: Kenya: Taita district: Ndi [03 14 S 38 30 E, 2 000 m] [Goto Description]. Syntype: BMNH 1879.1.21.1: ad. Turni and Kock (2008: 33). Reject the holotype status for this specimen and consider this also as a possible syntype. Syntype: ZMB 5267: ad ♀, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt; collection date: July 1877. See Turni and Kock (2008: 33). Syntype: ZMB 5378: ♂, skin and skull. Collected by: Dr. Johann Maria Hildebrandt; collection date: July 1877. See Turni and Kock (2008: 33). Syntype: ZMB 5379: ♂, skin and skull. Collected by: Dr. Johann Maria Hildebrandt; collection date: July 1877. See Turni and Kock (2008: 33). - Comments: Turni and Kock (2008: 33) reject the holotype status for the BMNH specimen and consider this also as a syntype. - Etymology: In honour of Johannes Maria Hildebrandt (1847 - 1881), a German naturalist, explorer and linguist, who collected a large number of plants and animals in eastern Africa, Madagascar, Comoro islands and Arabia (see Pearl, 1994: 3; Taylor, 2005, Lanza *et al.*, 2015: 101). (Current Combination)
1991. *Rhinolophus hildebrantii:* Avery, Durban Mus. Novit., 16: 1. (Lapsus)
? *Rhinolophus hildebrandti hildebrandti:* (Name Combination, Alternate Spelling)
? *Rhinolophus hildebrandti:* (Name Combination)
? *Rhinolophus hildebrandtii:* (Current Spelling)

TAXONOMY:
See Pearl (1994). Within the *fumigatus* species group (Csorba *et al.*, 2003: 51 - 53; Simmons, 2005: 356). See Csorba *et al.*, 2003: 52) for a review of the taxonomy.

Taylor *et al.* (2010: 297) indicate that cryptic species might be present in the southern African *R. hildebrandtii* complex. These species probably diverged during the late Neogene (Plio-Pleistocene) when more open woodlands replaced the seasonal woodland/forest habitats (Schoeman and Monadjem (2018: 4).

COMMON NAMES:
Afrikaans: Hildebrandt se saalneusvlermuis, Hildebrandt-saalneusvlermuis, Hildebrandtse Vlermuis. Chinese: 希氏菊头蝠. Czech: vrápenec Hildebrandtův. English: Hildebrandt's Horseshoe Bat. French: Rhinolophe d'Hildebrandt, Fer à cheval d'Hildebrant, Fer à cheval du Kenya. German: Hildebrandts Hufeisennase. Italian: Rinòlofo di Hildebrandt; Fèrro di cavàllo di Hildebrandt. Kiluba (DRC): Kasusu. Portuguese: Morcego ferradura de Hildebrandt. Yao: Lichinji (applied to all largish bats).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
R. hildebrandtii was found in the earlier half of the upper Pleistocene sequence at Border Cave, KwaZulu-Natal, South Africa (Avery, 1991: 6; Taylor, 1998: 35).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs, 2008h; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) assessed as *Rhinolophus hildebrandti* (Jacobs, 2008h; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs, 2004i; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
Jacobs (2008h) [in IUCN (2009)] reported there appear to be no major threats to *Rhinolophus hildebrantii* as a whole.

CONSERVATION ACTIONS:
Jacobs (2008h) [in IUCN (2009)] reported there appear to be no direct conservation measures in place. In view of the species wide East African and southern African range, it seems probable that the species is present in some protected areas.

GENERAL DISTRIBUTION:
Rhinolophus hildebrantii is largely endemic to East Africa, except for a Central African records from Rwanda and southern Democratic Republic of the Congo, and a single questionable West African record from Nigeria. In East Africa it ranges from Ethiopia and northern Sudan in the north, through Uganda, Kenya and Tanzania (including the island of Pemba [see O'Brien, 2011: 286]), into southern Africa of Zambia, Malawi, Mozambique, Zimbabwe and Botswana, being found as far south as northern South Africa. Taylor (1998: 35) mentioned Pleistocene deposits of this species reported by Avery (1991) from Border Cave, northern Maputaland, KwaZulu-Natal, South Africa. In South Africa, its distribution is mostly affected by precipitation seasonality (Babiker Salata, 2012: 49).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 946,716 km^2.

Native: Botswana (Monadjem *et al.*, 2010d: 559); Burundi; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Ansell, 1974; Monadjem *et al.*, 2010d: 559); Ethiopia (Kruskop *et al.*, 2014: 102 report the first record North of the Rift Valley); Kenya; Malawi (Ansell, 1974; Happold *et al.*, 1988; Happold and Happold, 1997b: 818; Monadjem *et al.*, 2010d: 559); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 559; Monadjem *et al.*, 2010c: 379); Rwanda; Somalia; South Africa (Monadjem *et al.*, 2010d: 559); Sudan; Tanzania (Stanley and Goodman, 2011: 42), United Republic of; Uganda (Kityo and Kerbis, 1996: 61); Zambia (Ansell, 1969; Monadjem *et al.*, 2010d: 559); Zimbabwe (Monadjem *et al.*, 2010d: 559).
Presence uncertain: Namibia (Cotterill, 2004a: 261); Nigeria.

ECHOLOCATION:
Taylor *et al.* (2005), using a Pettersson D980, reported three, slightly different maximum frequencies (42.3 (± 0.2) kHz, 43.2 (± 0.1) kHz, 42.4 (0) kHz) from three different localities in Kenya for individuals of *R.* cf. *hildebrandtii*. Jacobs (1996) reported a maximum frequency of 37 - 46 kHz for individuals at Sengwa in Zimbabwe. Aldridge and Rautenbach (1987) reported a maximum frequency of c. 40 kHz for individuals from Pafuri in South Africa. Jacobs *et al.* (2007a) reported a peak frequency of 33.0 ± 0.9 kHz for individuals in South Africa (detector type and localities not reported). From Mozambique

Monadjem *et al.* (2010c: 379) reported that the peak echolocation frequencies ranged between 35 - 40 kHz (ANABAT, Petterson D240x). At Uzungwa Scarp Forest Reserve, Tanzania, Trentin and Rovero (2011: 56) describe the calls as starting at 28.5 kHz, increasing in .5 msecs to 39.8 kHz, and after 5 msecs decreasing to 26.7 kHz. The maximum intensity is at 35.5 kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Both Peterson and Nagorsen (1975) and Rautenbach (1986) reported 2*n* = 58, FN = 60, BA = 4, and subtelocentric X and Y chromosomes.
Protein / allozyme - Unknown.

PREDATORS:
Schätti (1984: 337) refers to Broadley (in lit.) who mentions a *R. hildebrandtii* specimen having been swallowed by an African housesnake (*Lamprophis fuliginosus* (Boie, 1827)).

POPULATION:
Structure and Density - This species is quite common in Zambia (Jacobs, 2008h; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs, 2008h; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
A male with abdominal testes was collected in the West Usambara Mountains (Tanzania) on 15 July 1991 (Stanley and Goodman, 2011: 42). Trentin and Rovero (2011: 50) reported two lactating females, and six females with single youngs, netted in December 2005 at Uzungwa Scarp Forest Reserve, Tanzania.

PARASITES:
HAEMOSPORIDA
Schaer *et al.* (2015: 381) found *Nycteria* sp. parasites in *R. hildebrandtii* from Kenya. Lutz *et al.* (2016: 9) found eight out of 14 specimens from East Africa to be infected by *Nycteria* sp. Perkins and Schaer (2016: Suppl.) report on the presence of *Nycteria congolensis* (Garnham, 1966) on bats from the DRC and East Africa as well as of *Nycteria* sp. from Kenya and Malawi or Mozambique.

DIPTERA
Streblidae: *Ascodipteron brevior* Maa 1965, female cysts found at the base of the ears in Congo (Haeselbarth *et al.*, 1966: 106). *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100). *Raymondia intermedia* Jobling, 1936 in the Congo (Haeselbarth *et al.*, 1966: 102). *Raymondia waterstoni* Jobling, 1931 (Haeselbarth *et al.*, 1966: 104), these records may possibly also be associated with *R. smithersii* (see Shapiro *et al.*, 2016: 256). *Raymondia intermedia* Jobling, 1936 (Shapiro *et al.*, 2016: 255).
Theodor (1968) recorded *Raymondia setiloba* (Jobling, 1954) from "*R. hildebrandtii*" in the DRC, but Shapiro *et al.* (2016: 256) indicate that the identify of the host is uncertain, and therefore report it as *Rhinolophus* sp.

Nycteribiidae: *Nycteribia scissa* Speiser; *Nycteribia rotundata* Theodor; *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114).

ACARI
Sarcoptidae: Fain (1959a: 341) reports on *Nycteridocoptes eyndhoveni* Fain, 1959 collected on a bat of this species captured in Lubudi, DRC.
Trombiculidae: Stekolnikov (2018a: 116) found *Trisetica aethiopica* (Hirst, 1926).

VIRUSES:
Coronaviridae
31.3 % (5 out of 16) of the Kenyan bats tested by Tao *et al.* (2017: 3) were positive for CoV.

Rhabdoviridae
Vesiculovirus
Metselaar *et al.* (1969: 183) extracted a new virus (the "Mount Elgon Bat Virus") from the salivary glands of *R. hildebrandtii eloquens*, collected at the Kiminimi caves on the slopes of Mount Elgon, Kenya. Willoughby *et al.* (2017: Suppl.) mentions this virus as "Mount Elgon bat ledantevirus".

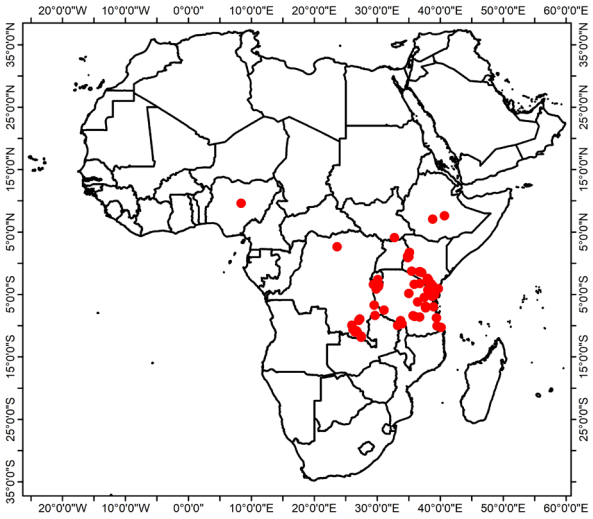


Figure 92. Distribution of *Rhinolophus hildebrandtii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Burundi, Congo (Democratic Republic of the), Ethiopia, Kenya, Nigeria, South Sudan, Sudan, Tanzania.

Rhinolophus hilli Aellen, 1973

*1973. *Rhinolophus hilli* Aellen, Period. biol., 75 (1): 101. Type locality: Rwanda: Cyangugu province: Uwinka [02 29 S 29 12 E, 2 300 m] [Goto Description]. Holotype: ZMZ 126639: ad ♀, skull and alcoholic. Collected by: U. Goepel; collection date: 25 August 1964. (Current Combination)

TAXONOMY:
Previously recognized as a synonym of *R. ruwenzorii* J. Eric Hill, 1942 but recognized as a separate species by Fahr *et al.* (2002: 108) and Simmons (2005).

COMMON NAMES:
Czech: vrápenec Hillův. English: Hill's Horseshoe Bat. French: Rhinolophe de Hill. German: Hills Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Critically Endangered (CR B1ab(iii,v)+2ab(iii,v) ver 3.1 (2001)) because its extent of occurrence appears to be less than 100 km² and its area of occupancy (presumably cave roosting sites) is probably less than 10 km² (field surveys in the Albertine rift have not found the species elsewhere), all individuals are in a single location (Nyungwe National Park), there is continuing decline in the extent and quality of its habitat, and there is believed to be an ongoing population decline related to over-harvesting for food (Fahr, 2008k; IUCN, 2009).

Assessment History -
2008 - CR B1ab(iii,v)+2ab(iii,v) ver 3.1 (2001) (Fahr, 2008k; IUCN, 2009). 2004 - CR (Fahr, 2004f; IUCN, 2004).

MAJOR THREATS:
Fahr *et al.* (2002) indicate that while there is little information available on this seemingly limited range species, it is probably threatened by habitat destruction (presumably by logging operations and the conversion of land to agricultural use) and direct exploitation (for subsistence food) in their day roosts (see Fahr, 2008k) [in IUCN (2009)]).

CONSERVATION ACTIONS:
Fahr (2008k) [in IUCN (2009)] reported that although *Rhinolophus hilli* is present within the Nyungwe National Park, it seems additional measures are needed to conserve the habitat of this species. There is a need for bat awareness programmes for local people to prevent over-harvesting of the species. Further field surveys are also needed to locate important roosts and to learn more about the natural history of this poorly known species.

GENERAL DISTRIBUTION:
Rhinolophus hilli is known only within the Nyunwe National Park, Rwanda. It has been identified from only two close localities (approximately 8 km apart). Field surveys in surrounding areas of potentially suitable habitat have not found additional populations. It has an elevational range of between 1,750 and 2,512 m asl (Fahr *et al.*, 2002).

Native: Rwanda.

POPULATION:
Structure and Density - There is little information available on the abundance of *Rhinolophus hilli*; colonies of this species have yet to be found but are likely to be small (Fahr *et al.*, 2002).
Trend - 2008 - Decreasing (Fahr, 2008k; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Rwanda.

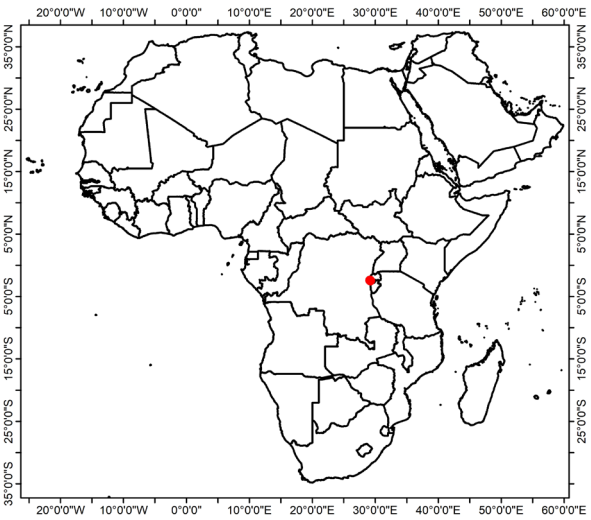


Figure 93. Distribution of *Rhinolophus hilli*

Rhinolophus hillorum Koopman, 1989

*1989. *Rhinolophus clivosus hillorum* Koopman, Am. Mus. Novit., 2946: 4. Publication date: 28 June 1989. Type locality: Liberia: Lofa county: ca 2 mi SW Voinjama, near Zozoma: John

Hegbe farm: (the type lable mentions John's Town) [08 25 N 09 35 W, 500 m] [Goto Description]. Holotype: AMNH 257044: ad ♀, skull and alcoholic. Collected by: Andrew S. Voros; collection date: early October; original number: 5924. Type lable mentions 3 September 1983. - Etymology: In honour of the two (often confused) eminent mammalogists named John E. Hill: J. Eric (1907-1947), and J. Edwards (1928-1997) (see Koopman, 1989b: 5).

? *Rhinolophus hillorum:* (Name Combination, Current Combination)

TAXONOMY:
Considered a synonym of *clivosus* by Koopman (1993a: 164), but see Simmons (2005: 356). See Csorba *et al.* (2003: 131) for remarks on taxonomy.

COMMON NAMES:
Czech: vrápenec západoafrický. English: Upland Horseshoe bat, Hill's Horseshoe bat. French: Rhinolophe de Lofa. German: Hochland-Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU A2c ver 3.1 (2001)) because it is suspected that a population decline, estimated to be more than 30 % would be met over the next 10 years, inferred from the loss of montane habitat, especially in northern Liberia and southern Guinea (Jacobs *et al.*, 2008ad; IUCN, 2009).

Assessment History -
2008 - VU A2c ver 3.1 (2001) (Jacobs *et al.*, 2008ad; IUCN, 2009). 2004 - VU A4c; B2ab(iii) ver 3.1 (2001) (Jacobs *et al.*, 2004s; IUCN, 2004).

MAJOR THREATS:
Colonies are threatened by general deforestation, often resulting from logging and mining operations, and overharvesting for the bushmeat trade (Jacobs *et al.*, 2008ad; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ad) [in IUCN (2009)] reported there appear to be no direct conservation measures in place for *Rhinolophus hillorum*. It is not known if the species is present in any protected areas, but it has been recorded from the Sapoba Forest Reserve in Nigeria and the Bali Forest Reserve in Cameroon (Cotterill, 2002a). There is a need to identify and protect important areas for this species. Further research is needed into the species distribution, including the location of any additional colonies.

GENERAL DISTRIBUTION:
Rhinolphus hillorum is largely endemic to West and Central Africa, with a single questionable record from northern Uganda. It has been recorded from a few small, disjunct, colonies in Liberia (including Voinjama; Tokadeh; and the Wonegizi Mountains), Guinea, Nigeria (Sapoba Forest Reserve) and Cameroon (including Lake Manenguba and the Bali Forest Reserve).

Native: Cameroon; Guinea (Fahr *et al.*, 2006a: 72); Liberia; Nigeria.
Presence uncertain: Uganda.

HABITAT:
Monadjem *et al.* (2016y: 366) recorded five specimens from forested habitats on the Liberian side of Mount Nimba, on altitudes ranging from 780 to 1,200 m.

ROOST:
Monadjem *et al.* (2016y: 366) found a roost in an old mine adit at Mount Tokadeh, Liberia.

POPULATION:
Structure and Density - The species appears to have a small population, but further research is needed to confirm this (Jacobs *et al.*, 2008ad; IUCN, 2009).
Trend - 2008 - Decreasing (Jacobs *et al.*, 2008ad; IUCN, 2009).

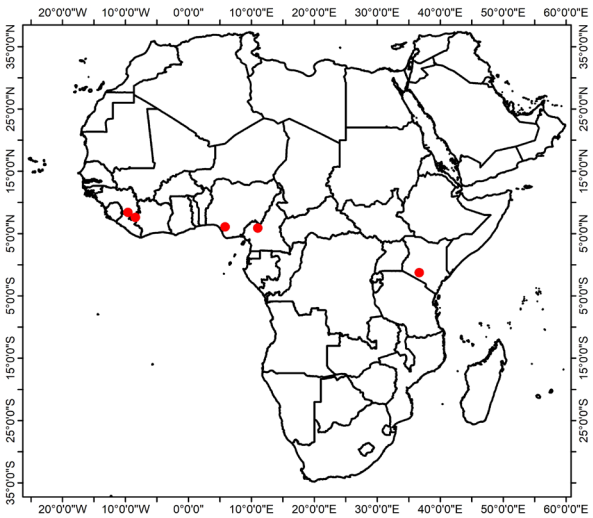


Figure 94. Distribution of *Rhinolophus hillorum*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Guinea, Kenya, Liberia, Nigeria.

Rhinolophus hipposideros (Bechstein, 1800)

1792. *minor* Kerr, in: Linnaeus, Animal Kingdom, 1 (1): xvii, 91. Publication date: February 1792. Type locality: France: "France". - Comments: Preoccupied by *minor* Kerr, 1792: 97 (two pages before this) (see Simmons, 2005).

*1800. *Vespertilio hipposideros* Bechstein, Allgemeine Uebersicht Vierfüssige Thiere, 2: 629. Type locality: France: "France". - Etymology: from the masculine Greek substantive "*ἵππος*" (híppos), meaning "horse" and from the neuter Greek substantive "*σίδηρος*" (síderos), meaning "iron", referring to the occurrence of a fleshy horseshoe-shaped expansion on the muzzle in this species as in all other species of the genus (see Lanza *et al.*, 2015: 104).

1861. *Rhinolophus miminus* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 4, 6. Publication date: 1861. Type locality: Eritrea: Kérén [ca. 15 45 N 38 20 E]. Holotype: SMNS 987: sad ♂, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Andersen (1904c: 455) mentions it as an immature, but full-grown specimen and 1862? as collection date. Dieterlen *et al.* (2013: 294) mention "skull and specimen in alcohol" and mention 1861 as collection date.

1870. *Rhinolophus Eggenhöffner* Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 62 (1): 151. - Comments: This might be an African form, but we do not have any further information.

1905. *Rhinolophus hipposiderus typicus* K. Andersen, Proc. zool. Soc. Lond., 1905, II, I (10): 141. Publication date: 7 October 1905. - Comments: This might be an African form, but we lack any further information.

1918. *[Rhinolophus hipposideros] escaleræ* K. Andersen, Ann. Mag. nat. Hist., ser. 9, 2 (10): 378. Publication date: 1 October 1918. Type locality: Morocco: Mogador [=Essaouira]: Ha-ha [ca. 31 31 N 09 46 W] [Goto Description]. Holotype: BMNH 1910.11.24.2: ♀. Collected by: D. Manuel M. de la Escalera. Presented/Donated by: Michael Rodgers Oldfield Thomas. See Andersen (1918: 378).

1937. *Rhinolophus hipposideros vespa* Laurent, Bull. Soc. Hist. nat. Afr. Nord, 28: 157, text-fig. 1 - 2. Publication date: February 1937. Type locality: Morocco: near Rabat: Oued Korifla [ca. 34 02 N 06 50 W]. Holotype: MNHN 919: ♂, alcoholic (skull not removed). Collected by: Prof. Dr. R. Laurent; collection date: 8 August 1927. Number 181 in Rode (1941: 238). Paratype: MNHN 833: ♂, alcoholic (skull missing). Collected by: Prof. Dr. R. Laurent. Number 181a in Rode (1941: 238).

1978. *eggenhoffner:* Corbet, Mammals Palaearctic region, 43. - Comments: Possibly extralimital. (Lapsus)

? *Rhinolophus hipposideros minimus:* (Name Combination)

? *Rhinolophus hipposideros:* (Name Combination, Current Combination)

TAXONOMY:
Revised by Felten *et al.* (1977). The status of populations around the Mediterranean, on Mediterranean Islands, and on both sides of the Red Sea is unclear (see Horácek *et al.*, 2000: 101). *hipposideros* species group (Csorba *et al.*, 2003: 53 - 55; Simmons, 2005: 356 - 357). See Csorba *et al.* (2003: 54) for review of taxonomy.

Kozhurina (2009: 72) points out that Borkhausen (1797 - Deutsche Fauna, oder kurzgefaßte Naturgeschichte der Thiere Deutschlands. Erster Theil: Säugethiere und Vögel. Frankfurt am Main: 85) was the first to give a scientific name to this species: *Noctilio Hipposideros*.

COMMON NAMES:
Albanian: Lakuriq nate hundpatkua i vogël. Arabian: Khafash abu hadwa saghir, Khaffash. Armenian: Փոքր պայտաքիթ. Azerbaijani: Kiçik nalburun. Basque: Ferra-saguzar txikia. Belarusian: Падкаванос малы. Bosnian: Mali potkovasti šišmiš. Breton: Frigribell vihan. Bulgarian: Малък подковонос. Castilian: Murciélago pequeño de herradura, Rinolofo pequeño de herradura. Catalan: Ratpenat de ferradura petit, Rat penat petit de ferradura, Ratapinyada petita de ferradura. Croatian: Mali potkovnjak. Czech: Vrápenec malý (wrápenec menš í, vrápenec menš í, malý vrápenec podkovní, vrápeník malý, vrápenec moravský). Danish: Lille hestekonæse, Dvaerghesteskonaes. Dutch: Kleine hoefijzerneus. English: Lesser Horseshoe Bat, Smaller Horseshoe Bat. Estonian: Väike-sagarnina. Finnish: Euroopanpikkuherkko. French: Petit rhinolophe, Petit rhinolophe fer à cheval, Petit Fer-à-Cheval. Frisian: Lytse hoefizernoas. Galician: Morcego de ferradura pequeño, Morcego pequeño de ferradura. Georgian: მცირე ცხვირნალა. German: Kleine Hufeisennase, Kleinhufeisennase. Greek: Μικροριν́λοφος. Hebrew: Parsaf Gamadi.

Hungarian: Kis patkósdenevér, Kis patkósorrú denevér, Rhinolophos i mikra. Irish Gaelic: Crú-ialtóg bheag. Italian: Rinolofo minore, Ferro di Cavallo Minore. Latvian: Mazais pakavdegunis. Lithuanian: Mažasis pasagnosis. Luxembourgish: Kleng Huffeisennues. Macedonian: Мал потковичар [= Mal Potkovichar]. Maltese: Rinolofu Żgħir, Farfett il-Lejl tan-Nala. Montenegrin: Mali potkovičar. Norwegian: Dverghesteskonese, Liten hesteskonese. Polish: Podkowiec mały. Portuguese: Morcego-de-ferradura-pequeno. Rhaeto-Romance: Rinolof pitschen, Nas fier-chaval pitschen. Romanian: Liliacul mic cu potcoavă, Liliac-mic-cupotcoavã. Russian: Подковонос малый [= Podkovonos malyj. Serbian: Мали потковичар [= Mali potkovič ar]. Scottish Gaelic: Crudh-ialtag bheag. Slovak: Podkovár malý. Slovenian: Mali podkovnjak. Swedish: Dvärghästskonäsa. Turkish: Küçük Nalburunlu Yarasa. Ukrainian: Підковик (Підковоніс) малий. Welsh: Ystlum pedol lleiaf.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
R. hipposideros is recorded from the Guenfouda Cave (syn. Ghar Zebouj) in eastern Morocco, dating from the beginning of the Holocene (Neolithic) period (López-García *et al.*, 2012: 51).

Dool *et al.* (2013: 4067) indicate that during the Pleistocene, *R. hipposideros* utilized multiple refugia across the Mediterranean.

Dool *et al.* (2016a: 206) indicate that *R. hipposideros* represents the oldest lineage of the genus and diverged fromthe other species around 16 Mya.

CONSERVATION STATUS:
Global - This species has a large range. Although there have been marked and well-documented declines in some areas, the species remains widespread, fairly common, and apparently stable in other areas. Assessed as Least Concern (LC ver 3.1 (2001)) (Jacobs *et al.*, 2008aq; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008aq; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004af; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
Threats include disturbance and loss of underground habitats and attics (conversion of attics in human habitat), agricultural intensification, fragmentation and isolation of habitats, and the use of pesticides in agricultural areas (Jacobs *et al.*, 2008aq; IUCN, 2009).

In Austria, Reiter *et al.* (2012: 283) studied the influence of landscape fragmentation on *R. hipposideros* and found that conservation measures for colonies of lesser horseshoe bats should be undertaken within 2.5 km of the nursery roost. As these bats seem to be unable to adapt their spatial foraging behaviour by shifting from woodland to a degraded landscape, any loss of woodland near the colonial roosts will negatively influence the colony.

R. hipposideros's aerial hawking and its long-distance disperal are considered to be major risk factors in view of climatic change (Sherwin *et al.*, 2012: 174).

CONSERVATION ACTIONS:
According to Jacobs *et al.* (2008aq) [in IUCN (2009)], *Rhinolophus hipposideros* is protected by national legislation in all European range states. There are international legal obligations for protection through Bonn Convention (Eurobats) and Bern Convention, where those apply. Included in Annex II (and IV) of EU Habitats and Species Directive and hence requiring special measures for conservation including designation of Special Areas for Conservation. Some habitat protection through Natura 2000. Recommended conservation measures include protecting maternity roosting sites, hibernation caves and foraging habitats. No specific conservation measures apply in South Asia; more research and monitoring are needed.

GENERAL DISTRIBUTION:
Rhinolophus hipposideros is widely distributed in the western and central Palaearctic. It is found in all the European countries (including the islands) of the Mediterranean region. In North Africa it is recorded from Morocco, Algeria, Tunisia and the eastern part of the Sinai (to Egypt); also occurs in eastern Africa. Also recorded from Anatolia and the countries of the Levant. It occurs from sea level to 2,000 m.

Native: Afghanistan; Albania; Algeria; Andorra; Armenia; Austria; Azerbaijan; Belgium; Bosnia and Herzegovina; Bulgaria; China; Croatia; Cyprus (Benda *et al.*, 2007: 71); Czech Republic; Djibouti (Pearch *et al.*, 2001: 388); Egypt (Sinai); Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 147); France [Corse]; Georgia; Germany; Gibraltar; Greece [Kriti]; Holy See [Vatican City State]; Hungary; India; Iran; Ireland; Islamic Republic of; Iraq; Ireland; Israel; Italy [Sardegna, Sicilia]; Jordan; Kazakhstan; Kyrgyzstan; Lebanon; Luxembourg; Macedonia, the former Yugoslav Republic of; Malta; Moldova; Monaco; Montenegro; Morocco (Benda *et al.*, 2010a: 157, El Ibrahimi and Rguibi Idrissi, 2015: 359); Pakistan; Palestinian Territory,

Occupied (Shehab *et al.*, 2006: 161); Poland; Portugal; Romania; Russian Federation; San Marino; Saudi Arabia; Serbia; Slovakia; Slovenia; Spain [Baleares]; Sudan; Switzerland; Syrian Arab Republic; Tajikistan; Tunisia (Dalhoumi *et al.*, 2014: 53; 2016b: 867); Turkey; Turkmenistan; Ukraine; United Kingdom; Uzbekistan.
Regionally extinct: Liechtenstein; Netherlands.

DETAILED MORPHOLOGY:
Baculum - See Csorba *et al.* (2003: 54).

ECHOLOCATION:
Jones and Siemers (2010: 449 - 450) indicated that females emit pulses with a higher frequency than males, and also that juveniles emit lower frequencies than adults.

Papadatou *et al.* (2008b: 132) report the following data for 5 Greek specimens: F_{start}: 96.6 ± 10.25 kHz, F_{end}: 84.8 ± 4.74 kHz, F_{peak}: 110.6 ± 3.93 kHz, bandwidth: 4.8 ± 1.61 kHz, duration 45.2 ± 6.43 msec and interpulse interval: 98.2 ± 29.10 msec.
For 52 calls of bats from France, Switzerland and the UK, Walters *et al.* (2012: suppl.) report the following figures: duration: 42.47 ± 12.66 msec, F_{max}: 109.76 ± 2.35 kHz, F_{min}: 94.35 ± 3.95 kHz, bandwidth: 15.41 ± 4.26 kHz, F_{peak}: 109.58 ± 2.36 kHz.
The following data for 18 Iranian calls were reported by Benda *et al.* (2012a: 182): F_{start}: 111.2 ± 0.8 (109.9 - 112.2) kHz, F_{end}: 108.5 ± 1.4 (106.2 - 110.7) kHz, F_{peak}: 110.3 ± 0.8 (109.0 - 111.1) kHz, duration: 49.9 ± 1.5 (47.8 - 52.0) msec, interpulse interval: 41.9 ± 3.8 (36.1 - 48.7) msec.

Disca *et al.* (2014: 226) indicate that the type of call is FM-FC-FM in Morocco, with F_{peak}: 116.9 ± 0.2 kHz and duration: 39.7 ± 13.2 msec, whereas Dalhoumi *et al.* (2016b: 866) report a frequency "> 112 kHz" (111.5 - 117.5 kHz).

57 calls were recorded by Hackett *et al.* (2016: 223) from Israel: Pulse duration: 42.28 ± 12.09 msec, F_{start}: 92.54 ± 6.79 (83.9 - 109.3) kHz, F_{end}: 93.37 ± 8.61 (80 - 114.2) kHz, F_{peak}: 107.58 ± 0.49 (103.5 - 109.3) kHz.

Dool *et al.* (2016b: Suppl.) showed that there is a sexual dimorphism in the peak frequencies in Irish bats, with males call on average 4 kHz lower.

MOLECULAR BIOLOGY:
DNA - See Puerma *et al.* (2007).

Karyotype - Capanna *et al.* (1967) reported 2*n* = 56, FN = 60. However, Rushton (1970: 463) reported 2*n* = 58, FN = 60, a metacentric X, and a minute Y. For a female from Jordan, Qumsiyeh and Baker (1985) reported 2*n* = 58, FN = 60, BA = 4. More recently, Puerma *et al.* (2007) reported 2*n* = 54, FN = 62, BA = 10, a submetacentric X and an acrocentric Y for specimens from Spain.

Volleth *et al.* (2013: 55) and Arslan and Zima (2014: 8) indicate that three diploid chromosome numbers are present in Europe: 54, 56, and 58. The specimens with 58 chromosomes occur in Asia Minor and the Middle East, those with 56 chromosomes in the Czech Republic, Slovakia, Italy and Greece, and those with 54 chromosomes in Spain, Germany and (possibly) Switzerland.

Protein / allozyme - Unknown.

DIET:
Andreas *et al.* (2013) using faecal analysis of *R. hipposideros* from southern Slovakia, showed that this species fed only on the small moths (<25mm) (%f = 59; %vol = 87) and this prey category was supplemented with Neuroptera (Hemerobiidae) (%f = 13.8; %vol = 1.5), nematoceran (%f = 20.7; %vol = 10.0) and brachyceran (%f = 6.9; %vol = 1.2) Diptera.

Droppings from northern Algeria were examined by Ahmim and Moali (2013: 175), who found the following prey items: Insecta (93.46 %) and Chilopoda (6.54 %). Among the Insecta, Diptera were mostly encountered (41.58 %), more specifically: Culicidae (15.59%), Chironomidae/Ceratopogonidae (9.68 %) and Tipulidae (6.45 %). Lepidoptera formed the second most important insect order (21.1 %), followed by Hemiptera (11.68 %).

POPULATION:
Structure and Density - According to Jacobs *et al.* (2008aq) [in IUCN (2009)], *Rhinolophus hipposideros*) is an infrequent species in the northern part of its range. In Europe the species forms summer colonies of 10 - 50 individuals (up to 1,500 animals), whereas it is solitary in winter or forms loose aggregations up to 500 animals per roost. Since the 1950s the northern border of the range in western and central Europe has moved to the south. In the Netherlands, northern Belgium and Germany (except for a few colonies in Bavaria, Thüringen, Sachsen and Sachsen-Anhalt) the species went extinct (Fairon *et al.*, 1982; Schofield, 1999). It disappeared from northern and western parts of Bohemia, and much of Poland where 87 % of the hibernating population was lost between 1950 and 1990 (Urbanczyk, 1994; Ohlendorf, 1997). In Switzerland and Austria the distribution became fragmented, as colonies remained only at higher elevations (>400 m) (Stutz and Haffner, 1984; Spitzenberger, 2002), although in Switzerland at least the population has started to slowly recover

over the last 10 years (increasing from 2,200 to 2,500 adults counted in maternity roosts: H. Kraettli *pers. comm.,* 2006). In Spain some colonies have disappeared due to the restoration of buildings, but there are no data on population trend (J. Juste and T. Alcalde *pers. comm.,* 2006), and in France there have been some declines in the north, although large populations in the south are thought to be more stable (EMA Workshop, 2006). In the southwest Asian part of the range it gathers in wintering colonies of up to 40 animals, although it is mainly solitary (K. Tsytsulina *pers. comm.,* 2005). In Turkey it is a commonly reported species, and the population is stable (A. Karatash *pers. comm.,* 2005). It is common in Iran although encountered less frequently than *R. ferrumequinum* (M. Sharifi *pers. comm.,* 2005). It is not known how abundant this species is in Jordan and Syria but it may be more common than the collection reports indicate (Amr, 2000). Size and trends within Africa and South Asia are unknown.
Trend - 2008 - Decreasing (Jacobs *et al.*, 2008aq; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Tuttle and Stevenson (1982: 120) indicate that some females might attain sexual maturity in as little as three months, whereas other females and males might need 15 months.
At birth, the young has about 34.4 % of the mother's body mass (4.2 g versus 12.3 g) (see Kurta and Kunz, 1987: 82).

POSTNATAL DEVELOPMENT:
In Austria, Reiter (2004: 234) found that the average forearm length at one day of age was 17.5 mm and the average weight 2.0 g. He also found that the growth of both the forearm and weight was almost linear during the first 14 days. In some cases, a loss of weight could be observed between day 15 and 20, which occurred a few days before the first flights took place (at between 18 and 20 days of age). At the time of their first flight, the forearm was 92 % of that the adult female, and weight was 70 % of the adult's.

PARASITES:
Lainson and Naiff (2000: 128) repored *R. hipposideros* as host for *Eimeria hessei* Lavier, 1924 (Apicomplexa).

In Italy, Voyron *et al.* (2011: 193) reported the following fungal entitiy from *R. hipposideros* carcasses: *Mortierella gamsii* Miko, 1974.
Genov *et al.* (1992) reported the presence of the Nematode *Molinostrongylus alatus* (Ortlepp, 1932) in Moldova.

Benda *et al.* (2010b: 234) found the bat fly *Phthiridium integrum* (Theodor and Moscona, 1954) (Nycteribiidae) on *R. hipposideros* in Jordan. They also indicate that *Phthiridium bilobum* (Theodor and Moscona, 1954) was reported before from Palestine, and the fleas *Ischnopsyllus octactenus* (Kolenati, 1856) and *Rhinolophopsylla u. unipectinata* (Taschenberg, 1880) from Turkey.

From Algeria, Bendjeddou *et al.* (2013: 325) reported infestations by *Phthiridium biarticulatum* Hermann, 1804 (Diptera: Nycteribiidae) and *Cimex lectularius* (Linnaeus, 1758) (Hemiptera: Cimicidae). Another Algerian ectoparasite was reported by Bendjeddou *et al.* (2017: 15): Arachnida: *Ixodes ricinus* (Linnaeus, 1758).

VIRUSES:
Coronaviridae
Alphacoronavirus
This virus was reported from Italy by Kohl and Kurth (2014: 3112).
Betacoronavirus
Kohl and Kurth (2014: 3112) reported this virus from Bulgaria, Germany, Slovenia, Italy.

Reoviridae
Orthoreovirus
Reported from Italy by Kohl and Kurth (2014: 3113).

Orthomyxoviridae
Despite sampling and testing of 6 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

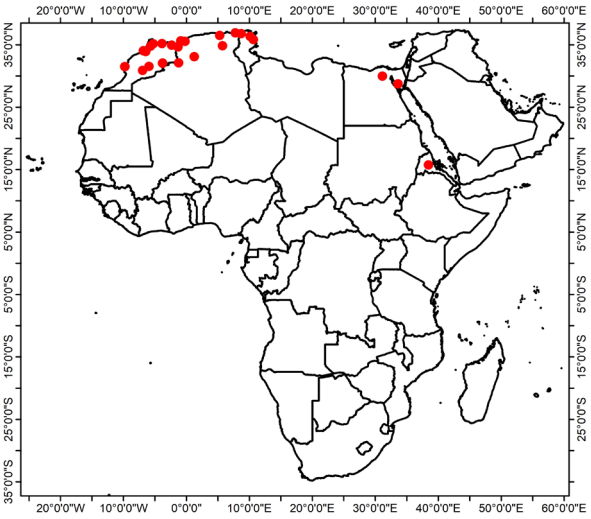


Figure 95. Distribution of *Rhinolophus hipposideros*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Angola, Cameroon, Egypt, Eritrea, Ethiopia, Liberia, Morocco, Sudan, Tunisia.

Rhinolophus horaceki Benda and Vallo, 2012

*2012. *Rhinolophus horaceki* Benda and Vallo [Goto Description]. Holotype: NMP 49880: ad ♂, skin and skull. Collected by: Michal Andreas, Petr Benda, Vladimir Hanák, Antonin Reiter and Marcel Uhrin; collection date: 15 May 2002; original number: pb2124. Paratype: NMP 49861: ad ♂, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Vladimir Hanák, Antonin Reiter and Marcel Uhrin; collection date: 12 May 2002; original number: pb2104. Paratype: NMP 49879: ad ♂, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Vladimir Hanák, Antonin Reiter and Marcel Uhrin; collection date: 15 May 2002; original number: pb2123. Paratype: NMP 49882: ad ♀, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Vladimir Hanák, Antonin Reiter and Marcel Uhrin; collection date: 16 May 2002; original number: pb2127. Paratype: NMP 49915: ad ♀, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Vladimir Hanák, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2163. (Current Combination)

TAXONOMY:
Based on cytochrome *b* sequences, Benda and Vallo (2012) were able to distinguish a new species of *Rhinolophus* from northern Libya (Cyrenaica). The cytochrome *b* shares unique base positions with the *ferrumequinum*/*clivosus* complex, but also with the *fumigatus* group.

Benda *et al.* (2014c: 24) indicate that specimens of this species were reported as *R. clivosus* by Qumsiyeh and Schlitter (1982).

COMMON NAMES:
Dutch: Horacekcs hoefijzerneus. German: Lybische Hufeisennase.

GENERAL DISTRIBUTION:
Benda *et al.* (2014c: 22) indicate that *R. horaceki* is an endemic of the Mediterranean part of Cyrenaica, streching about 360 km along the coast, and covering no more than 4,000 km^2.

ROOST:
Benda *et al.* (2014c: 22) found a group of four bats in a cave situated in the northern slope of the side valley of the western part of Wadi Al Kuf (Libya).

DIET:
The diet of this species was determined by Benda *et al.* (2014c: 26). One group of faecal pellets contained 99.8 % by volume medium-sized moths and 0.2 % small nematoceran Diptera. A second group of pellets contained 54 % of medium-size Lepidoptera, 38 % of Blattoidea, 4 % of Formicoidea, 2 % of Auchenorrhyncha and 2 % of Coleoptera.

REPRODUCTION AND ONTOGENY:
Two pregnant females were collected by Benda *et al.* (2014c: 24) on 16 and 20 May 2002.

Rhinolophus kahuzi Fahr and Kerbis Peterhans, 2013

*2013. *Rhinolophus kahuzi* Fahr and Kerbis Peterhans, in: Kerbis Peterhans, Fahr, Huhndorf, Kaleme, Plumptre, Marks and Kizungu, Bonn. Zool. Bull., 62 (2): 192, 194, figs 5, 6. Publication date: November 2013. Type locality: Congo (Democratic Republic of the): Western slope of Mt. Kahuzi [02 15 09 S 28 40 09 E, 2 600 m] [Goto Description]. Holotype: FMNH 219793: ad ♂, skull and alcoholic. Collected by: R. Kizungu; collection date: 28 July 2007; original number: JCK 5406. Presented/Donated by: ?: Collector Unknown. - Etymology: The name refers to the type locality and is used as a noun in apposition (see Kerbis Peterhans *et al.*, 2013: 194). (Current Combination)

COMMON NAMES:
English: Kahuzi horseshoe bat. German: Kahuzi-Hufeisennase.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the).

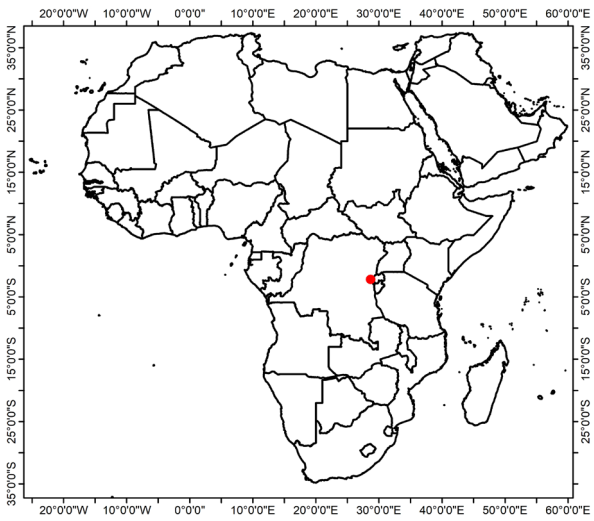


Figure 96. Distribution of *Rhinolophus kahuzi*

Rhinolophus landeri Martin, 1838

*1838. *Rhinolophus landeri* Martin, Proc. zool. Soc. Lond., 1837, V (lviii): 101. Publication date: 25 May 1838. Type locality: Equatorial Guinea: Bioko [formerly Fernando Po] [ca. 03 21 N 08 40 E]. Holotype: BMNH 1855.12.26.250:. - Etymology: Named by Martin after Richard Lemon Lander (1804 - 1834), an English explorer of western Africa (see Rosevear, 1965; Taylor, 2005; Lanza *et al.*, 2015 109). (Current Combination)

1904. *Rhinolophus Dobsoni* Thomas, Ann. Mag. nat. Hist., ser. 7, 14 (80): 156, footnote. Publication date: 1 August 1904. Type locality: Sudan: Kordofan [ca. 13 00 N 30 00 E] [Goto Description]. Holotype: BMNH 1847.5.7.49: ♀.

1917. *Rhinolophus axillaris* Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 429. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Aba [03 53 N 30 17 E] [Goto Description]. Holotype: AMNH 49175: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 17 December 1911; original number: 1807. The museum labels indicate it as a female.

? *Rhinolophus landeri dobsoni:* (Name Combination)

? *Rhinolophus landeri landeri:* (Name Combination)

TAXONOMY:

Meester *et al.* (1986) state that Rosevear (1965) and Kock (1969a) regard *guineensis* Eisentraut, 1960, from Guinea, as subspecifically distinct from *landeri*. Hayman and Hill (1971), on the other hand, consider it a synonym, while Böhme and Hutterer (1979, Csorba *et al.* (2003: 59 - 61) and Simmons (2005: 356) regard it as a distinct species, sympatric with *landeri* and somewhat larger.

Other names associated with *landeri* are *dobsoni* Thomas, 1904, which is either a synonym (Kock, 1969a) or a valid subspecies (Koopman, 1975). See Csorba *et al.* (2003: 62) for remarks on taxonomy. *lobatus* Peters, 1852 and *angolensis* Seabra, 1898 were removed by Taylor *et al.* (2018a: 22).

COMMON NAMES:

Afrikaans: Lander se saalneusvlermuis, Lander-saalneusvlermuis. Chinese: 兰德菊头蝠. Czech: vrápenec Landerův. English: Lander's Horseshoe Bat. French: Rhinolophe de Lander. German: Landers Hufeisennase, Kastanienrothe Kammnase, Rundlappigen Kammnase, Lander's Rundblattnase. Italian: Rinòlofo di Lànder. Kiluba (DRC): Kasusu. Portuguese: Morcego ferradura de Lander. Spanish (Castillian): Murciélago de Herradura

CONSERVATION STATUS:

Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008an; IUCN, 2009).

Assessment History -

2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008an; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004ap; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to *Rhinolophus landeri* as a whole (Jacobs *et al.*, 2008an; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008an) reported in IUCN (2009) that in view of the wide range of *Rhinolophus landeri* it seems probable that it is present in some protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Rhinolophus landeri has been widely reported from much of sub-Saharan Africa. It ranges from Senegal and The Gambia in the west, through most of West and Central Africa to Sudan and Ethiopia in the east. The species had been recorded as far south as eastern South Africa, but all southern and eastern African specimens are now referred to *R. lobatus* (see Taylor *et al.*, 2018a: 24). On Mount Cameroon, they have been taken at an altitude of 1,200 m asl and at 900 m asl on Mount Bintamane in Sierra Leone (Rosevear, 1965).

Native: Benin (Capo-Chichi *et al.*, 2004: 162); Burkina Faso (Kangoyé *et al.*, 2015a: 610); Cameroon; Central African Republic; Congo; Côte d'Ivoire; Equatorial Guinea (including Bioko); Ethiopia; Gabon; Gambia (Emms and Barnett, 2005: 50); Ghana; Guinea (Fahr and Ebigbo, 2003: 128; Decher *et al.*, 2016: 264); Liberia (Monadjem and Fahr, 2007: 47); Niger; Nigeria; Senegal; Sierra Leone; Somalia; Sudan; Togo.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Menzies (1973) [in Young (1975: 76)] indicates that, in some colonies in northern Nigeria, rufous bats get a grey fur during the molting season, and subsequently change back to rufous.

SEXUAL DIMORPHISM:
Krutzsch (2000: 117) mentions the presence of shoulder glands in the males.

ECHOLOCATION:
In Guinea, Fahr and Ebigbo (2003) reported the frequency of the CF-component as 103.3 kHz. In Kenya, O'Shea and Vaughan (1980) using a Holgate ultrasonic sensor reported a frequency of 55 kHz for individuals at Masalani, later Taylor *et al.* (2005) using a Pettersson D980 reported a maximum frequency of 110 (± 0) kHz for an individual from Bungule.

In Burkina Faso, Kangoyé *et al.* (2015a: 613) recorded one male calling at 108.5 kHz, and a female calling at 105.6 kHz.

In Sierra Leone, two males called at 102.0 (101.5 - 102.5) kHz (Weber *et al.*, 2019: 21).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - 2*n* = 58, FN = 60, BA = 4, and a submetacentric X chromosome (Rautenbach *et al.*, 1993). Koubínová *et al.* (2010b) agree with Rautenbach *et al.* (1993), and reported for a female from Senegal 2*n*= 58, and a Fna= 64, which contained four pairs of biarmed autosomes three pairs of which were medium to small sized meta- or submetacentrics and one was a medium sized subtelocentric, the remaining 24 pairs were a gradated series of acrocentrics.
Protein / allozyme - Unknown.

HABITAT:
Monadjem *et al.* (2016y: 366) recorded this species in the Mount Nimba area in forested habitats between 550 and 1,000 m.

POPULATION:
Structure and Density - This species is rather common locally, colonies can consist of hundreds of individuals (Jacobs *et al.*, 2008an; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008an; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Orr and Zuk (2014: 902) refer to Racey (1982) [who in turn refers to Menzies (1973)] and indicated that in *R. landeri* it can take up to two months before the blastocyst gets implanted.

PARASITES:
HAEMOSPORIDA
Adam and Landau (1973a: 5) report on the presence of a protozoan parasite of the genus *Polychromophilus* (Haemoproteidae) in *R. landeri*. About 50 % of the specimens from Congo they examined, were found to be infected. Gametocytes were found year-round. The bats were also infested by the nycteribiids *Penicillidia fulvida* Bigot, 1885 and *Nycteribia schmidlii scotti* Falcoz, 1923, of which the prior was a major carrier of *Polychromophilus* sporozoites. Schaer *et al.* (2013a: 17416) also found this parasite (possibly *N. congolensis* or *N. gabonensis*) in one out of two West African bats they examined.
Polychromophilus ? murinus was reported by Garnham (1973: 237), based on a record by Adam and Landau.

Espinosa-Álvarez *et al.* (2018: Suppl.) reported *Trypanosoma livingstonei* from three bats from Mozambique.

Schaer *et al.* (2015: 381) found *Nycteria* sp, in a bat from Guinea and *Nycteria* cf. *congolensis* in a

R. landeri from Sierra Leone. Perkins and Schaer (2016: Suppl.) reported on *Nycteria congolensis* (Garnham, 1966) from Sierra Leone, and *Nycteria* sp. from Côte d'Ivoire or Guinea. Rosskopf *et al.* (2018: 31) also found *Nycteria* parasites in bats from Gabon.

Justine (1989b: 537, 544) described two new stomach parasites: *Capillaria landauae* and *Capillaria brosseti* (Nematoda) from *R. landeri* from Makokou (Gabon).

Polyctenidae: *Androctenes horvathi* Jordan, 1912 recorded from Congo (Haeselbarth *et al.*, 1966: 17).

Streblidae: *Ascodipteron lophotes* Monticelli 1898 from Kenya (Haeselbarth *et al.*, 1966: 106, but Maa (1965) suggests that these records need verification). *Brachytarsina africana* (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100). *Penicillidia pachymela* Speiser, 1901, from Somalia, Sudan, Kenya, Tanzania, the Congo, Guinea and the Cameroon Mts (Haeselbarth *et al.*, 1966: 114). *Raymondia intermedia* Jobling, 1936 in Sierra Leone (Haeselbarth *et al.*, 1966: 102), Kenya (Haeselbarth *et al.*, 1966: 102, host referred to as *R. axillaris*), see also Shapiro *et al.* (2016: 255). *Raymondia simplex* Jobling, 1955 at Kasongo, Congo (Haeselbarth *et al.*, 1966: 104; Shapiro *et al.*, 2016: 256). *Raymondia waterstoni* Jobling, 1931 (Shapiro *et al.*, 2016: 256).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Rhinolophus landeri*: Astroviruses and Coronaviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Seven out of 58 (12.1 %) Kenyan bats tested positive for CoV (Tao *et al.*, 2017: Suppl.).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that the single specimen they examined from Ghana tested negative for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*. In South Africa, however, Mortlock *et al.* (2015: 1841) reported that the only *R. landeri* specimen they examined, tested positive for *Paramyxovirus* sequences.

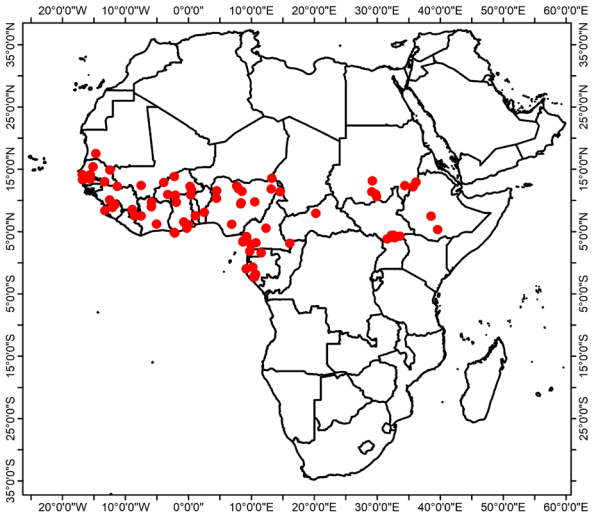


Figure 97. Distribution of *Rhinolophus landeri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Cameroon, Central African Republic, Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Liberia, Mali, Mauritania, Nigeria, Senegal, Sierra Leone, South Sudan, Sudan, The Gambia, Togo.

Rhinolophus lobatus Peters, 1852

1852. *Rhinolophus lobatus* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 41, pl. 9; pl. 13, figs 16 - 17. Publication date: 1852. Type locality: Mozambique: S bank Zambesi River, Tette: Sena [17 28 S 35 01 E] [Goto Description]. Syntype: ZMB 24922: ♂, complete skeleton. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). Syntype: ZMB 24927: ♀, complete skeleton. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). Syntype: ZMB 2496: ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). Syntype: ZMB 375: ♀, skin only. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). - Comments: Brown and Dunlop (1997: 1) mention the type locality as "Africa orientalis, Sena, Tette" (=Sena, Mozambique) restricted by Moreau *et al.* (1946: 399). For coordinates: see Ansell and Dowsett (1988: 33). Taylor *et al.* (2018a: 22) situate Sena at -15.679 S, 33.809 E [=15 40 44 S 33 48 32 E]. This is in the Tete province, but north of Tete and 57 km north of the Zambezi River, whereas they also mention the locality to be on the south bank of the Zambezi River. According to Google maps these coordinates point to Muchena, which is on the Revuboe River. We believe

the type locality is the same as "Vila de Sena", which is located at 17 26 30 S 35 01 38 E in the Sofala province, at the south bank of the Zambezi River.

1898. *Rhinolophus angolensis* Seabra, J. Sci. mat. phys. nat., ser. 2, 5: 250. Type locality: Angola: Hanha [12 15 S 13 45 E].

? *Rhinolophus landeri lobatus:* (Name Combination)

TAXONOMY:
Used to be included in *R. landeri* Martin, 1838, but Taylor *et al.* (2018a: 22) found molecular differences which led them to recognize the taxon as a separate species. They also transferred *angolensis* Seabra, 1898, although this taxon might turn out to be a separate species.

CONSERVATION STATUS:
Regional -
South Africa (as *R. landeri*): 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016h). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

GENERAL DISTRIBUTION:
For southern African "*R. landeri*", Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,008,924 km^2. Taylor *et al.* (2018a: 25) suggest that all savannah populations in southern and eastern Africa might belong to *R. lobatus*.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 560); Burundi; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259Monadjem *et al.*, 2010d: 560); Kenya; Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 560); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 560; Monadjem *et al.*, 2010c: 379); Namibia; Rwanda; South Africa (Monadjem *et al.*, 2010d: 560); Tanzania (including Unguja [=Zanzibar] [O'Brien, 2011: 286]); Uganda; Zambia (Ansell, 1969; Ansell, 1978; Monadjem *et al.*, 2010d: 560); Zimbabwe (Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 560) [All as *R. landeri*].

However, as most of the underlying specimens have not been re-examined, some records from the northeastern DRC and northern Uganda might actually represent *R. landeri*.

ECHOLOCATION:
In South Africa, Aldridge and Rautenbach (1987) reported (as *R. landeri*) a maximum frequency of 110 kHz for individuals from Pafuri, while Jacobs *et al.* (2007a) reported a peak frequency of 107.3 (± 2.1) kHz (detector type and locality not reported). Monadjem *et al.* (2010c: 379) reported from Mozambique that the peak echolocation frequencies for a single female was102.2 kHz (ANABAT), while a single male was recorded at 104 kHz (Pettersson S240x).

Four specimens from Chihalatan and Malashane (Mozambique) had peak frequency of 106.8 ± 0.4 kHz (Taylor *et al.*, 2018a: 24).

PARASITES:
HAEMOSPORIDA
Texeira and Camargo [in Lima *et al.* (2013: 13)] described *Trypanosoma livingstonei* from a "*R. landeri*" specimen collected in Mozambique (see also Barbosa *et al.*, 2016: 215).

DIPTERA
Streblidae: *Raymondia aspera* Maa, 1968 was reported from "*R. landeri*" in Mozambique (Shapiro *et al.*, 2016: 254).

VIRUSES:
Astroviridae
None of the nine Mozabican bats tested by Hoarau *et al.* (2018: 2) was positive for Astroviridae.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera of two "*R. landeri*" specimens from then Limpopo Province, South Africa, neither was positive (0/2).

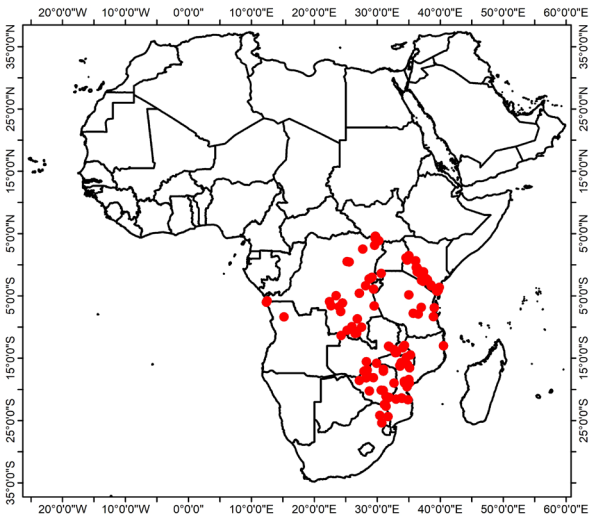


Figure 98. Distribution of *Rhinolophus lobatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Burundi, Congo (Democratic Republic of the), Kenya, Malawi, Mozambique, Rwanda, South Africa, Tanzania, Uganda, Zambia, Zimbabwe.

Rhinolophus mabuensis Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012

*2012. *Rhinolophus mabuensis* Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, PLoS ONE, 7(9): 17. Publication date: 12 September 2012. Type locality: Mozambique: Mt. Mabu [161702S 362353E, 1043 m] [Goto Description]. Holotype: DNSM 10842: ad ♀, skull and alcoholic. Collected by: Michael Curran and Mirjam Kopp; collection date: 13 October 2008. Presented/Donated by: ?: Collector Unknown. Baculum prepared Taylor *et al.* (2012c: 17). Paratype: DNSM 11485: ad ♀, skull and alcoholic. Collected by: J. Bayliss; collection date: 5 September 2009. Presented/Donated by: ?: Collector Unknown. - Etymology: Taylor *et al.* (2012c: 17) selected the specific epithet to draw attention to the serious threats to the unique biodiversity isolated on the montane forest islands in northern Mozambique – notably Mts Mabu and Inago. None of these landforms lie within formally protected areas, and all are undergoing major habitat degradation and destruction from ever-increasing human activities - hunting, fires, timber harvesting and expanding agriculture. - ZooBank: C205928E-D72C-40D5-9647-FDC9391CB1A6. (Current Combination)

TAXONOMY:
Based on mitochondrial and nuclear DNA sequences and morphological and morphometric data, Taylor *et al.* (2012c) found that the *Rhinolophus hildebrandtii* group includes more species than previously recognized.

COMMON NAMES:
English: Mount Mabu Horseshoe Bat. German: Mt Mabu Hufeisennase.

GENERAL DISTRIBUTION:
Known only from two mountains in northern Mozambique but quite possibly extending to nearby Mts. Namuli, Chiperone, Mulanje and the Malawi Rift (Taylor *et al.*, 2012c: 17).

Accurate delimitation of this species' range is subject to further collecting and reappraisal of existing museum material, previously refered to as *R. hildebrandtii*.

Native: Mozambique (Taylor *et al.*, 2012c: 17).

ZOOBANK:
C205928E-D72C-40D5-9647-FDC9391CB1A6

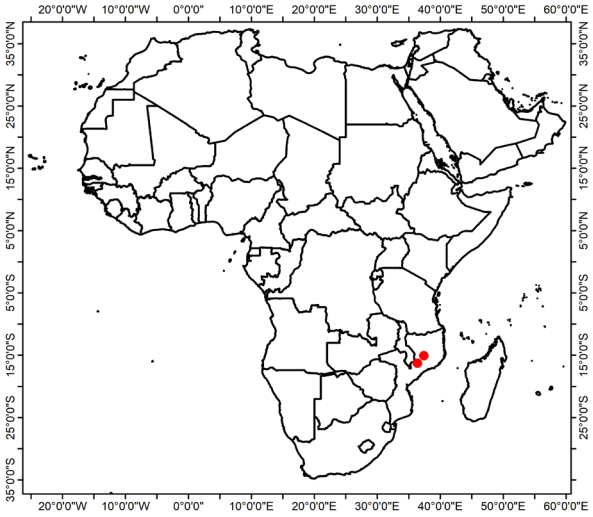


Figure 99. Distribution of *Rhinolophus mabuensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Mozambique.

Rhinolophus maclaudi Pousargues, 1898

*1898. *Rhinolophus Maclaudi* Pousargues, Bull. Mus. natn. Hist. nat., Paris, sér 1, 3 (8): 358, f. 1, 2 (for 1897). Publication date: 22 January 1898. Type locality: Guinea: Conakry Island [09 31 N 13 43 W] [Goto Description]. Holotype: MNHN ZM-MO-1897-281: ♀, skull and alcoholic. Collected by: Dr. C. MacLaud. Number 177 in Rode (1941: 237). - Comments: Grubb *et al.* (1998: 78) mention 1898 as year of publication. - Etymology: Named in honour of dr. Maclaud, collector of the holotype (Pousargues, 1897: 361). (Current Combination)
? *Rhinolophus maclaudi:* (Current Spelling)

TAXONOMY:
R. maclaudi is an ecomorphological outlier having long-ears, which traditionally placed it in the *R. philippinensis* group (Andersen, 1905c). Csorba *et al.* (2003: xvii, 63 - 64) state that it is located well inside the Africa clade, in the *maclaudi*-group, and are followed by Simmons (2005: 358). Koopman (1993a: 167) included *ruwenzorii* and *hilli*, but this is revised by Fahr *et al.* (2002), who recognizes

them as distinct species (followed by Csorba *et al.*, 2003 and Simmons, 2005).

COMMON NAMES:
Czech: vrápenec Maclaudův. English: MacLaud's Horseshoe Bat. French: Rhinolophe de MacLaud. German: Maclauds Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Endangered (EN B2ab(iii) ver 3.1 (2001)) because its area of occupancy (cave roosts) is probably less than 500 km², its distribution is severely fragmented through habitat degradation, and the extent of its habitat in the Fouta Djallon Highlands is declining (Fahr, 2008l; IUCN, 2009).

Assessment History -
2008 - EN B2ab(iii) ver 3.1 (2001) (Fahr, 2008l; IUCN, 2009). 2004 - EN B1ab(iii) ver 3.1 (2001) (Fahr, 2004e); IUCN, 2004. 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The relatively limited range of *Rhinolophus maclaudi* is quite densely populated, and it is threatened by habitat loss and degradation of remaining patches of forest, and by overharvesting for the bush meat trade (Fahr *et al.*, 2002).

Sagot and Chaverri (2015: 1670) mention habitat degradation or loss, and hunting as major threats for this species.

CONSERVATION ACTIONS:
Fahr (2008l) [in IUCN (2009)] reported that there appear to be no direct conservation measures in place. It is not known if *Rhinolophus maclaudi* is present in any protected areas. Protection of habitat, further research, and awareness education urgently required.

GENERAL DISTRIBUTION:
Rhinolophus maclaudi is known from a very few localities in eastern Guinea. Fahr *et al.* (2002) report that "apart from the type locality, supposedly Conakry Island, all records are located along the lower, southern slope of the Fouta Djallon region between Kindia and Mamou near the border with Sierra Leone". However, recent surveys have revealed additional localities in the Fouta Djallon Highlands, ranging as far north as the Gessorewoul River in Prefecture Mali (Weber and Fahr, 2007).

Fahr (2007a: 104) re-identified specimens reported from Liberia by Simmons (2005: 358) as *R. ziama*. Specimens from Nigeria reported by Koopman *et al.* (1995: 6, 19), Happold (1987: 60 - 61), and Csorba *et al.* (2003: 64) were re-identified Fahr *et al.* (2002: 99) as *R. hildebrandtii*.

Native: Guinea.
Presence uncertain: Liberia (Simmons (2005: 358); Nigeria (Koopman *et al.*, 1995: 6, 19; Happold, 1987: 60 - 61; Csorba *et al.*, 2003: 64).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Csorba *et al.* (2003: 63) indicate that *R. maclaudi* is a very large species wiith enormous ears (40.0 - 44.0 mm) and a broad horseshoe, covering almost the whole muzzle. There is also a distinct ridge running on its surface nearly parallel to the outer ridge. There is no secondary horseshoe. The sella is very broad with a broadly rounded summit and parallel margined above. The lancet is long, narrow and cuneate.

ROOST:
For Guinea, Weber and Fahr (2006: 4) indicate that *R. maclaudi* largely or exclusively depends on the availability of caves as day roosts.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species. The species roosts singly or in small groups (Fahr *et al.*, 2002).
Trend - 2008 - Decreasing (Fahr, 2008l; IUCN, 2009).

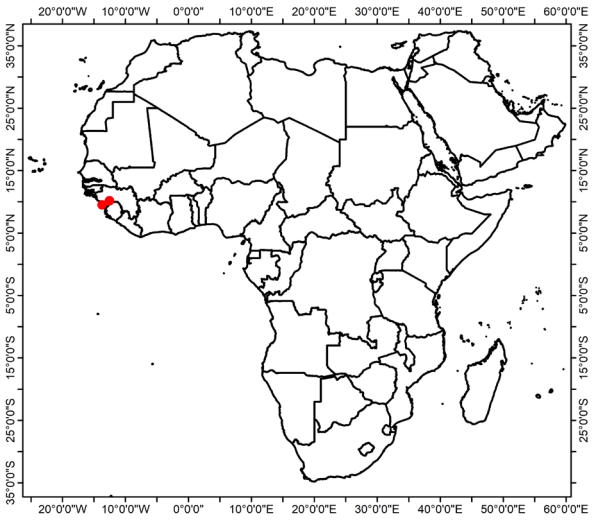


Figure 100. Distribution of *Rhinolophus maclaudi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Guinea.

Rhinolophus maendeleo Kock, Csorba and Howell, 2000

*2000. *Rhinolophus maendeleo* Kock, Csorba and Howell, Senckenb. biol., 80 (1/2): 233, 234, figs 1, 4, 7. Publication date: 22 December 2000. Type locality: Tanzania: Tanga district: 2.5 km W of Tanga, Mkulumuzi River Gorge: Amboni Cave Forest [05 05 S 39 02 E, 0 - 80 m] [Goto Description]. Holotype: SMF 79643: ad ♂, skull and alcoholic. Collected by: L. Stubblefield; collection date: 25 February 1992; original number: KMH 7673. Paratype: SMF 66960: ad ♀. Collected by: H. Grossmann; collection date: 29 August 1985; original number: KMH 3216. Presented/Donated by: ?: Collector Unknown. - Etymology: From the Swaihili "*maendeleo*" for progress; a noun in apposition. Named in allusion to the increasing knowledge of the Tanzanian bat fauna (see Kock *et al.* (2000). (Current Combination)

2010. *Rhinolophus cf. maendeleo:* Monadjem, Schoeman, Reside, Pio, Stoffberg, Bayliss, Cotterill, Curran, Kopp and Taylor, Acta Chiropt., 12 (2): 379.

TAXONOMY:
adami species group (Csorba *et al.*, 2003: 5 - 7; Simmons, 2005: 359). See Csorba *et al.* (2003: 6) for remarks on taxonomy.

COMMON NAMES:
Czech: vrápenec tanganjický. English: Maendeleo Horseshoe Bat. French: Rhinolophe de Tanga. German: Tanzania-Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since it has only recently been discovered, and there is still very little information on its extent of occurrence, status and ecological requirements (Jacobs *et al.*, 2008ae; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008ae; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004r; IUCN, 2004).

MAJOR THREATS:
The threats to *Rhinolophus maendeleo* are not known (Jacobs *et al.*, 2008ae; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ae) [in IUCN (2009)] reported that while *Rhinolophus maendeleo* is present in the Mazumbai Forest Reserve, further habitat protection is generally needed. Additional field surveys are needed to better determine the true extent of the species geographic range.

GENERAL DISTRIBUTION:
Rhinolophus maendeleo is a poorly known species that has only been recorded from two localities in Tanzania at elevations of up to 1,900 m asl, the type locality of 'Amboni Cave Forest, Mkulumuzi River Gorge, 2.5 km W of Tanga, Tanga District' (Anciaux de Faveaux, 1958) and Mazumbai Forest Reserve in the Usambara Mountains. It has recently been recorded from a single locality in Mozambique. Additional surveys are needed to better determine the range of this recently described species.

Native: Mozambique (Monadjem *et al.*, 2010d: 560; Monadjem *et al.*, 2010c: 379); Tanzania (Kock *et al.*, 2000; Csorba *et al.*, 2003: 6).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
Csorba *et al.* (2003: 6) indicate that the skull of *R. maendeleo* has an open foramen infraorbitale (without bony bar).

DETAILED MORPHOLOGY:
Baculum - See Csorba *et al.* (2003: 6).

POPULATION:
Structure and Density - *Rhinolophus maendeleo* is currently known only from two specimens, and there is no information on population sizes or trends (Jacobs *et al.*, 2008ae; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008ae; IUCN, 2009).

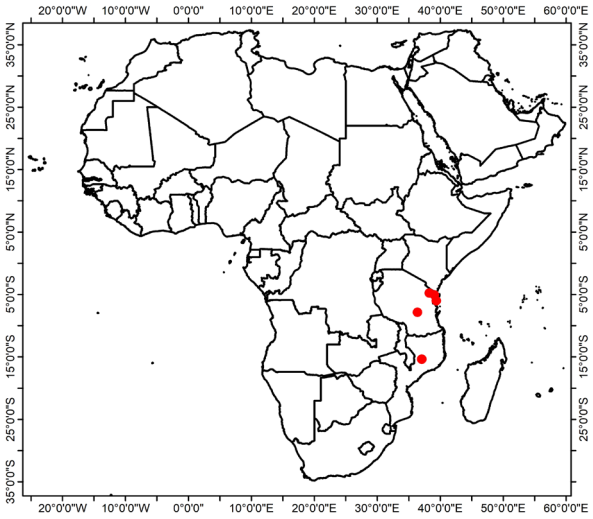


Figure 101. Distribution of *Rhinolophus maendeleo*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Mozambique, Tanzania.

Rhinolophus mehelyi Matschie, 1901

*1901. *Rhinolophus mehelyi* Matschie, Sber. Ges. naturf. Freunde Berlin, 225. Type locality: Romania: Ilfov province: Bucharest [44 26 N 26 06 E]. - Etymology: In honour of Lajos Méhely (1862 - 1952) (see Kozhurina, 2002: 16). (Current Combination)

1904. *E[uryalus] barbarus* K. Andersen and Matschie, Sber. Ges. naturf. Freunde Berlin, 79. Type locality: Morocco: Tangiers [35 48 N 05 50 W]. Holotype: ZMB 12967: ♂, skull and alcoholic. Collected by: Kurt Floericke; collection date: 12 March 1898. See Turni and Kock (2008). Paratype: MHNG ♂, skull and alcoholic. Former ZMB 12968, exchanged in 1909; see Turni and Kock (2008: 28). Paratype: MHNG ♂, skull and alcoholic. Former ZMB 12972, exchanged in 1909; see Turni and Kock (2008: 28). Paratype: ZMB 12969: ♂, skull and alcoholic. Collected by: Kurt Floericke. See Turni and Kock (2008: 28). Paratype: ZMB 12970: ♂, skull and alcoholic. Collected by: Kurt Floericke. See Turni and Kock (2008: 28). Paratype: ZMB 12971: ♂, skull and alcoholic. Collected by: Kurt Floericke. See Turni and Kock (2008: 28). Paratype: ZMB 12972: Collected by: Kurt Floericke; collection date: 12 March 1898. Paratype: ZMB 12973: alcoholic (skull missing). Collected by: Dr. Lühe; collection date: 12 March 1898. From cave near Tebourba; see Turni and Kock (2008: 28). Paratype: ZMB 12974: ♂, alcoholic, skull and skeleton. Collected by: Dr. Lühe; collection date: 12 March 1898. From cave near Terbourba, see Turni and Kock (2008: 28) [lost]. Paratype: ZMB 12975: alcoholic (skull missing). Collected by: Dr. Lühe; collection date: 12 March 1898. From cave near Tebourba; see Turni and Kock (2008: 28).

1904. *E[uryalus] meridionalis* K. Andersen and Matschie, Sber. Ges. naturf. Freunde Berlin, 79. Type locality: Algeria: "Algeria". Holotype: ZMB 12976: ♀, skull and alcoholic. Collected by: Verreaux; collection date: undated. See Turni and Kock (2008: 26). Paratype: ZMB 3052: ♀. Collected by: Verreaux; collection date: undated. Number of paratype is 3052, not 12977 as mentioned by Andersen and Matschie (1904: 83): see Turni and Kock (2008: 29).

1955. *Rhinolophus euryale tuneti* Deleuil and Labbé, Bull. Soc. Sci. nat. Tunisie, 8: 52, 53. Type locality: Tunisia: Cap Bon: El Haouaria cave [37 03 N 11 01 E] [Goto Description]. Neotype: USNM 498999: ad ♂, skin and skull. Collected by: Tom Vaughan and Pamela Vaughan; collection date: 4 May 1975; original number: TPV 3244. Presented/Donated by: ?: Collector Unknown. Fisher and Ludwig (2015: 54) mention that a type specimen was not designated by Deleuil and Labbe (1955a), and that the type series has been lost. They also indicate that Cockrum (1976: 868) incorrectly gave the wrong number when assigning the neotype (USNM 498998). - Comments: Horácek *et al.* (2000: 102) consider it a valid subspecies. Dalhoumi *et al.* (2011: 267) indicate that Deleuil and Labbe (1955a) based their description on a specimen belonging to *R. mehelyi* (type) and two belonging to *R. blasii* (paratypes), as was already suggested by Aellen and Strinati (1970: 231) and Cockrum (1976: 685).

1993. *tunetae:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 167. (Lapsus)

1995. *tunetai:* Pavlinov, Borissenko, Kruskop and Jahonton, Arch. Zool. Mus., Moscow State Univ., 133: 81. (Lapsus)

? *Rhinolophus euryale barbarus:* (Name Combination)

? *Rhinolophus mehelyi mehelyi:* (Name Combination)

? *Rhinolophus mehelyi tuneti:* (Name Combination)

TAXONOMY:
Revised by DeBlase (1972). *euryale* species group (Csorba *et al.*, 2003: 17 - 18; Simmons, 2005: 359). See Csorba *et al.* (2003: 17 - 18) for remarks on taxonomy.

Based on the measurements given by Andersen and Matschie (1904), Puechmaille *et al.* (2012: 216) suggest that *R. barbarus* Andersen et Matschie, 1904 and *R. meridionalis* Andersen et Matschie, 1904 are both synonyms of *R. mehelyi* Matschie, 1901 rather than of *R. euryale* Blasius, 1853.

COMMON NAMES:
Albanian: Lakuriq nate hundëpatkua i Mehely-it. Arabian: Khaffash. Armenian: Մեհելիի պայտաքիթ. Azerbaijani: Eynə kli nalburun. Basque: Mehelyi ferra-saguzar. Belarusian: Падкаванос Мегеля. Bosnian: Meheljev potkovasti š iš miš. Breton: Frigribell Méhely. Bulgarian: Подковонос на Мехели. Castilian:

Murciélago mediano de herradura, Rinolofo mediano de herradura. Catalan: Ratpenat de ferradura mitjà, Rat penat mitjá de ferradura. Croatian: Meheljev potkovnjak. Czech: Vrápenec Mehelyů v. Danish: Mehelys hestekonæse. Dutch: Mehely's hoefijzerneus, Mehely-hoefijzerneus. English: Mehely's Horseshoe Bat, Mediterranean Horseshoe Bat. Estonian: Meheli sagarnina. Finnish: Täpläherkko. French: Rhinolophe de Mehély, Rhinolophe des forêts, Rhinolophe de Roumanie. Frisian: Mehely's hoefizernoas. Galician: Morcego de ferradura mediano. Georgian: მეჰელის ცხვირნალა. German: Mehely-Hufeisennase. Greek: Ρινόλοφος του Mehely. Hebrew: Parsaf Hiver. Hungarian: Méhely-patkósdenevér, Rhinolophos i mehelios. Irish Gaelic: Crú-ialtóg Mehely. Italian: Rinolofo di Méhely, Ferro di cavallo di Méhely. Latvian: Mehel̦ a pakavdegunis. Lithuanian: Mehelio pasagnosis. Luxembourgish: Méhelÿ - Huffeisennues. Macedonian: Мехелов потковичар. Maltese: Rinolofu ta' Mehely. Montenegrin: Mehelijev potkovič ar. Norwegian: Middelhavshesteskonese. Polish: Podkowiec ś redni. Portuguese: Morcego-de-ferradura-mourisco. Rhaeto-Romance: Rinolof da Méhely. Romanian: Liliacul cu potcoavă a lui Mehely, Liliac-românesc. Russian: Подковонос Мегели (очковый). Serbian: Тамнооки потковичар [= Tamnooki potkovič ar]. Scottish Gaelic: Crudh-ialtag Mehelyi. Slovak: Podkovár Mehélyho. Slovenian: Mehelyjev podkovnjak. Swedish: Kusthästskonäsa. Turkish: Mehely Nalburunlu Yarasası. Ukrainian: Підковик (Підковоніс) Мегеля. Welsh: Ystlum pedol Mehely.

CONSERVATION STATUS:
Global - The species is declining throughout its range, which is becoming increasingly fragmented. The rate of decline has been estimated as 10 % in the last 10 years in Andalucia (Spain). Elsewhere, declines have not been quantified but appear to have been considerable, with some colonies having been reduced to a fraction of their former size. Overall, declines throughout the global range are thought likely to exceed 30 % over 3 generations (27 years) over a time window including both the past and the future. The species is going extinct in France and is declining in Morocco due to disturbance in caves. The species only roosts in caves and does not use artificial roosts. Hence the species is listed as Vulnerable (VU A4c ver 3.1 (2001)) (Hutson *et al.*, 2008n; IUCN, 2009).

Assessment History -
2008 - VU A4c ver 3.1 (2001) (Hutson *et al.*, 2008n; IUCN, 2009). 1996 - VU A2c ver 2.3 (1994) (Baillie and Groombridge, 1996).

MAJOR THREATS:
Rhinolophus mehelyi is affected by disturbance and loss of underground habitats, changes in foraging habitats, and destruction of caves by tourism. Mortality due to collision with cars is a problem in some areas (e.g., Portugal). The reasons for the declines are not fully understood (Hutson *et al.*, 2008n; IUCN, 2009).

According to Sherwin *et al.* (2012: 174), climatic change will have an inportant impact due to the following risk factors: its small range, roosting in caves or trees, its water stress and aerial hawking feeding style.

Roost loss or disturbance, and habitat degradation or loss are considered the major threats for this species by Sagot and Chaverri (2015: 1670).

CONSERVATION ACTIONS:
Hutson *et al.* (2008n) [in IUCN (2009)] reported that *Rhinolophus mehelyi* is protected by national legislation in all European range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention where those apply. It is included in Annex II (and IV) of EU Habitats and Species Directive, and hence equires special measures for conservation including designation of Special Areas for Conservation. There is some habitat protection through Natura 2000 (some roosts are already protected by national legislation). An EU-LIFE funded project aims to ensure the long-term conservation of the large populations of cave and forest-dwelling bats, including this species, in Spain. There are no specific conservation measures in place in North Africa. Research is required on the causes of the declines across the range.

GENERAL DISTRIBUTION:
Rhinolophus mehelyi is largely restricted to the Mediterranean. It has a discontinuous distribution from north Africa (Morocco, Algeria, Tunisia and Egypt) and southern Europe (southern Portugal and Spain, possibly one occurrence in France, a few places in Italy and the Balkans) through Asia Minor, Anatolia, to Transcaucasia, Iran and Afghanistan (where its exact roost location is not known: Srinivasulu et al., in press). It is patchily distributed in some large and vulnerable colonies. It occurs up to 2,000 m in High and Saharan Atlas mountains, although it is typically found at lower altitudes in other parts of its range (e.g. in Spain it tends to occur below 700 m).

Native: Afghanistan; Algeria (Horácek *et al.*, 2000: 102); Armenia; Azerbaijan; Bosnia and Herzegovina; Bulgaria; Cyprus; Egypt; Georgia; Gibraltar; Greece; Iran, Islamic Republic of; Iraq;

Israel; Italy (Sardegna, Sicilia); Jordan; Libyan Arab Jamahiriya; Macedonia, the former Yugoslav Republic of; Mediterrranean islands; Moldova; Montenegro; Morocco (El Ibrahimi and Rguibi Idrissi, 2015: 359); Palestinian Territory, Occupied; Portugal; Romania; Russian Federation; Serbia; Slovenia; Spain; Syrian Arab Republic; Tunisia (Dalhoumi *et al.*, 2016b: 867); Turkey; Yugoslavia.
Regionally extinct: Croatia.
Presence uncertain: France.

ECHOLOCATION:
Jones and Siemers (2010: 450) indicate that juveniles emit lower frequencies than adults, and that the CF-frequency is positively related to the body condition (mass/forearm length). Puechmaille *et al.* (2014b: 4) demonstrated that the body length and weight for bats caught during the mating season showed a strong positive correlation (which was significant) with the peak frequency in both sexes: larger and heavier bats call at higher frequencies. Females clearly show a preference for higher calling males, and the latter have a larger offspring. Puechmaille *et al.* (2014b: 6) also found that the distribution of the echolocation frequencies was not normally distributed in adults, but left-skewed (meaning that there are more individuals calling at higher frequencies). Furthermore (p. 7), they indicate [referring to Jones and Ransome (1993)] that the peak frequency in horseshoe bats increases with about 0.45 kHz during the first year and an average reduction of 0.09 kHz per year occurs over their lifetime.

For 16 Greek specimens, Papadatou *et al.* (2008b: 132) report a start frequency of 96.2 ± 7.06 kHz, a terminating frequency of 90.3 ± 2.16 kHz, a peak frequency of 109.5 ± 1.44 kHz, and a bandwidth of 5.1 ± 2.62 kHz. The duration of the call is 35.9 ± 12.04 msec, and the interpulse interval is 62.5 ± 23.92 msec.
Walters *et al.* (2012: suppl.) presen the following figures for 41 calls from Bulgarian bats: duration: 27.73 ± 7.12 msec, F_{max}: 108.59 ± 1.51 kHz, F_{min}: 92.61 ± 4.73 kHz, bandwidth: 15.98 ± 4.44 kHz, F_{peak}: 107.78 ± 2.74 kHz. Tunisian bats emitted sounds at 106.11 ± 1.31 kHz (111.5 - 117.5 kHz; Dalhoumi *et al.*, 2016b: 866).

Schuchmann *et al.* (2012: 161) found that both sexes were able to recognize the sex of conspecifics from their echolocation calls.

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotype - Đulic and Soldatovic (1969) and Rushton (1970 463) reported 2*n* = 58, FN = 64, a submetacentric X chromosome, and an acrocentric Y chromosome. While Baker *et al.* (1974; 1975) reported FN = 60 and BA = 4. Volleth *et al.* (2002: 483) and Volleth and Eick (2012: 166) report 2*n* = 58 and a segment number [= autosomal segments + X] of 44. Arslan and Zima (2014: 8) indicate that different numbers of bi-armed auosomes have been reported, leading to FNa values between 60 and 64.
Đulic and Soldatovic (1969: 5) also reported the type of the autosomes as 4 metacentric, 2 small-sized and 24 acrocentric.

Protein / allozyme - Unknown.

HABITAT:
In south-western Spain, Russo *et al.* (2005: 327) found that *R. meheyli* least preferred open habitats, but was frequently found in a semi-natural oak savanna habitat. Salsamendi *et al.* (2012a: 122) pointed out that this was in an area where both *R. mehelyi* and *R. euryale* occurred, and they reported that *R. mehelyi*, in another area, always foraged in woodlands, preferably in cluttered spaces, but also in less-clutttered/more-open ones, and was avoiding open spaces. They also indicated that the bats foraged generally less than 500 m from water bodies. The bats were using linear landscape elements (tree lines and riparian forests) to travel from their roosts to their feeding areas. Salsamendi *et al.* (2012a: 129) also indicated that habitat types used by males and females in south-western Spain were different: males foraged in riparian forest and broad-leaved woodlands, whereas females foraged in dehesa, scrubland and eucalypt plantations.

HABITS:
Kameneva (1976) [in Pervushina *et al.* (2012: 750)] found that among captive *R. mehelyi* individuals, conflicts took place during foraging flights, although they were primarily friendly or neutral to one another when resting during the day.

ROOST:
Based on data from Sardinia, Russo *et al.* (2014: 9) rule out that *R. euryale* and *R. mehelyi* compete for roosting sites.

DIET:
In the Iberian peninsula, Salsamendi *et al.* (2009: 282) report that Lepidoptera form the most important prey category for this species (from 51.3 to 100.0 volume percent; 90.9 to 100.0 occurrence percentage), followed by Neuroptera, Diptera, Coleoptera, Hemiptera and undefined items. In Iran, Lepidoptera also form the dominant food item, followed by scarabaeid beetles and muscid dipterans (see Benda *et al.*, 2012a: 247).

In the southwestern Iberian peninsula, Arrizabalaga-Escudero *et al.* (2018: Suppl.) identified the following food items from faecal samples of *R. mehelyi* (food items marked with an asterisk were also found in faecal samples of *R. euryale*): Coleoptera (Cerambycidae: *Arhopalus ferus* (Mulsant, 1839)*); Diptera (Tachinidae: unidentified*; Anthomyiidae: *Hylemya* sp.; Muscidae: *Neomyia cornicina* (Fabricius, 1781); Calliphoridae: *Pollenia vagabunda* (Meigen, 1826)); Lepidoptera (Blastobasidae: *Blastobasis phycidella* (Zeller, 1839); Cosmopterigidae: *Eteobalea intermediella* (Riedl, 1966); Crambidae: *Calamotropha paludella* (Hübner, 1824)*; *Ostrinia nubilalis* (Hübner, 1796)*; *Udea ferrugalis* (Hübner, 1796); Erebidae: *Catocala nymphagoga* (Esper, 1787)*; Gelechiidae: *Teleiopsis* sp.*; Geometridae: *Camptogramma bilineata* (Linnaeus, 1758)*; *Ennomos quercaria* (Hübner, 1813)*; *Pachycnemia hippocastanaria* (Hübner, 1799)*; *Rhoptria asperaria* (Hübner, 1817)*; Lasiocampidae: *Malacosoma neustria* (Linnaeus, 1758); Lecithoceridae: *Eurodachtha canigella* (Caradja, 1920); Noctuidae: *Agrotis segetum/trux**; *Agrotis ipsilon* (Hufnagel, 1766)*; *Autographa gamma/pulchrina**; *Calophasia platyptera* (Esper, [1788])*; *Heliothis incarnata* Freyer, 1838; *Mythimna albipuncta* (Denis & Schiffermüller, 1775)*; *Mythimna vitellina* (Hübner, 1808); *Mythimna loreyi/sicula**; *Peridroma saucia* (Hübner, 1808)*; *Polyphaenis sericata* (Esper, 1787)*; *Sesamia nonagrioides* (Lefèbvre, 1827)*; Praydidae: *Prays fraxinella* Bjerkander, 1784*; Pterophoridae: *Crombrugghia laetus* (Zeller, 1847); *Emmelina monodactyla* (Linnaeus, 1758); *Stenoptilia zophodactyla* Duponchel, 1840; Pyralidae: *Pempelia palumbella* (Denis & Schiffermüller, 1775)*; Tortricidae: *Archips xylosteana* (Linnaeus, 1758); *Cnephasia* sp. 1*; *Cnephasia* sp. 2*; Yponomeutidae: *Zelleria oleastrella* (Millière, 1864); Neuroptera (Hemerobiidae: *Wesmaelius nervosus* (Fabricius, 1793); Chrysopidae: *Chrysoperla* sp.*; Myrmeleontidae: *Distoleon tetragrammicus* (Fabricius, 1798)*). Of the 64 prey taxa, 32 (representing over 75 % of all food items) were consumed by both *R. mehelyi* and *R. euryale*.

Benda *et al.* (2014c: 33) analysed 22 faecal pellets from Wadi Darnah (Libya) and found these to consist primarily of Blattoidea (99.1 % by volume) and 0.9 % of Lepidoptera.

POPULATION:
Structure and Density - Hutson *et al.* (2008n) [in IUCN (2009)] indicate that *Rhinolophus mehelyi* is an infrequent species, which is reported to have declined in all parts of its range for which data are available. In Andalucia (Spain), the rate of decline has been estimated at 10 % over the last ten years. The species is close to extinction in France (Rodrigues and Palmeirim, 1999), Romania (Botnariuc and Tatole, 2005), and north-east Spain (J. Juste and T. Alcalde *pers. Comm.,* 2006). In France, only one individual was recorded in 2004 (S. Aulagnier *pers. Comm.,* 2006), and in Romania the population was estimated at 5,000 in the 1950s, but now numbers approximately 100 (Dumitrescu *et al.*, 1962-3, Botnariuc and Tatole, 2005). It is also declining in southern Spain (Franco and Rodrigues de los Santos, 2001), Portugal (Rodrigues *et al.*, 2003), the Russian Federation (K. Tsytsulina *pers. Comm.,* 2005), Georgia, and Morocco (SW Asia Workshop 2005). In Iran mixed-species colonies including *R. mehelyi*, which in the 1970s were estimated to be over 10,000 individuals, now only number a few hundred individuals (M. Sharifi *pers. obs.,* 2005). Summer nursery colonies typically number 30 - 500 individuals (although colonies of up to 3,000 individuals have been recorded, separated in smaller groups within the same cave). Winter clusters consist of up to 5,000 animals.
Trend - 2008 - Decreasing (Hutson *et al.*, 2008n; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Benda *et al.* (2014c: 30) captured a lactating female on 15 May at Wadi Darnah (Libya).

MATING:
Puechmaille *et al.* (2011b: 40-41) found that during the mating season, females prefer males with higher frequency calls, indicating that this high frequency is probably a signal of good body condition.

POSTNATAL DEVELOPMENT:
In western Iran, Sharifi (2004: 155) determined that Fa and body mass followed a linear pattern of growth until day 14 (resp. 1.55 mm/day and 0.58 g/day) and subsequently decreased to reach a stable level. The length of the gap of the metacarpal-phalangeal joint showed an increase up to 10 days and decreased until it had closed at over 55 days. At about four weeks of age, the young started to fly.

PARASITES:
Beaucournu and Kock (1996) report the presence of the flea *Rhinolophopsylla unipectinata arabs* Jordan and Rothschild, 1921 on specimens from Algeria.

Benda *et al.* (2014c: 33) recorded the following parasites from Libyan *R. mehelyi*:
Ischnopsyllidae: *Rhinolophopsylla unipectinata arabs* Jordan and Rothschild, 1921,
Nycteribiidae: *Phthiridium biarticulatum* (Hermann, 1864),

Streblidae: *Brachytarsina flavipennis* Macquart, 1851

The following ectoparasites were found on Algerian bats by Bendjeddou *et al.* (2017: 15): Nycteribiidae: *Nycteribia (Nycteribia) pedicularia* Latreille, 1805 and *Phthiridium biarticulatum* Hermann, 1804; Streblidae: *Brachytarsina (Brachytarsina) flavipennis* Macquart, 1851; and Arachnida: *Spinturnix myoti* (Kolenati, 1856) and *Eyndhovenia euryalis* (G. Canestrini, 1885).

From Iran, Sharifi *et al.* (2013: 181) mention the presence of the following ectoparasites: *Eyndhovenia* sp. (Acari: Spinturnicidae; on 89.65 % of the 87 bats examined, with 13.79 ind/bat, primarily on wing and tail membranes), *Penicillidia* sp. (Diptera: Nycteribiidae; 66.66 %, 2.31, mainly on fur) and one species from Streblidae (Diptera; 11.49 %, 1.80, on all parts of the body).

In Azerbaijan, Duszynski (2002: 6) mentions *Eimeria mehelyi* Musaev and Gauzer, 1971 (Apicomplexa) as parasite.

VIRUSES:
Coronaviridae - Coronaviruses
Luis *et al.* (2013: suppl.) mention the presence of a SARS coronavirus-related virus.

Alphacoronavirus
This virus was reported from Germany by Kohl and Kurth (2014: 3112).
Betacoronavirus
Kohl and Kurth (2014: 3112) report this virus from Bulgaria and Germany.

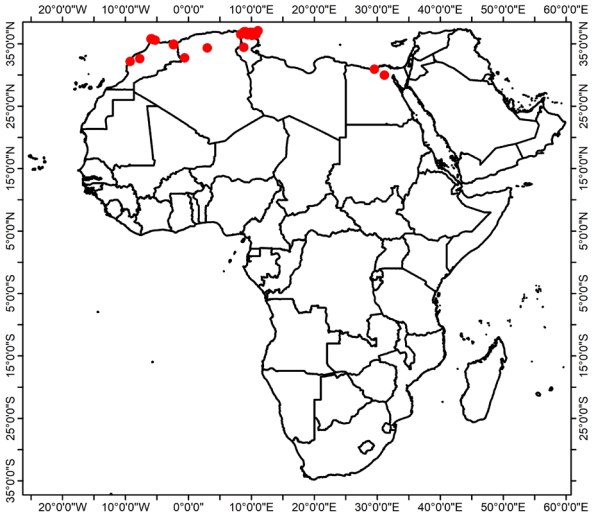


Figure 102. Distribution of *Rhinolophus mehelyi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, Egypt, Morocco, Tunisia.

Rhinolophus mossambicus Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012

*2012. *Rhinolophus mossambicus* Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, PLoS ONE, 7(9): 19. Publication date: 12 September 2012. Type locality: Mozambique: Nissa Game Reserve: Maputo Camp [121056S 373300E, 489 m] [Goto Description]. Holotype: DNSM 8578: ♂, skull and alcoholic. Collected by: Dr. Ara Monadjem; collection date: 1 July 2006. Presented/Donated by: ?: Collector Unknown. Baculum; skull and mandible in good condition (Taylor *et al.*, 2012c: 19). Paratype: DNSM 11276: ad ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 8577: ad ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: DNSM 8579: ad ♂, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Baculum. Paratype: DNSM 8580: ad ♂, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Baculum. - Etymology: The name denotes the country of origin (Mozambique) of the type specimen of this species (Taylor *et al.*, 2012c: 20). - ZooBank: 0D97DC39-F9CD-415E-A7AE-4DCF70C807B4. (Current Combination)

TAXONOMY:
Based on mitochondrial and nuclear DNA sequences and morphological and morphometric data, Taylor *et al.* (2012c) found that the *Rhinolophus hildebrandtii* group includes more species than previously recognized.

Carr *et al.* (2017) performed some additional analyses, which confirmed that *R. mossambicus* forms a well-defined clade based on mtDNA, but based on nuclear DNA, however, this taxon groups with *R. fumigatus* from Namibia.

COMMON NAMES:
English: Mozambican Horseshoe Bat. German: Mossambique-Hufeisennase.

GENERAL DISTRIBUTION:
Based on genetic data, the species is known from five localities in Mozambique from altitudes of

1,500 m - Chinizuia Forest, Gerhard's Cave, Gorongosa Caves, Namapa, Niassa Game Reserve and one locality, Lutope-Ngolangola Confluence in NW Zimbabwe. These scattered records across the subregion suggest that *R. mossambicus* is widespread across the savanna biome of Zimbabwe and Mozambique (Taylor *et al.*, 2012c: 20).

PARASITES:
DIPTERA:
Streblidae: *Raymondia aspera* Maa, 1968 (Shapiro *et al.*, 2016: 254). *Raymondia waterstoni* Jobling, 1931 (Shapiro *et al.*, 2016: 256).

VIRUSES:
Astroviridae
None of the 20 Mozambican bats tested by Hoarau *et al.* (2018: 2) was positive for this group of viruses.

ZOOBANK:
0D97DC39-F9CD-415E-A7AE-4DCF70C807B4

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Malawi, Mozambique, Zimbabwe.

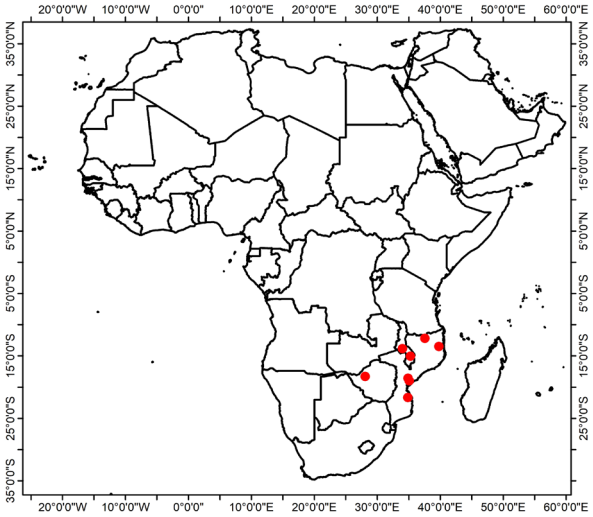


Figure 103. Distribution of *Rhinolophus mossambicus*

Rhinolophus rhodesiae Roberts, 1946

1946. *Rhinolophus swinnyi rhodesiae* Roberts, Ann. Transv. Mus., 20 (4): 304. Type locality: Zimbabwe: Limpopo valley: Bezwe river: a tributary of the Wanetsi (? Nuanetsi) River [ca. 21 22 S 30 45 E] [Goto Description]. Holotype: TM 1325: ad ♀. Collected by: Austin Roberts; collection date: 19 August 1913. Presented/Donated by: ?: Collector Unknown. - Etymology: The name refers to Southern Rhodesia (currently Zimbabwe), the country where the type specimen was collected.

2018. *Rhinolophus rhodisiae:* Hoarau, Le Minter, Joffrin, Schoeman, Lagadec, Ramasindrazana, Dos Santos, Goodman, Gudo, Mavingui, Lebarbenchon, Virology J., 15: Suppl.. Publication date: 30 June 2018. (Lapsus)

ECHOLOCATION:
Taylor *et al.* (2018a: 21) mention a peak frequency ranging from 99 to 102 kHz for eight bats from the Malashane cave (Mozambique).

VIRUSES:
Astroviridae
None of the 31 Mozambican bats tested by Hoarau *et al.* (2018: 2) was positive for this group of viruses.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Malawi, Mozambique, South Africa, Tanzania, Zambia, Zimbabwe.

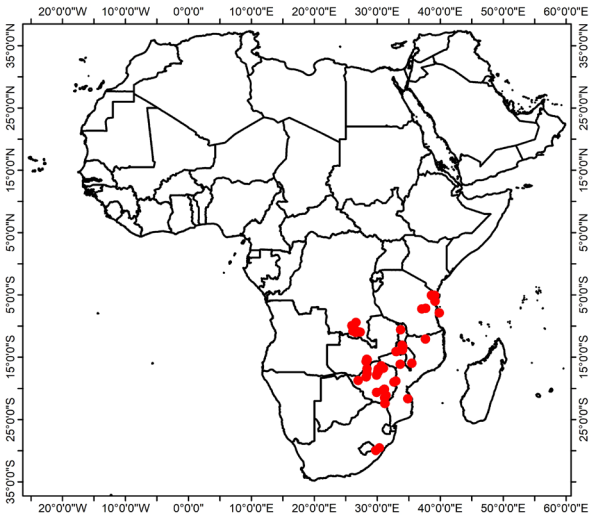


Figure 104. Distribution of *Rhinolophus rhodesiae*

Rhinolophus ruwenzorii J. Eric Hill, 1942

*1942. *Rhinolophus ruwenzorii* J. Eric Hill, Am. Mus. Novit., 1180: 1, fig. 1. Publication date: 28 July 1942. Type locality: Congo (Democratic Republic of the): Kivu province: W slope of

Mount Ruwenzori: Buhatu valley [00 22 N 29 44 E,, 7 500 ft] [Goto Description]. Holotype: AMNH 82394: ad ♀, skull and alcoholic. Collected by: James Paul Chapin, Dewitt L. Sage, Frank P. Mathews and The Ruwenzori-Kivu Expedition; collection date: 24 December 1926. - Comments: Fahr *et al.* (2002: 99) mention "S-side of Butahu Valley, 2286 m, W slope Rwenzori Mts., Congo (K.)." as type locality. - Etymology: Referring to the Ruwenzori mountains, where the type specimen was collected. (Current Combination)

? *Rhinolophus maclaudi ruwenzorii:* (Name Combination)

TAXONOMY:
Included in *maclaudi* by Koopman (1993a: 167), see Smith and Hood (1980: 170); but see Fahr *et al.* (2002), Csorba *et al.* (2003: 65 - 66) and Simmons (2005: 362).

COMMON NAMES:
Czech: vrápenec ruwenzorijský. English: Ruwenzori Horseshoe bat. French: Rhinolophe du Ruwenzori. German: Ruwenzori-Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU B1a+2b(ii,iii,iv,v) ver 3.1 (2001)) because its extent of occurrence is less than 20,000 km^2, it is known from fewer than ten locations, and there is continuing decline in the extent and quality of its montane forest habitat, and probable loss of colonies through disturbance of roosting sites (Fahr, 2008m; IUCN, 2009).

Assessment History -
2008 - VU B1a+2b(ii,iii,iv,v) ver 3.1 (2001) (Fahr, 2008m; IUCN, 2009). 2004 - VU A4c; B1ab(iii) ver 3.1 (2001) (Fahr, 2004d; IUCN, 2004); and assessed as *R. hilli* by Fahr (2004f).

MAJOR THREATS:
Rhinolophus ruwenzorii is threatened by the deforestation of its montane habitat, generally through logging and mining activities, and the conversion of forest to farmland. It is dependent on cave habitats for roosting, and it is likely that disturbance of these sites could be an important threat to the species. It may be threatened by overharvesting for subsistence food, and while this needs to be fully confirmed populations are vulnerable to direct exploitation (Fahr, 2008m; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008m) [in IUCN (2009)] reported that *Rhinolophus ruwenzorii* has been recorded from some protected areas, such as the Mount Ruwenzori National Park. There is a need to reduce levels of deforestation within the Albertine Rift region as a whole. There is a need to initiate and develop public awareness programmes in the region, and to reduce the disturbance of roosting localities. Further field surveys are needed to locate additional population of this species.

GENERAL DISTRIBUTION:
Rhinolophus ruwenzorii is restricted to the mountains of the Albertine Rift, where it has been recorded from the countries of the eastern Democratic Republic of the Congo, western Uganda, and Rwanda, at elevations of 1,666 to 2,666 m asl. The distribution includes the Ruwenzori Mountains, Kivu Region and Kibali-Ituri-Forest, Bwindi-Impenetrable Forest and Mutura in northwestern Rwanda (Fahr *et al.*, 2002). Eastern Democratic Republic of the Congo, Western Uganda.

Native: Congo (The Democratic Republic of the) Kityo and Kerbis (1996: 60); Rwanda (Fahr *et al.*, 2002); Uganda Kityo and Kerbis (1996: 60).

POPULATION:
Structure and Density - This species is known only from 36 specimens collected from 13 localities, these total only eight distinct locations (Fahr, 2008m; IUCN, 2009).
Trend - 2008 - Decreasing (Fahr, 2008m; IUCN, 2009).

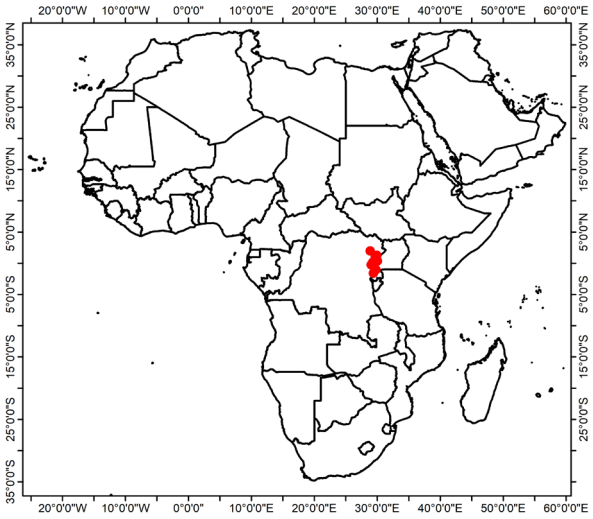


Figure 105. Distribution of *Rhinolophus ruwenzorii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Rwanda, Uganda.

Rhinolophus sakejiensis Cotterill, 2002

*2002. *Rhinolophus sakejiensis* Cotterill, J. Zool., Lond., 256: 166, figs. 2a, 3, 4a, 5a, 6a, 7a. Type locality: Zambia: Mwinilunga district; Ikelenge Pedicle: btw Sakeji/Zambezi rivs,c.11 km NNE source Zambezi: Kavunda [11 17 S 24 21 E, 1 388 m] [Goto Description]. Holotype: NHMZ 29153: ad ♂, skull and alcoholic. Collected by: F.P.D. ("Woody") Cotterill; collection date: 11 October 1990; original number: FWC 1090. Baculum extracted. Paratype: HZM 1.32236: ad ♂, skull and alcoholic. Collected by: F.P.D. ("Woody") Cotterill; collection date: 11 October 1990; original number: FWC 1092. Baculum extracted. Paratype: NHMZ 29154: sad ♂, skull and alcoholic. Collected by: F.P.D. ("Woody") Cotterill; collection date: 11 October 1990; original number: FWC 1091. Baculum extracted. (Current Combination)

TAXONOMY:
Cotterill (2002b: 5) considers it a member of the *ferrumequinum* species group, and is followed by Simmons (2005: 362). See Csorba *et al.* (2003: 132 - 133) for remarks on taxonomy.

COMMON NAMES:
Czech: vrápenec sakežianský. English: Sakeji Horseshoe bat. French: Rhinolophe de Sakeji. German: Sakeji-Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since it has only recently been discovered, and there is still very little information on its extent of occurrence, ecological requirements and threats (Cotterill, 2008a; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Cotterill, 2008a; IUCN, 2009). 2004 - DD ver 3.1 (2001) (IUCN, 2004; Cotterill, 2004c).

MAJOR THREATS:
The threats to *Rhinolophus sakejiensis* are not well known, but it is presumably threatened by the loss of roosting sites resulting from logging and the conversion of suitable habitat to agricultural use (Cotterill, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Cotterill (2008a) [in IUCN (2009)] reported that it is not known if *Rhinolophus sakejiensis* is present in any protected areas. Further surveys are needed to better determine the extent of the distribution of this species, to gather more information on the species natural history, and to review the threats to this species.

GENERAL DISTRIBUTION:
Rhinolophus sakejiensis is known only from the type locality of Kavunda, between the Sakeji and Zambezi rivers: c. 11 km north-north-east of the source of the Zambezi River in the Ikelenge Pedicle, Mwinilunga District of north-west Zambia (Cotterill, 2002a). It is likely that the species is also present within similar suitable habitat in Angola and the Congo basin (Cotterill, 2002a).

Native: Zambia (Monadjem *et al.*, 2010d: 560).

POPULATION:
Structure and Density - *Rhinolophus sakejiensis* is currently known only from the type collection of three bats, taken from a cluster of six roosting bats (Cotterill, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Cotterill, 2008a; IUCN, 2009).

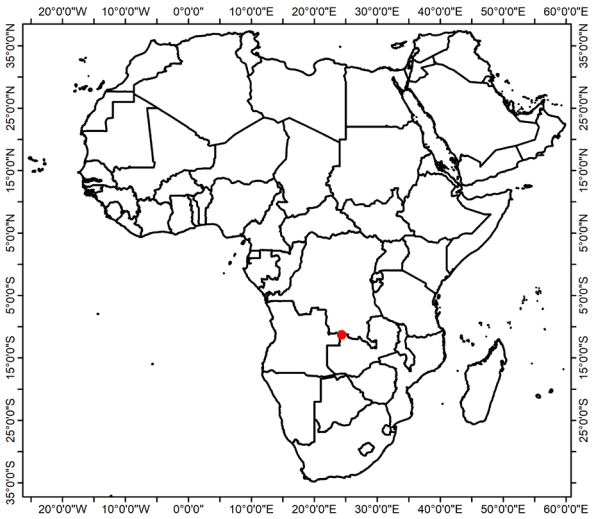


Figure 106. Distribution of *Rhinolophus sakejiensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Zambia.

Rhinolophus silvestris Aellen, 1959

*1959. *Rhinolophus silvestris* Aellen, Archs Sci. Genève, 12 (2): 228. Type locality: Gabon: Lastourville: N'Dumbu cave [ca. 00 50 S 12 03 E] [Goto Description]. Holotype: MHNG 965.040: ad ♂, alcoholic (skull not removed). Collected by: Pierre Strinati and Villy Aellen;

collection date: 4 August 1957. - Etymology: From the Latin for forest dweller (see Flannery, 1995a: 321). (Current Combination)

2016. *Rhinolophus sylvestris:* Karadjian, Hassanin, Saintpierre, Gembu Tungaluna, Ariey, Ayala, Landau and Duval, PNAS, 113 (35): 9835. Publication date: 30 August 2016. (Lapsus)

? *Rhinolophus clivosus silvestris:* (Name Combination)

TAXONOMY:
Considered a subspecies of *clivosus* by Hayman and Hill (1971: 23), but Barratt *et al.* (1995: 386), Cotterill (2002a), Csorba *et al.* (2003: 46 - 48) and Simmons (2005: 363), which indicate the relationships of *Rhinolophus deckeni* and *R. silvestris* are unclear, with the forms possibly being conspecific. Considered part of the *ferrumequinum* species group (Cotterill, 2002a; Csorba *et al.*, 2003: 46 - 48; Simmons, 2005: 363).

COMMON NAMES:
English: Forest Horseshoe Bat. French: Rhinolophe sylvestre. German: Wald-Hufeisennase.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Cotterill, 2008b; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Cotterill, 2008b; IUCN, 2009). 2004 - VU B2ab(iii) ver 3.1 (2001) (Cotterill, 2004g; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
Rhinolophus silvestris is considered to be threatened by habitat loss through conversion of land to agricultural use and logging operations. Additional threats include general disturbance of cave roost sites and overharvesting of the species for the bushmeat trade (Cotterill, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Cotterill (2008b) [in IUCN (2009)] reported that *Rhinolophus silvestris* does not appear to have been recorded from any protected areas. An additional examination of the taxonomic relationship between this species and *Rhinolophus deckeni* is needed. Further field surveys are needed to better determine the distribution, natural history and the extent of threats to this little-known bat.

GENERAL DISTRIBUTION:
Rhinolophus silvestris a poorly known species has only been recorded from three localities in Gabon (Benga; Belinga; and the type locality of Dumbu Cave, Latoursville), and a single site in Congo (Meya-Nzouari).

Native: Congo (Bates *et al.*, 2013: 335); Gabon.

POPULATION:
Structure and Density - *Rhinolophus silvestris* is usually found in small colonies of fewer than 20 bats. It is believed to be in overall decline (Cotterill, 2008b; IUCN, 2009).
Trend - 2008 - Decreasing (Cotterill, 2008b; IUCN, 2009).

PARASITES:
Adam and Landau (1973a: 5) report on the presence of a protozoan parasite of the genus *Polychromophilus* (Haemoproteidae) in *R. clivosus sylvestris*. About 50 % of the specimens from Congo they examined, were found to be infected. Gametocytes were found year-round. The bats were also infested by the nycteribiids *Penicillidia fulvida* Bigot, 1885 and *Nycteribia schmidlii scotti* Falcoz, 1923, of which the prior was a major carrier of *Polychromophilus* sporozoites.

The Haemosporidan *Nycteria gabonensis* Rosin, Landay & Hugot, 1978 was reported by Landau *et al.* (2012: 142), Perkins and Schaer (2016: Suppl.) and Karadjian *et al.* (2016: 9835) from the Republic of Congo and Gabon.

Justine (1989a: 334; 1989b: 553) described two new stomach parasites: *Capillaria chabaudi* and *Capillaria gabonensis* (Nematoda) from *R. silvestris* from Belinga (Gabon).

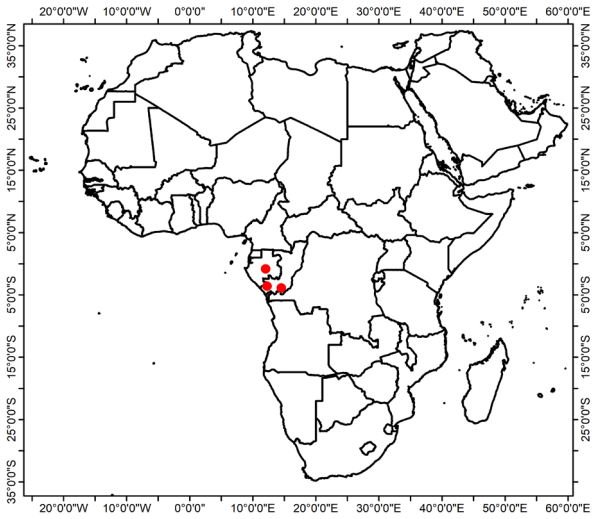


Figure 107. Distribution of *Rhinolophus silvestris*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: "Africa", Congo, Gabon.

Rhinolophus simulator K. Andersen, 1904

*1904. *Rhinolophus simulator* K. Andersen, Ann. Mag. nat. Hist., ser. 7, 14 (83): 384. Publication date: 1 November 1904. Type locality: Zimbabwe: Mashonaland: Mazoe [17 30 S 31 03 E, 4 000 ft] [Goto Description]. Holotype: BMNH 1902.2.7.10: ad ♂, alcoholic (skull not removed). Collected by: J.ff. Darling Esq. - Etymology: From the masculine Latin substantive *simulàtor*, meaning "simulator", as *R. simulator*, according its descriptor, "[...] by quite superficial inspection, could be taken for a curiously small and long-tailed form of [*R. capensis*]." (see Lanza *et al.*, 2015: 115). (Current Combination)

1914. *Rhinolophus bembanicus* Senna, Annuario Mus. Zool. R. Univ. Napoli, (2) 4: no 9, p. 1, 2, text-fig 1, 2. Publication date: 27 March 1914. Type locality: Zimbabwe: Lake Bengueolo [=Lake Bangweulu]. - Comments: Ansell and Dowsett (1988: 34) indicate that *bembanicus* might represent a separable species, but the type specimen no longer exists.

1936. *Rhinolophus alcyone alticolus* Sanborn, Field Mus. Nat. Hist., Zool. Ser., (362) 20 (14): 108. Publication date: 15 August 1936. Type locality: Cameroon: Mount Cameroon [04 13 N 09 11 E, 5 800 ft] [Goto Description]. Holotype: FMNH 42596: ad ♀. Collected by: Rudyerd Boulton and Laura Boulton; collection date: 2 July 1934; original number: 53. - Comments: Fahr (2007a: 103) refers to Csorba *et al.* (2003), who indicate that *alticolus* might possibly represent a separate species.

? *Rhinolophus alticolus:*

? *Rhinolophus simulator alticolus:* (Name Combination)

? *Rhinolophus simulator simulator:* (Name Combination)

TAXONOMY:



Figure 108. *Rhinolophus simulator* from Beneve mine, KwaZulu Natal, South Africa.

Includes *alticolus* and *bembanicus* (see Koopman, 1975: 387; Hayman and Hill, 1971: 25; Koopman, 1993a: 169; Simmons, 2005: 363). Considered part of the *capensis* species group (Csorba *et al.*, 2003: 10 - 12; Simmons, 2005: 363).

Monadjem *et al.* (2016y: 366) refer to Csorba *et al.* (2003), who indicated that *alticolus* might represent a separate species, as their specimens from the Mount Nimba area are about 2,000 km from the nearest records in Nigeria and Cameroon, which, in turn, are again thousands of kilometers from the main distribution area. However, they still retain *alticolus* as a subspecies of *simulator*.

COMMON NAMES:
Afrikaans: Bosveldsaalneusvlermuis, Bosveldvlermuis. Chinese: 布什维尔德菊头蝠. English: Bushveld Horseshoe Bat. French: Rhinolophe de brousse, Rhinolophe du Veld, Rhinolophe du Bushveld. German: Buschveld-Hufeisennase, Buschland-Rundblattnase. Italian: Rinòlofo sirnulatóre, Fèrro di cavàllo simulatóre. Portuguese: Morcego ferradura das savanas.

ETYMOLOGY OF COMMON NAME:
The colloquial name refers to its occurrence in savanna woodland in the subregion (see Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
R. simulator may be present in the late Holocene at Nkupe, South Africa (Avery, 1991: 6).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008ao; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008ao; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004al; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Jacobs *et al.*, 2016l). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
Rhinolophus simulator is threatened in parts of its range by cave disturbance and the loss of habitat resulting from the conversion of land to agricultural use and mining operations (Jacobs *et al.*, 2008ao; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ao) [in IUCN (2009)] reported that there appear to be no direct conservation measures in place. In view of the species East African and southern African distribution, it seems likely that it is present in some protected areas.

GENERAL DISTRIBUTION:
Rhinolophus simulator is widely distributed in sub-Saharan Africa. There are records in West Africa from the Wonegizi Mountains and Mount Nimba (Guinea and Liberia), and from central Nigeria. In Central Africa it has been reported from Cameroon. In East Africa there are many more records, with the species being reported from as far north as Ethiopia and southern Sudan, ranging southwards through Uganda, Kenya and Tanzania to Zambia, Malawi, Mozambique, Zimbabwe, eastern South Africa, Swaziland and southern Botswana. In South Africa, its distribution is strongly associated with the amount of precipitation in the warmest quarter of the year (Babiker Salata, 2012: 49).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 855,537 km^2.

Native: Botswana (Skinner and Smithers, 1990; Csorba *et al.*, 2003: 12; Monadjem *et al.*, 2010d: 560); Cameroon (Rosevear, 1965; Csorba *et al.*, 2003: 12); Côte d'Ivoire; Ethiopia (Hill and Morris, 1971; Largen *et al.*, 1974; Csorba *et al.*, 2003: 12); Guinea (Brosset, 1985; Csorba *et al.*, 2003: 12: Denys *et al.*, 2013: 282); Kenya (Koopman, 1975; Aggundey and Schlitter, 1984; Csorba *et al.*, 2003: 12); Liberia; Malawi (Ansell and Dowsett, 1988; Happold *et al.*, 1988; Happold and Happold, 1997b: 818; Csorba *et al.*, 2003: 12; Monadjem *et al.*, 2010d: 560); Mozambique (Smithers and Lobão Tello, 1976: 561; Csorba *et al.*, 2003: 12; Monadjem *et al.*, 2010c: 380); Nigeria (Rosevear, 1965 Happold, 1987; Csorba *et al.*, 2003: 12); South Africa (Ellerman *et al.*, 1953; Taylor, 1998; Rautenbach *et al.*, 1984; Maree and Grant, 1997; Csorba *et al.*, 2003: 11; Monadjem *et al.*, 2010d: 561); Sudan (Koopman, 1975; Csorba *et al.*, 2003: 12); Swaziland (Monadjem, 2005: 6; Monadjem *et al.*, 2010d: 561); Tanzania (Aellen, 1957; Csorba *et al.*, 2003: 12; Stanley and Goodman, 2011: 42; Stanley and Goodman, 2011: 42); Uganda; Zambia (Ansell, 1967; Ansell, 1969; Ansell, 1973; Ansell, 1978; Csorba *et al.*, 2003: 12; Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 561) ; Zimbabwe (Smithers and Wilson, 1979; Csorba *et al.*, 2003: 12; Monadjem *et al.*, 2010d: 561).

ECHOLOCATION:
Jacobs (1996) and Fenton and Bell (1981) reported a maximum frequency of 78 kHz for an individual from Sengwa in Zimbabwe. Monadjem *et al.* (2007a), using an Anabat detector, reported a maximum frequency of 84.1 (± 0.36) kHz for individuals from various localities in Swaziland. Additional parameters from the same country were given by Monadjem *et al.* (2017c: 179): F_{min}: 72.1 ± 2.97 (68.6 - 76.0) kHz, F_{knee}: 83.8 ± 0.18 (83.6 - 84.1) kHz, F_c: 83.4 ± 0.20 (83.7 - 84.2) kHz, and duration: 16.8 ± 4.70 (12.0 - 25.9) msec.

For individuals in South Africa, Taylor (1999b), using a Pettersson D980, reported a maximum frequency at Shongweni of 82.7 (± 0.4) kHz, while Jacobs *et al.* (2007a) reported a peak frequency of

80.6 (± 1.0) kHz (detector type and locality not indicated). Taylor (2000) reported a constant frequency component at 83 kHz.

Mutumi and Jacobs (2013: 108) investigated the peak frequency over the entire distribution range and found that this frequency was not correlated to body size or vegetation index, but in one location (where the mean annual rainfall and temperatures where the highest), they found that the peak frequency was significantly lower. They suggest that this lower frequency was linked with an increased detection range due to the more humid conditions. The resting call frequency was studied by Mutumi *et al.* (2016), who concluded that the acoustic divergence was best predicted by latitude, geography and climate-induced differences in atmospheric attenuation.

Taylor *et al.* (2013b: 19) reported 9 calls from Waterberg, South Africa with the following characteristics: F_{max}: 82.0 ± 0.58 (81.1 - 82.9) kHz, F_{min}: 79.3 ± 1.42 (75.9 - 80.6) kHz, F_{knee}: 80.5 ± 0.46 (79.8 - 81.2) kHz, F_{char}: 81.5 ± 0.47 (80.9 - 82.1) kHz, duration: 12.4 ± 1.71 (9.6 - 14.4) msec. An additional 16 calls from Swaziland had the following parameters: F_{max}: 84.0 ± 0.34 (83.2 - 84.4) kHz, F_{min}: 78.6 ± 3.77 (71.5 - 82.3) kHz, F_{knee}: 83.1 ± 0.83 (80.3 - 83.7) kHz, F_{char}: 83.4 ± 1.20 (79.2 - 84.1) kHz, duration: 13.1 ± 3.66 (7.0 - 18.9) msec.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg range (RSA): F_{min}: 76 - 81 kHz, F_{peak}: 79 - 84 kHz, F_{knee}: 80 - 84 kHz, Slope: 70 - 368 OPS, duration: 7 - 19 msec.
20 calls from Mapungubwe National Park (RSA) recorded by Parker and Bernard (2018: 57) had the following characteristics: F_{char}: 79.70 ± 1.02 kHz, F_{max}: 79.86 ± 0.99 kHz, F_{min}: 75.43 ± 4.93 kHz, F_{knee}: 79.71 ± 1.01 kHz, duration: 37.79 ± 9.97 msec, with 7.46 ± 3.46 calls/sec.

Jacobs (2016: 119) indicates that the second harmonic of this bat coincides with the third harmonic of *R. capensis*.

Molecular Biology:
DNA - Unknown.
Karyotype - Rautenbach (1986) reported 2*n* = 58, FN = 60, BA = 4, and submetacentric X and Y chromosomes.
Protein / allozyme - Unknown.

Roost:
Taylor *et al.* (1999: 70) reported a colony of 50 - 60 bats roosting in the Shongweni Dam tunnel (RSA).

Diet:
From Sudwala (RSA), Jacobs (2000: 201) reported the following proportions of prey: Lepidoptera (57.6 ± 34.9), Coleoptera (18.3 ± 23.0), Isoptera (19.4 ± 29.8), Hymenoptera (1.5 ± 4.1), Diptera (2.2 ± 4.2), Hemiptera (0.2 ± 1.1), Mandotea (0.2 ± 0.7), and unknown (0.6 ± 2.5).

Weier *et al.* (2019b: 6) examined droppings from this species in the Levubu region (Limpopo, RSA) and found DNA sequences of *Nezara viridula* (Linnaeus, 1758) (Hemiptera).

Predators:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

Population:
Structure and Density - *Rhinolophus simulator* can be locally common. Colonies may consist of a couple of hundred individuals, although these are often quite fragmented because of the species association with caves for breeding (Jacobs *et al.*, 2008ao; IUCN, 2009).
Trend - 2008 - Decreasing (Jacobs *et al.*, 2008ao; IUCN, 2009).

Reproduction and Ontogeny:
Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] reported that births take place around mid November.

Parasites:
Bacteria:
Dietrich *et al.* (2016a: 4) found *Rickettsia* in the faeces of bats from South Africa.

Streblidae:
Brachytarsina africana (Walker, 1849) has a wide distribution in sub Saharan Africa (Haeselbarth *et al.*, 1966: 100). *Raymondia hardyi* Fiedler, 1954 from South Africa (Shapiro *et al.*, 2016: 254). *Raymondia waterstoni* Jobling, 1931 (Haeselbarth *et al.*, 1966: 104; Shapiro *et al.*, 2016: 256).

Viruses:
Polyomaviridae
Carr *et al.* (2017) reported two new virsuses from *R. blasii* from Zambia: *Rhinolophus simulator polyomavirus 4* and *Rhinolophus simulator polyomavirus1*, besides the two already known: *Rhinolophus simulator polyomavirus 2* and *Rhinolophus simulator polyomavirus 3*

Reoviridae
Sasaki *et al.* (2016: 2489) retrieved a VP7 type Rotavirus from a Zambian *R. simulator*: RVA/Bat-wt/ZMB/LUS12-14/2012/G3P[3] (LUS12-14).

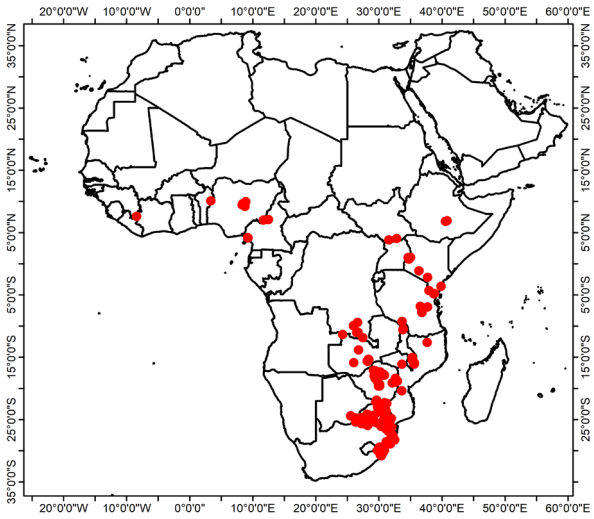


Figure 109. Distribution of *Rhinolophus simulator*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Botswana, Cameroon, Congo (Democratic Republic of the), Ethiopia, Guinea, Kenya, Liberia, Malawi, Mozambique, Nigeria, South Africa, South Sudan, Swaziland, Tanzania, Zambia, Zimbabwe.

Rhinolophus smithersi Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, 2012

*2012. *Rhinolophus smithersi* Taylor, Stoffberg, Monadjem, Schoeman, Bayliss and Cotterill, PLoS ONE, 7(9): 19. Publication date: 12 September 2012. Type locality: Zimbabwe: Sebungwe: Gokwe Communal Land: Ngolangola Gorge at confluence with Lutope River [181705S 280500E, 1000 m] [Goto Description]. Holotype: NHMZ 33647: ♀, skull and alcoholic. Collected by: F.P.D. ("Woody") Cotterill and Peter John Taylor; collection date: 26 October 2000; original number: FWC 4764. Presented/Donated by: ?: Collector Unknown. Skull and mandible in good condition(Taylor *et al.*, 2012c: 19). Paratype: NHMZ 33652: ♂, skull and alcoholic. Collected by: F.P.D. ("Woody") Cotterill and Peter John Taylor; collection date: 26 October 2000; original number: FWC 4769. Presented/Donated by: ?: Collector Unknown. - Etymology: Taylor *et al.* (2012c: 19) selected the specific epithet in recognition of the late Reay Henry Noble Smithers (1907–1987), former Director of the National Museums of Zimbabwe, prodigious collector and researcher of mammals including bats, and author of important regional texts on the mammalogy of Botswana, Zimbabwe and Mozambique, notably his definitive monograph – The Mammals of the Southern African Subregion subsequently updated and revised. The species name combines the surname Smithers and genitive singular case-ending ‘‘i’’ indicative of masculine gender. - ZooBank: E78B0F44-7534-4991-975A-F176CB668DDE. (Current Combination)

2015. *[Rhinolophus] smthersi:* Kaipf, Rudolphi and Meinig, NABU - Biodiversity Assessment in Kafa, Ethiopia, 13.

TAXONOMY:
Based on mitochondrial and nuclear DNA sequences and morphological and morphometric data, Taylor *et al.* (2012c) found that the *Rhinolophus hildebrandtii* group includes more species than previously recognized.

COMMON NAMES:
English: Smithers's Horseshoe Bat. German: Smithers Hufeisennase.

CONSERVATION STATUS:
Global -

Assessment History

Global - not assessed.

Regional -
South Africa: 2016 - NT D1 ver 3.1 (2001) (Taylor *et al.*, 2016b).

GENERAL DISTRIBUTION:
Known from Lutope-Ngolangola Gorge south of the Zambezi Escarpment in NW Zimbabwe and also from Pafuri in the Limpopo Valley in the foothills of the Soutpansberg Mountains of northern Limpopo Province, South Africa but likely more widespread across savanna woodlands of the Limpopo and Zambezi valleys, and their escarpments (the Gwembe horst, and the

Soutpansberg and Waterberg Mountains, respectively) (Taylor *et al.*, 2012c: 19).

Accurate delimitation of this species' range is subject to further collecting and reappraisal of existing museum material, previously refered to as *R. hildebrandtii*.

Native: South Africa (Taylor *et al.*, 2012c: 19); Zimbabwe (Taylor *et al.*, 2012c: 19); Malawi (tentavively, all of the material previously assigned to *R. hildebrandtii*, but Meredith Happold (pers. comm., 24/02/2019) indicated that two species might be involved).

Kaipf *et al.* (2015: 22) report "*Rhinolophus smithersi* or a new species" from God's Bridge in Ethiopia.

ECHOLOCATION:
For 7 calls from specimens from Blouberg, South Africa, Taylor *et al.* (2013b: 18) recorded the following parameters: Fmax: 45.2 ± 0.17 (44.9 - 45.4) kHz, Fmin: 40.6 ± 1.28 (38.1 - 41.7) kHz, Fknee: 44.7 ± 0.13 (44.5 - 44.8) kHz, Fchar: 44.6 ± 0.13 (44.3 - 44.7) kHz, duration: 34.9 ± 6.69 (26.0 - 46.9) msec. 13 calls from Waterberg resulted in the following parameters: Fmax: 47.8 ± 0.31 (47.0 - 48.4) kHz, Fmin: 45.7 ± 0.91 (44.1 - 44.7) kHz, Fknee: 47.2 ± 0.31 (46.3 - 47.7) kHz, Fchar: 47.3 ± 0.29 (46.4 - 47.7) kHz, duration: 18.2 ± 4.52 (10.9 - 24.8) msec, and 10 calls from Soutpansberg: Fmax: 46.0 ± 0.12 (45.9 - 46.2) kHz, Fmin: 44.8 ± 0.20 (44.4 - 45.0) kHz, Fknee: 45.2 ± 0.07 (45.2 - 45.4) kHz, Fchar: 45.5 ± 0.05 (45.5 - 45.6) kHz, duration: 12.0 ± 2.22 (9.6 - 16.5) msec. 19 calls recorded at the Mapungubwe National Park (RSA) by Parker and Bernard (2018: 57) had the following characteristics: F_{char}: 47.23 ± 1.62 kHz, F_{max}: 47.47 ± 1.50 kHz, F_{min}: 43.27 ± 2.65 kHz, F_{knee}: 47.26 ± 1.54 kHz, duration: 44.74 ± 22.83 msec, with 8.02 ± 3.70 calls/sec.

PARASITES:
DIPTERA:
Streblidae: *Ascodipteron brevior* Maa, 1965, female cysts found at the base of the ears from Namibia and South Africa (Haeselbarth *et al.*, 1966: 106 host referred to as *R. hildebrandtii*). *Raymondia hardyi* Fiedler, 1954 from South Africa (Shapiro *et al.*, 2016: 254; based on a record by Theodor (1968), who mentioned "*R. hildebrandtii*" as host).
Nycteribiidae: *Nycteribia scissa rhodesiensis* Theodor, 1957 from Zimbabwe and Malawi (Haeselbarth *et al.*, 1966: 108, host as *R. hildebrandtii*). *Nycteribia rotundata* Theodor, 1957 from Mazoe, Zimbabwe (Haeselbarth *et al.*, 1966: 110, host referred to as *R. hildebrandtii*). *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114, host referred to as *R. hildebrandtii*).

ZOOBANK:
E78B0F44-7534-4991-975A-F176CB668DDE

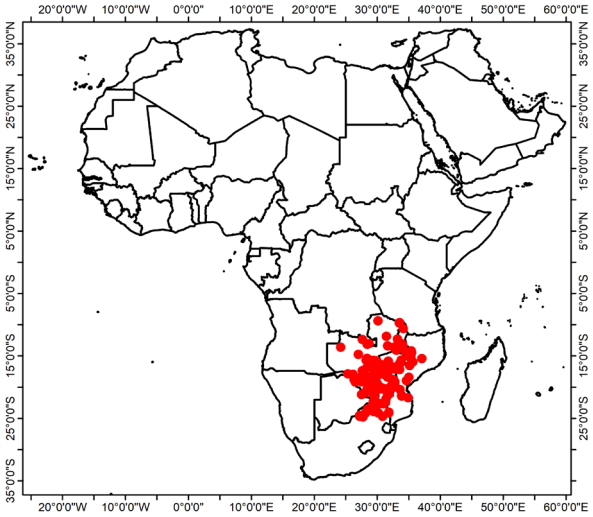


Figure 110. Distribution of *Rhinolophus smithersi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Botswana, Malawi, Mozambique, South Africa, Zambia, Zimbabwe.

Rhinolophus swinnyi Gough, 1908

*1908. *Rhinolophus swinnyi* Gough, Ann. Transv. Mus., 1: 71, 2 text-f. Publication date: April 1908. Type locality: South Africa: Cape province: Ngqeleni district: W Pondoland: "Ngqeleni district" [30 40 S 29 02 E] [Goto Description]. Holotype: TM 1021: ad ♂, skin and skull. Collected by: H.H. Swinny; collection date: 22 February 1908; original number: 153. Paratype: TM 1022: ad ♂, skin and skull. Collected by: H.H. Swinny; collection date: 23 February 1908; original number: 154. Notes: skull found lying loose- may not belong to this specimen [signed A. Roberts]). - Comments: Meester *et al.* (1986: 41) mentioned the type locality as "Ngqeleni district, west of Port St. Johns, Transkei". (Current Combination)

1913. *Rhinolophus swinnyi piriensis* Hewitt, Records Albany Mus., 2: 402. Publication date: 6 February 1913. Type locality: South Africa: E Cape province: near King William's Town: Pirie [32 43 S 27 18 E].

TAXONOMY:
Koopman (1966, 1982) suggests that this species may be conspecific with *denti*. *capensis* species group (Csorba *et al.*, 2003: 12 - 14; Simmons, 2005: 364). See Csorba *et al.* (2003: 11) for remarks on taxonomy.

COMMON NAMES:
Afrikaans: Swinny se saalneusvlermuis, Swinny-saalneusvlermuis, Swinnyse Vlermuis. Czech: vrápenec mosambický. English: Swinny's Horseshoe Bat. French: Rhinolophe de Swinny. German: Swinnys Hufeisennase. Portuguese: Morcego ferradura de Swinny.

ETYMOLOGY OF COMMON NAME:
Named after H.H. Swinny, who collected the original specimens from the Nqqueleni district, Eastern Cape (Taylor, 2005).

CONSERVATION STATUS:
Global - Although *Rhinolophus swinnyi* is known mainly from sparse records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large overall population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Cotterill, 2008c; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Cotterill, 2008c; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Cotterill, 2004h; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - VU C2a(i) ver 3.1 (2001) (Jacobs *et al.*, 2016h). 2004 - EN C2a(i) ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
Populations may be locally threatened by deforestation, largely resulting from logging operations, local use of timber and firewood, and general conversion of land to agricultural use (Cotterill, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Cotterill (2008c) [in IUCN (2009)] reported that *Rhinolophus swinnyi* is present in some protected areas (e.g. Kruger National Park, South Africa). Further studies are needed into the taxonomic status of this species, the distribution and possible threats.

GENERAL DISTRIBUTION:
Rhinolophus swinnyi has been recorded from eastern parts of South Africa, much of Zimbabwe, northwestern Mozambique, with additional scattered records further north in Malawi, Zambia, Democratic Republic of the Congo and Tanzania (including the island of Unguja [=Zanzibar]) (Skinner and Chimimba, 2005; O'Brien, 2011: 286). It may be present in Angola, but this needs confirmation. In South Africa, its distribution is mainly affected by temperature seasonality (Babiker Salata, 2012: 49).

Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,054,284 km^2.

Native: Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Happold *et al.*, 1988; Kock and Howell, 1988; Csorba *et al.*, 2003: 14; Monadjem *et al.*, 2010d: 561); Malawi (Happold and Happold, 1997b: 818; Csorba *et al.*, 2003: 14); Mozambique (Smithers and Lobão Tello, 1976; Skinner and Smithers, 1990; Csorba *et al.*, 2003: 14; Monadjem *et al.*, 2010d: 561; Monadjem *et al.*, 2010c: 380); South Africa (Maree and Grant, 1997; Rautenbach and Espie, 1982; Kock and Howell, 1988; Taylor, 1998; Csorba *et al.*, 2003: 13; Monadjem *et al.*, 2010d: 561); Tanzania (Skinner and Smithers, 1990; Kock and Howell, 1988; Csorba *et al.*, 2003: 14); Zambia (Ansell, 1969; Ansell, 1978; Csorba *et al.*, 2003: 14; Monadjem *et al.*, 2010d: 561); Zimbabwe (Cotterill, 1996a; Cotterill, 2004a: 261; Csorba *et al.*, 2003: 14; Monadjem *et al.*, 2010d: 561).
Presence uncertain: Angola

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:



Figure 111. Clockwise from top lateral, ventral and dorsal skull images of TM 1021, holotype of *Rhinolophus swinnyi* Gough, 1908.

ECHOLOCATION:

Aldridge and Rautenbach (1987) reported a maximum frequency of 115 kHz for individuals from Pafuri in South Africa. Jacobs *et al.* (2007a) reported a slightly different peak frequency of 107.0 (± 0.8) kHz for individuals from South Africa. Monadjem *et al.* (2010c: 380) reported from Mozambique that the peak echolocation frequencies ranged between 99 - 103 kHz (Petterson D240x).

Taylor *et al.* (2018a: 25) mention a mean frequency of 106.6 ± 0.4 kHz for 10 specimens from the Eastern Cape Province and 105.6 ± 0.76 kHz from KwaZulu-Natal.

Mutumi *et al.* (2016) found that acoustic divergence in RF was best predicted by latitude, geography and climate-induced differences in atmospheric attenuation.

Jacobs (2016: 119) indicates that the second harmonic of this bat coincides with the third harmonic of *R. capensis*, which possibly might illustrate "harmonic hopping".

MOLECULAR BIOLOGY:

DNA - Unknown.
Karyotype - Rautenbach (1986) reported 2*n* = 58, FN = 62, BA = 6, a subtelocentric X chromosome and a metacentric Y chromosome.
Protein / allozyme - Unknown.

POPULATION:

Structure and Density - In parts of its range *Rhinolophus swinnyi* is considered to be uncommon, however, Taylor (2000) records that it is fairly common in Zimbabwe. It generally forms small colonies of fewer than ten animals (Cotterill, 2008c; IUCN, 2009).
Trend - 2008 - Unknown (Cotterill, 2008c; IUCN, 2009).

PARASITES:

DIPTERA:
Streblidae: *Raymondia waterstoni* Jobling, 1931 (Shapiro *et al.*, 2016: 256).

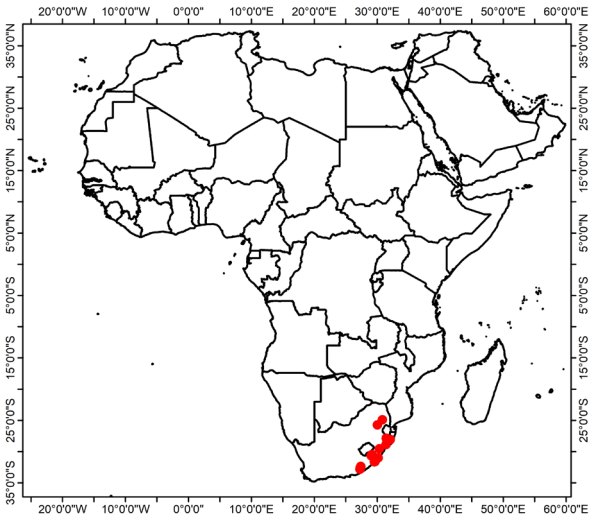


Figure 112. Distribution of *Rhinolophus swinnyi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:

South Africa.

Rhinolophus willardi Kerbis Peterhans and Fahr, 2013

*2013. *Rhinolophus willardi* Kerbis Peterhans and Fahr, in: Kerbis Peterhans, Fahr, Huhndorf, Kaleme, Plumptre, Marks and Kizungu, Bonn. Zool. Bull., 62 (2): 190, figs 3, 4, 6. Publication date: November 2013. Type locality: Congo (Democratic Republic of the): Misotschi-Kabogo highlands [05 06 19 S 29 03 56 E, 1 880 m] [Goto Description]. Holotype: FMNH 195182: ad ♂, skull and alcoholic. Collected by: A.J. Plumptre and E.A. Mulungu; collection date: 17 February 2007; original number: DCM 1680. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 195082: ad ♀, skin and skeleton and skull. Collected by: B.D. Marks; collection date: 14 February 2007; original

number: MHH 837. Presented/Donated by: ?: Collector Unknown. From 4 km SW of the village Talama, "Camp 2", 4°59'29''S, 29°04'49''E, 1950 m. Paratype: FMNH 195083: ad ♀, skin and skeleton and skull. Collected by: B.D. Marks; collection date: 14 February 2007; original number: MHH 838. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 195084: ad ♀, skin and skeleton and skull. Collected by: Prince Kiswele Kaleme; collection date: 16 February 2007; original number: PK 754. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 198083: ad ♀, complete skeleton. Collected by: B.D. Marks; collection date: 14 February 2007; original number: MHH 838. Presented/Donated by: ?: Collector Unknown. From 4 km SW of the village Talama, "Camp 2", 4°59'29''S, 29°04'49''E, 1950 m. Paratype: FMNH 198084: ad ♀, complete skeleton. Collected by: B.D. Marks; collection date: 16 February 2007; original number: PK 754. Presented/Donated by: ?: Collector Unknown. From 4 km SW of the village Talama, "Camp 2", 4°59'29''S, 29°04'49''E, 1950 m. - Etymology: In honour of Dr. David Willard (Collection Manager, Division of Birds, FMNH) in recognition of his unparalleled 35+ years of service to the Field Museum of Natural History (see Kerbis Peterhans *et al.*, 2013: 191). (Current Combination)

COMMON NAMES:
English: Willards horseshoe bat. German: Willards Hufeisennase.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the).

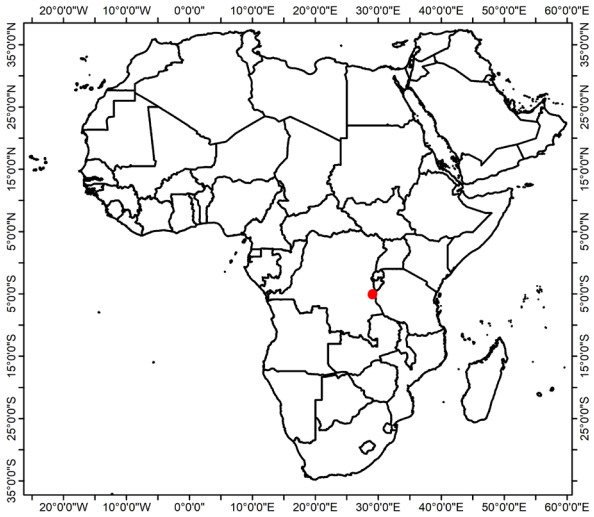


Figure 113. Distribution of *Rhinolophus willardi*

Rhinolophus ziama Fahr, Vierhaus, Hutterer and Kock, 2002

*2002. *Rhinolophus ziama* Fahr, Vierhaus, Hutterer and Kock, Myotis, 40: 102, 109, figs 1 - 7. Type locality: Guinea: Guinée Forestière: border "Réserve Biosphère de la Massif du Ziama": Sérédou, W edge of: near Park Station [ca. 08 23 N 09 17 W] [Goto Description]. Holotype: ZFMK 1999.0934: ad ♂, alcoholic, skull and skeleton. Collected by: Henning Vierhaus; collection date: 12 August 1992; original number: HV 2590. Paratype: AMNH 265708: ad ♂, skull and alcoholic. Collected by: Dr. Robert W. Dickerman; collection date: 4 March 1990; original number: 2144. 7 mi ?, 1 mi E Ziggida, Lofa county, Wonegizi Mts., Liberia: see Fahr *et al.* (2002: 109). - Etymology: In reference to the protected area near the type locality, the "Réserve de la Biosphère du Massif de Ziama", and as a noun in apposition (Fahr *et al.*, 2002: 110). (Current Combination)

TAXONOMY:
maclaudi species group (Fahr *et al.*, 2002; Simmons, 2005: 365).

COMMON NAMES:
Czech: vrápenec liberijský. English: Ziama Horseshoe Bat (first use Simmons, 2005: 365). French: Rhinolophe du Ziama. German: Ziama-Hufeisennase.

CONSERVATION STATUS:
Global - *Rhinolophus ziama* is listed as Endangered (EN B1ab(iii) ver 3.1 (2001)) because its extent of occurrence is less than 5,000 km^2, all individuals appear likely to be in fewer than five

locations, and there is continuing decline in the extent and quality of its habitat (Fahr, 2008n; IUCN, 2009).

Assessment History -
2008 - EN B1ab(iii) ver 3.1 (2001) (Fahr, 2008n; IUCN, 2009). 2004 - EN B1ab(iii) ver 3.1 (2001) (Fahr, 2004c; IUCN, 2004).

MAJOR THREATS:
Rhinolophus ziama is threatened by deforestation of its habitat, largely through logging and mining operations, and conversion of land to agricultural use. It is also considered possible that the species could be threatened by overharvesting for subsistence food in the future (Fahr, 2008n; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008n) [in IUCN (2009)] reported that it is not known if the species is present in any protected areas. There is a need to protect suitable areas of forest habitat for this species, and to initiate appropriate bat conservation awareness programmes among local people. In addition, further studies are needed into the distribution, abundance, natural history, and threats to this species.

GENERAL DISTRIBUTION:
Rhinolophus ziama is a West African bat, known from two localities in the Guinea Highlands (c. 600 m asl) of southeast Guinea (Ziama Forest) and north-west Liberia (Wonegizi Mountains) (Fahr *et al.*, 2002). Surrounding areas have been surveyed but the species has not been found elsewhere.

Native: Guinea; Liberia; Sierra Leone (Decher *et al.*, 2010; Norris *et al.*, 2015: 83)..

POPULATION:
Structure and Density - *Rhinolophus ziama* is known only from four specimens (Fahr, 2008n; IUCN, 2009).
Trend - 2008 - Decreasing (Fahr, 2008n; IUCN, 2009).

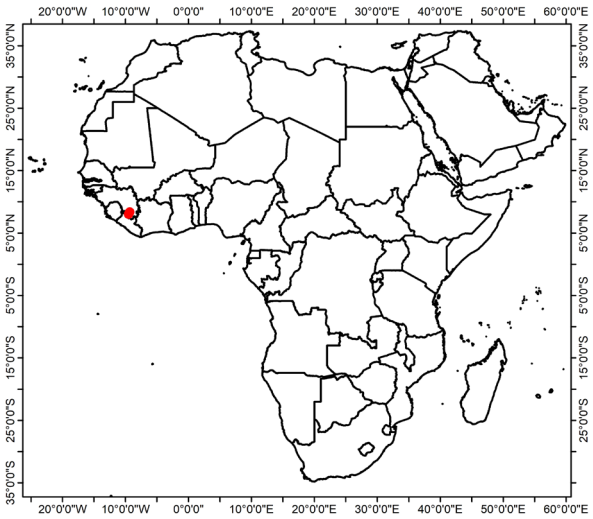


Figure 114. Distribution of *Rhinolophus ziama*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Guinea, Liberia.

Family RHINONYCTERIDAE J. E. Gray, 1866

*1866. *Rhinonycteridae* Gray, Proc. zool. Soc. Lond., 81.
1866. *Rhinonycterina* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 81. Publication date: May 1866. - Comments: Proposed as tribe (?). Type genus: *Rhinonicteris* J. Gray, 1866, and originally included the genus *Rhinonicteris* J. Gray, 1847. Retained as subtribe by Koopman (1994: 68) (see Jackson and Groves, 2015: 251).
*2009. *Triaenopini* Benda and Vallo, Folia Zool., 58 (Mon. 1): 2, 33 [Goto Description]. - Comments: Type genus: *Traenops* Dobson, 1871. Proposed as tribe and originally included the genera *Triaenops* Dobson, 1871 and *Paratriaenops* Benda and Vallo, 2009. Synonymized with *Rhinonycteridae* by Foley *et al.* (2014: 319) (see Jackson and Groves, 2015: 251).
? *Rhinonicteridae* (Alternate Spelling)

TAXONOMY:
Based on the phylogram, the timetree, and a unique retrotransposon insertion, Foley *et al.* (2014: 313) elevated the subtribe Rhinonycterina Gray, 1866 to family level: Rhinonycteridae. They also found (p. 318) that the monophyletic grouping of this family is supported by a unique shared indel in the *THY* gene fragment.

The validity of this family was also confirmed by Amador *et al.* (2016: 3, 6).

Single known subfamily - Rhinonycterinae
Known genera of Rhinonycteridae: †*Archerops* Hand and Kirsch, 2003, †*Brachipposideros* Sigé, 1968, †*Brevipalatus* Hand and Archer, 2005, ***Cloeotis*** Thomas, 1901, ***Paratriaenops*** Benda and Vallo, 2009, *Rhinonicteris* Gray, 1847, ***Triaenops*** Dobson, 1871.

SIMILAR SPECIES:
Key characters for the genera:
Cloeotis – Head and body length is 33 – 50 mm, tail length is 22 – 33 mm (tail completely enclosed by interfermoral membrane and is longer than the femur), and forearm length is 30 – 39 mm. Posterior component of noseleaf with three tall tapering projections. Two upper premolars on each side, M^3 not reduced (four ridges) (Nowak, 1994: 118, Happold, 2013al: 357).
Paratriaenops – Head and body length is 35 – 62 mm, tail length is 20 – 34 mm (tail completely enclosed by interfemoral membrane), and the forearm length is about 49 – 61 mm. Posterior component of noseleaf with three tall tapering projections. Two upper premolars on each side, M^3 not greatly reduced (three ridges).
Rhinonicteris – Head and body length is 45 – 53 mm, tail length is 24 – 28 mm, forearm length is 47 – 50 mm. The complex upper portion of the nose-leaf surmounts the nostrils like a crown. The crown-like portion of the leaf is extensively honeycombed and sculptured (Nowak, 1994: 116).
Triaenops – Head and body length is 35 – 62 mm, tail length is 20 – 34 mm (tail completely enclosed by interfemoral membrane), and forearm length is 45 – 61 mm. Posterior component of noseleaf with three tall tapering projections as in *Cloeotis*. Cranially, *Triaenops* differs from genera in its raised and inflated rostrum and relatively much larger cochleae but resembles *Rhinonycters* in the structure of the anterorbital region and zygoma and in the curiously thickened premaxillae, two upper premolars on each side, M^3 not greatly reduced (three ridges) (Nowak, 1994: 115, Happold, 2013al: 357).

†Genus ***Brachipposideros*** Sigé, 1968

*1968. *Brachipposideros* Sigé, Paleovert., 1 (3): 83.

†Genus ***Brevipalatus*** Hand and Archer, 2005

*2005. *Brevipalatus* Hand and Archer, Palaeontology, 48 (2): 372.

Genus ***Cloeotis*** Thomas, 1901

*1901. *Clœotis* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 28. Publication date: 1 July 1901 [Goto Description]. - Comments: Type species: *Clœotis percivali* Thomas, 1901. - Etymology: From the Greek "*κλοτός*", meaning collar and "*ούς*" or "*ώτός*", meaning ear, referring to Thomas' statement that "the whole ear is very like a man's 'stand-up' collar with angles in front rounded off." (see Palmer, 1904: 191). Alternatively "*cloeotis*" might simply mean short-eared.
2016. *Cleotis:* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 42. Publication date: 9 May 2016.
? *Cloeotis:* (Current Spelling)

TAXONOMY:
Reviewed by Hill (1982b).

Known species to the genus *Cloeotis*: ***percivali*** Thomas 1901.

COMMON NAMES:
Czech: jihoafričtí číponosi. English: Short-eared Trident Bats, Short-eared Bats, African Trident Bats, African Trident-nosed Bats, Trident-nosed Bats. French: Cléothes. German: Kleinohr-Dreizackblattnase. Italian: Cloeòtidi.

Cloeotis percivali Thomas, 1901

*1901. *Clœotis Percivali* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 28. Publication date: 1 July 1901. Type locality: Kenya: Coast province: N of Mombassa: Takaungu [03 42 S 39 51 E,

20 m] [Goto Description]. Holotype: BMNH 1901.5.1.11: ♂. Collection date: 15 February 1901. Presented/Donated by: Arthur Blayney Percival. - Etymology: In honour of Arthur Blayney Percival, game ranger in the former British East Africa, and collector of the type specimen (see Lanza *et al.*, 2015: 133). (Current Combination)

1917. *Clœotis percivali australis* Roberts, Ann. Transv. Mus., 5: 264-5. Publication date: 16 May 1917. Type locality: South Africa: W Transvaal province: Rustenburg district: Mooimeisiesfontein [25 01 S 27 37 E] [Goto Description]. Holotype: TM 1670: ad ♀, skin and skull. Collected by: W. Powell; collection date: 28 May 1915. Paratype: TM 1669: ad ♀, skin and skull. Collected by: W. Powell; collection date: 26 May 1915. Roberts (1917b: 265) called this a "Metatype". Paratype: TM 1671: ad ♀, skin and skull. Collected by: W. Powell; collection date: 27 May 1915. Roberts (1917b: 265) called this a "Metatype". Paratype: TM 1672: ad ♀, skin and skull. Collected by: W. Powell; collection date: 28 May 1915. Roberts (1917b: 265) called this a "Metatype". Paratype: TM 1673: ad ♀, skin and skull. Collected by: W. Powell; collection date: 28 May 1915. Roberts (1917b: 265) called this a "Metatype". Paratype: TM 1674: ad ♂, skin and skull. Collected by: W. Powell; collection date: 26 May 1915. Roberts (1917b: 265) called this a "Metatype". Paratype: TM 1675: ad ♂, skin and skull. Collected by: W. Powell; collection date: 26 May 1915. Roberts (1917b: 265) called this a "Metatype". Paratype: TM 1676: ad ♂, skin and skull. Collected by: W. Powell; collection date: 26 May 1915. Roberts (1917b: 265) called this a "Metatype". - Comments: Considered a valid subspecies by Taylor (1998: 41).

Monadjem *et al.* (2010d: 147) mentioned TM 1690 as type specimen, but Roberts (1917b: 265) indicated TM 1670, which is part of the eight *percivali* specimens collected by W. Powell at Mooimeisjesfontein and mentioned by the author (TM 1669 - 1676).

? *Cloeotis percivali australis:*

? *Cloeotis percivali percivali:* (Name Combination)

? *Cloeotis percivali:* (Current Spelling)

Taxonomy:



Figure 115. *Cloeotis percivali* (TM 46644) from Miggies gat, Mpumalanga, South Africa.

Meester *et al.* (1986: 43 - 44) recognized two subspecies: *percivali* and *australis*.

Common Names:

Afrikaans: Drietand-bladneusvlermuis, Drietand-blaarneusvlermuis. Chinese: 珀氏三叉蝠. Czech: cíponos jihoafrický. English: Percival's Short-eared Trident Bat, Percival's Trident Bat, Short-eared Trident Bat, African Trident Bat, East African Trident Bat. French: Cléothe de Percival, Asellia d'Afrique orientale, Phyllorhine à petites oreilles, Phyllorhine de Percival. German: Percivals Kleinohr-Dreizackblattnase. Italian: Cloeòtide di Pèrcival. Kiluba (DRC): Kasusu. Portuguese: Morcego tridentado. SiSwati: Lilulwane.

Conservation Status:

Global - Although poorly known and with some recorded population declines, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008do; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008do; IUCN, 2009). 2004 - VU A2bc+A3bc, C1 ver 3.1 (2001) (Mickleburgh *et al.*, 2004db; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - E C2a(i) ver 3.1 (2001) (Balona *et al.*, 2016). 2004 - CR A2a ver 3.1 (2001) (Friedmann and Daly, 2004). 1996 - Indeterminate (Smithers, 1986).
Swaziland: 2003 - DD ver 3.1 (2001) (Monadjem *et al.*, 2003).

Major Threats:

There have been seemingly stochastic extinctions of colonies, though it is not known if the animals simply move to new locations. Roost disturbance seems to be an important factor, but there might be others, and there has been speculation that DDT might be a cause of population

disappearances (Mickleburgh *et al.*, 2008do; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008do) [in IUCN (2009)] report that in South Africa, KwaZulu-Natal province they are protected from human disturbance. It might occur in some protected areas. Protection of maternity/breeding and roosting sites from disturbance is important.

GENERAL DISTRIBUTION:
Largely confined to southern Africa, with records from South Africa (KwaZulu-Natal, Limpopo, and Mpumalanga), Swaziland, south-east Botswana, southern Zambia, Zimbabwe (the core of the distribution), and extralimital records from southern Democratic Republic of Congo, Malawi, northwestern Mozambique, and coastal Kenya (Taylor, 2000). Reported from Mafia Island Tanzania, but no vouchers were collected (Kock and Stanley, 2009; O'Brien, 2011: 287).

For southern Africa (south of 8°S), Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 955,464 km^2. In the RSA, its distribution is best predicted by geology (Babiker Salata, 2012: 50).

Native: Botswana (Smithers, 1971, Tiunov, 1986: 536); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 536); Kenya; Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 536); South Africa (Seamark, 2005c: 3; Monadjem *et al.*, 2010d: 536; Balona, 2016: 5); Swaziland (Monadjem *et al.*, 2005; Monadjem *et al.*, 2010d: 536); Tanzania; Zambia (Ansell, 1969; Ansell, 1986; Monadjem *et al.*, 2010d: 536); Zimbabwe (Monadjem *et al.*, 2010d: 536).

FUNCTIONAL MORPHOLOGY:
Davies *et al.* (2013b: 6) found that this species' cochlea contains a highly modified basal turn compared to the other species they studied, and these modifications are consistent with the tonotopic organisation of the cochlea in which the basal area corresponds to the highest frequencies used by this bat.

ECHOLOCATION:
For an individual from Sengwa in Zimbabwe, Jacobs (1996) and Fenton and Bell (1981) reported a maximum frequency of 212 kHz, the highest frequency pure tone documented from the natural world (Bell and Fenton, 1984 in Thiagavel *et al.*, 2017: 1). Monadjem *et al.* (2007a), using an Anabat detector reported a maximum frequency of 103.4 (± 0.74) kHz for individuals from various localities in Swaziland. While Monadjem *et al.* (2010d: 57) report a maximum frequency of 103.2 (± 0.7) using an Anabat detector. Taylor (1999b) using a Pettersson D980 detector reported a maximum frequency of 104.2 (± 0.4) kHz for *C. percivali* from Jozini in South Africa. Taylor (2000) reported a constant frequency of 104 kHz (fundamental) and 208 kHz (first harmonic). Fenton (2004b: 3) indicates that the calls are dominated by sounds higher than 200 kHz. Monadjem *et al.* (2010d: 144) report HD-CF calls with high peak frequency (207.8 ± 3 kHz, n = 6) and intermediate duration (4.6 ± 1.2 msec, n = 6), with a second harmonic, where the fundamental harmonic is at around 104 kHz.

Monadjem *et al.* (2007a) also reported sexual dimorphism in the call with males calling at a higher frequency than females (males 103.7 ± 0.71 kHz, females 102.9 ± 0.52 kHz).

In Swaziland, Monadjem *et al.* (2017c: 179) recorded the following parameters: F_{min}: 99.2 ± 1.02 (98.1 - 100.1) kHz, F_{knee}: 103.1 ± 0.65 (102.6 - 103.8) kHz, F_c: 102.6 ± 0.51 (102.2 - 103.2) kHz, duration: 2.3 ± 0.04 (2.2 - 2.3) msec.

Three bats (one unknown sex, one female and one male) from the Fikirini caves in Kenya called with F_{max} respectively: 217.1, 225.3, and 219.6 kHz and a duration of 3.9, 4.0 and 4.0 msec (Webala *et al.*, 2019: 15).

MOLECULAR BIOLOGY:
DNA - Eick *et al.* (2005) and Matthee *et al.* (2006).
Karyotype - 2*n* = 40 (Rautenbach *et al.*, 1993).
Protein / allozyme - Unknown.

HABITAT:
Its elevational range is from sea level to 1,000 m (Mickleburgh *et al.*, 2008do).

ROOST:
Caves and mine tunnels for day roosting (Taylor, 2000).

DIET:
It feeds exclusively on moths (Taylor, 2000).

From Zambia, Black (1979: 54) reported the occurrence of the following prey taxa in the stomachs of 55 bats: Lepidoptera (moths): 100, Coleoptera (beetles): 7.3, Diptera (flies): 5.5, Unidentified insects: 3.6, Hemiptera (bugs): 1.8, and Isoptera (termites): 1.8. Only 7 of the 55 bats had eaten prey other than moths.

For South Africa, Jacobs (2000: 201) mentioned the following prey proportions: Lepidoptera (98.7 ± 3.2), Coleoptera (0.3 ± 1.2), Diptera (0.2 ± 0.7), and unknown (0.8 ± 3.1).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - Large fluctuations in population numbers are known, and it is prone to local extinctions. It is never found in very large colonies, with the largest known colony (of about 300 individuals) being reported from KwaZulu-Natal, South Africa, on the southern section of its range. However, the current estimated population size of the KwaZulu-Natal colony is only 50 animals. There are no population estimates from elsewhere in its range, although the largest population might be in Zimbabwe (Mickleburgh *et al.*, 2008do; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008do; IUCN, 2009). 2004- Unknown (Mickleburgh *et al.*, 2004db; IUCN, 2004).

PARASITES:
Streblidae: *Raymondia alulata* Speiser, 1908 recorded at Kanye, Botswana (Haeselbarth *et al.*, 1966: 102; Shapiro *et al.*, 2016: 253). *Raymondia hardyi* Fiedler, 1954 from South Africa (Shapiro *et al.*, 2016: 254). *Raymondia huberi huberi* Frauenfeld, 1855 (Shapiro *et al.*, 2016: 254). *Raymondia seminuda* Jobling,1954 from southern Botswana (Haeselbarth *et al.*, 1966: 103; Shapiro *et al.*, 2016: 255). *Raymondia waterstoni* Jobling, 1931 (Haeselbarth *et al.*, 1966: 104).

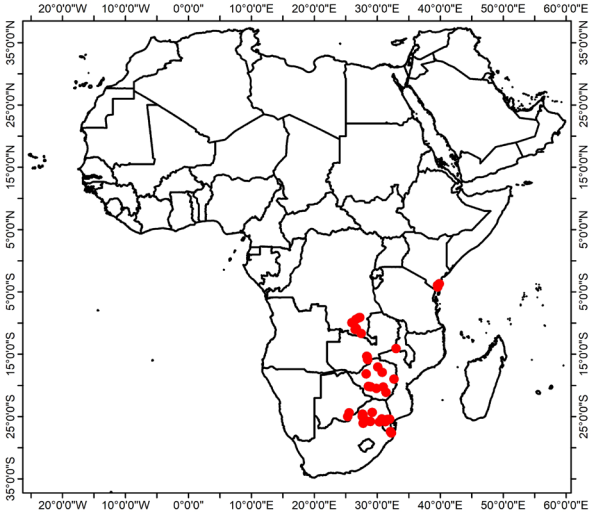


Figure 116. Distribution of *Cloeotis percivali*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Botswana, Congo (Democratic Republic of the), Kenya, South Africa, Swaziland, Zambia, Zimbabwe.

Genus ***Paratriaenops*** Benda and Vallo, 2009

*2009. *Paratriaenops* Benda and Vallo, Folia Zool., 58 (1): 1, 31 [Goto Description]. - Comments: Type species: *Triaenops furcula* Trouessart, 1906. - Etymology: The name refers to close similarity of *Paratriaenops* with the genus *Triaenops*; Greek prefix *para* - means besides, next to. Masculinum.

TAXONOMY:
Differs primarily from *Triaenops* Dobson, 1871 and *Cloeotis* Thomas, 1901 in the shape and morphology of the noseleaf, and lacking of lateral supplementary leaflets (Benda and Vallo, 2009).
Based on a considerable genetic distance (21.6 - 26.2 % in 731 bp sequence of cyt *b*) and substantial morphological differences from the continental forms of *Triaenops* as well as from Malagasy *T. menamena*, Benda and Vallo (2009: 1) propose generic status for the group of Malagasy species, *T. furculus*, *T. auritus*, and *T. pauliani*. They also separate *Paratriaenops* and *Triaenops* from the other hipposiderid bats in the tribus *Triaenopini*.
Ramasindrazana *et al.* (2013: 436) support the recognition of *Paratriaenops* as a separate genus based on an additional character: the inversed sexual dimorphism, where females are larger than males.

Known species of the genus *Paratriaenops*: ***auritus*** (G. Grandidier, 1912); ***furculus*** (Trouessart, 1907); ***pauliani*** (Goodman and Ranivo, 2008).

COMMON NAMES:
Czech: malí cíponosi. German: Madagaskar-Dreizack-Blattnasen.

Paratriaenops auritus (G. Grandidier, 1912)

*1912. *Triænops aurita* G. Grandidier, Bull. Mus. natn. Hist. nat., Paris, sér. 1, 18 (1): 8, fext-fig. Publication date: 25 January 1912. Type locality: Madagascar: extreme N Madagascar: near Diégo-Suarez [=Antsiranana] [ca. 12 16 S 49 17 E] [Goto Description]. Holotype:

MCZ 45080: ♂, skin and skull. Collected by: Dr. Mazières. Body mummified; see Peterson (1987: 81). on label: "envoi du Dr. Mazières, Diégo Suarez - Madag. 1910": see Ranivo and Goodman (2006: 974), Helgen and McFadden (2001: 143).

2009. *Paratriaenops auritus:* Benda and Vallo, Folia Zool., 58: 33. (Name Combination, Current Combination)

? *Triaenops auritus:* (Current Spelling)

TAXONOMY:
Until recently, only known from the holotype (see Peterson *et al.*, 1995: 81), but additional specimens were reported by Ranivo and Goodman (2006: 977). Included in *furculus* (Hayman and Hill, 1971; Koopman, 1993a: 175, 1994), but Peterson *et al.*, 1995: 81), Russ *et al.* (2001), Hutson *et al.* (2001: 18), Ranivo and Goodman (2006: 974) consider it a valid species. Benda and Vallo (2009) placed it in the genus *Paratriaenops*.

COMMON NAMES:
Czech: cíponos zlatý. English: Grandidier's trident bat. French: Triaenops à grandes oreilles. German: Grandidiers Dreizahn-Blattnase.

CONSERVATION STATUS:
Global - This species is listed as Vulnerable (VU B1ab(iii) ver 3.1 (2001)) as it has what appears to be restricted geographic range of less than 20,000 km² in northwestern Madagascar. The habitat is severely fragmented, and there is a continuing decline in the area and quality of habitat mainly due to agricultural activities. Further survey work is needed to help better ascertain the limits of the range of this species (Andriafidison *et al.*, 2008n; IUCN, 2009).

Assessment History -
2008 - VU B1ab(iii) ver 3.1 (2001) [assessed as *Triaenops auritus*] (Andriafidison *et al.*, 2008n; IUCN, 2009). 2000 - DD ver 2.3 (1994) [assessed as *Triaenops auritus*] (IUCN, 2000).

MAJOR THREATS:
As a forest dependent species any decline in extent or quality of the remaining forest poses a threat to this species. In northern Madagascar, forest is lost because of expanding agriculture. There is also the threat of disturbance to cave roosting sites (Andriafidison *et al.*, 2008n; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008n) [in IUCN (2009)] report that this species is known to occur in three protected areas: Réserve Spéciale d'Ankarana, Réserve Spéciale d'Analamerana and Daraina forest (Ranivo and Goodman, 2006; Russell *et al.*, 2007). Conservation should be focused at the known cave roosts to secure the existing populations and closely monitor seasonal and annual population changes.

GENERAL DISTRIBUTION:
Paratriaenops auritus is endemic to the island of Madagascar where it has a restricted range in the north-western tip of the island, ranging between 50 m and 160 m above sea-level (Ranivo and Goodman, 2006; Robinson *et al.*, 2006; Russell *et al.*, 2007). The Andrafiamena Mountains likely form the southern limit of this species (S. M. Goodman *pers. comm.*).

Native: Madagascar (Ranivo and Goodman, 2006: 963; Robinson *et al.*, 2006; Russell *et al.*, 2007).

BIOGEOGRAPHY:
See Russell *et al.* (2007).

DETAILED MORPHOLOGY:
Baculum:
The only specimen examined by Rakotondramanana and Goodman (2017: 56) had an elongated baculum with a pointed tip and expanded rounded basal lobe; length: 1.78 mm, width: 0.49 mm.

ECHOLOCATION:
Kofoky *et al.* (2009: 380) reported the calls from 10 individuals, which consisted of a distinctive narrowband CF component that ended with short FM sweeps with a maximum energy of 100.3 kHz.

Ramasindrazana *et al.* (2013: 434) mention the following values for 5 ♂♂ specimens: Resting frequency: 107.8 ± 1.51 (106.9 - 109.6) kHz, F_{max}: 108.8 ± 1.48 (106.5 - 110.2) kHz, F_{min}: 106.5 ± 1.59 (104.8 - 108.2) kHz, duration: 11.7 ± 3.65 (7.6 - 17.5) msec, interpulse interval: 28.9 ± 8.02 (19.5 - 38.6) msec, and for 2 ♀♀: Resting frequency: 95.6 (95.1, 96.1) kHz, F_{max}: 96.4 (95.6, 97.2) kHz, F_{min}: 93.9 (93.8, 94.1) kHz, duration: 13.7 (13.5, 14.0) msec, interpulse interval: 25.5 (25.4, 25.7) msec.

MOLECULAR BIOLOGY:
DNA - Russell *et al.* (2007).
Karyotype - Unknown
Protein / allozyme - Unknown

HABITAT:
Dammhahn and Goodman (2013: 108) mention that the bat's foraging habitat is the lower portion of forest.

POPULATION:
Structure and Density - This species is thought to be relatively abundant within a localized area in the northern part of Madagascar. The largest roost recorded was 2,000 individuals in Réserve Spéciale d'Ankarana (S. G. Cardiff *pers. obs.*) and up to 1,000 individuals were recorded from a mine tunnel approximately 5 km from Andavokoera (J. Ranivo *pers. comm.*).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008n; IUCN, 2009).

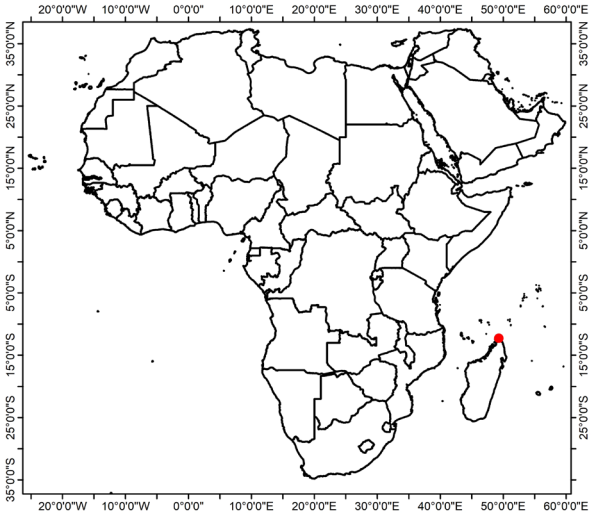


Figure 117. Distribution of *Paratriaenops auritus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Paratriaenops furculus (Trouessart, 1907)

*1907. *Triaenops furcula* Trouessart, Bull. Mus. natn. Hist. nat., Paris, sér. 1, 12 (7): 446 (for 1906). Publication date: 26 February 1907. Type locality: Madagascar: Tuléar province: 20 km S Tuléar, St. Augustine Bay: Sarodrana cave [23 33 S 43 45 E]. Holotype: MNHN ZM-MO-1912-40a (186): ♂, alcoholic (skull missing). Collected by: Guillaume Grandidier; collection date: 19 May 1898. - Comments: Issue 12 (7) was for a meeting on 27 November 1906, but was only distributed around 26 February 1907 (see Bull. Vol 13 (2). Trouessart (1907: 446) mentions *Triaenops* in name for the new taxon, but refers to the other taxa as *Triænops*).
2009. *Paratriaenops furculus:* Benda and Vallo, Folia Zool., 58: 33. (Name Combination, Current Combination)
? *Triaenops furculus:* (Current Spelling)

TAXONOMY:
Hayman and Hill (1971: 30) and Koopman (1993a: 175) included *aurita*, but see Peterson *et al.* (1995), Russ *et al.* (2001), Hutson *et al.* (2001: 18), Simmons (2005: 378), Ranivo and Goodman (2006: 963) who consider it a valid species. Benda and Vallo (2009) placed it into the genus *Paratriaenops*.

COMMON NAMES:
Czech: cíponos malý. English: Trouessart's Trident Bat, Trouessart's Triden Bat, Madagascar Leaf-nosed Bat. French: Triaenops malgache, Triaenops de Madagascar, Triaenops de Trouessart. German: Trouessarts Dreizahn-Blattnase.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Sabatier and Legendre (1985: 23) and Gunnell *et al.* (2014: 3) refer to fossils from the Anjohibe, Tsimanampetsotsa, and Andrahomana caves on Madagascar.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution. There is no evidence that this species is declining fast enough to place it in a category of higher threat although its roosting colonies should be monitored especially in areas undergoing habitat change (Andriafidison *et al.*, 2008o; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Triaenops furculus*] (Andriafidison *et al.*, 2008o; IUCN, 2009).
1996 - VU A2c ver 2.3 (1994) (Baillie and Groombridge, 1996).

MAJOR THREATS:
There may be possible threats from disturbance at the cave sites. This species is tolerant to some degree of forest degradation, but appears to require forested areas to survive (Goodman *et al.*, 2005a) and may therefore be one of the few Malagasy bat species really susceptible to

deforestation and forest fragmentation (Andriafidison *et al.*, 2008o; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008o) [in IUCN (2009)] report that this species is present in Parc National du Tsingy de Bemaraha, Parc National de Namoroka, Parc National Kirindy-Mite and Parc National Tsimanampetsotsa (Goodman *et al.*, 2005a). Roosting colonies need to be the focus of further conservation and research.

GENERAL DISTRIBUTION:
Paratriaenops furculus is found on Madagascar where it is restricted to lowland (an elevation span of 30 m to 200 m above sea level) areas in the west and south-west (Goodman *et al.*, 2005a; Ranivo and Goodman, 2006: 963). It is also found on Cosmoledo and Aldabra Atolls in the outer Seychelles (von Brandis, 2004: 135; Hutson, 2004a).

Native: Madagascar (Goodman *et al.*, 2005a; Ranivo and Goodman, 2006: 963); Seychelles (Hutson, 2004a).

BIOGEOGRAPHY:
See Russell *et al.* (2007).

DETAILED MORPHOLOGY:
Baculum:
The penis bone is elongated with a slightly pointed tip and triangular basal lobe; length: 1.66 ± 0.154 (1.48 - 1.93) mm, width: 0.37 ± 0.105 (0.22 - 0.53) mm.

ECHOLOCATION:
Kofoky *et al.* (2009: 380) reported the calls from 18 individuals, the pulses were of longer duration than *Triaenops menamena* and consisted of a narrowband CF component that *T. menamena*, began and ended with short FM sweeps with a high duty cycle (52.5%) and with up to two harmonics, with the second harmonic containing the most energy at about 103.4 kHz. The frequency of maximum amplitude (FMA) was reported as 100.2 ± 0.2 kHz (n = 18) by Bambini *et al.* (2011: 84).

Ramasindrazana *et al.* (2013: 434) mention for 6 ♂♂ specimens the following values: Resting frequency: 113.1 ± 1.80 (110.6 - 115.1) kHz, F_{max}: 114.8 ± 1.90 (111.9 - 116.8) kHz, F_{min}: 110.5 ± 2.16 (106.8 - 113.0) kHz, duration: 12.4 ± 2.71 (8.9 - 16.9) msec, interpulse interval: 23.4 ± 8.50 (14.4 - 36.9) msec, and for 10 ♀♀: Resting frequency: 98.2 ± 1.41 (96.8 - 101.2) kHz, F_{max}: 99.5 ± 1.21 (98.1 -102.3) kHz, F_{min}: 95.7 ± 2.20 (91.4 - 99.4) kHz, duration: 16.0 ± 4.55 (8.1 - 22.5) msec, interpulse interval: 37.7 ± 18.00 (13.9 - 68.5) msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) and Russell *et al.* (2007).
Karyotype - Unknown
Protein / allozyme - Unknown

HABITAT:
Hutson (2004a: 129) reports, that on Madagscar, this bat is essentially a cave inhabitant (often sea caves), but on Aldabra (Seychelles) - where there are no true caves - it might inhabit some vertical solution holes, which are at most about 5m deep, and other small hollows which might provide a limited cave-like environment.

ROOST:
Recorded in a variety of roosts including caves, shallow sea caves, rock overhangs, under bridges, and large road drainage pipes (Goodman and Ranivo, 2008).

DIET:
On Madagascar, Rakotoarivelo *et al.* (2007) found that *Paratriaenops furculus* mainly consumed Lepidoptera. This was confirmed by Bambini *et al.* (2011: 81), who also indicated that Coleoptera were also part of the diet. These two order also made up the major volume percentage of preys found in feacal pellets collected by Ramasindrazana *et al.* (2012: 120-121) in the Tsimanampetsotsa NP: Lepidoptera (65.7 ± 4.8), Coleoptera (27.6 ± 4.6), Psocoptera (1.9 ± 0.5), Diptera (1.9 ± 0.7), Hymenoptera (1.5 ± 0.7), Homoptera/Hemiptera (1.0 ± 0.7), and Neuroptera (0.4 ± 0.3). The percentages of Lepidoptera and Coleoptera were about equal during the dry season (46.0 ± 8.5 versus 47.7 ± 8.3), but differed considerably during the wet season (74.7 ± 3.9 versus 18.3 ± 3.4).

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of one individual in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

POPULATION:
Structure and Density - There are few data available on *Paratriaenops furculus*, but it appears to be a relatively rare member of the chiropteran assemblage in western Madagascar as determined by mist netting and acoustic sampling (Kofoky *et al.*, 2007; Rakotoarivelo and Randrianandrianina, 2007). However, it can occur in large colonies and a roost of over 10,000 individuals was reported from the Sept Lacs in southern Madagascar (Olsson *et al.*, 2006). There is no information on population size of *P. furculus*

from Aldabra, but it appears to be rather rare with only a few specimen records (Hutson, 2004a).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008o; IUCN, 2009).

PARASITES:
Lagadec *et al.* (2012: 1696) and Gomard *et al.* (2016: 5) report the presence of *Leptospira* sp bacteria in this species.

Perkins and Schaer (2016: Suppl.) report the presence of an unidentified haemosporidan. Ramasindrazana *et al.* (2018: Suppl.) identified the haemosporidian *Polychromophilus melanipherus* Dionisi, 1899 from this bat species.

Ramasindrazana *et al.* (2016: 7) report one male specimen (out of five examined) to be infected by an unnamed filarial Nematode.

VIRUSES:
Astroviridae
Lebarbenchon *et al.* (2017: Suppl.) found 11 out of 31 examined bats to test positive for Astroviridae.

Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 1 individuals from the Madagascar using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids.
Mélade *et al.* (2016b: 4) tested 14 Madagascan specimens, of which one was positive for paramyxoviruses.

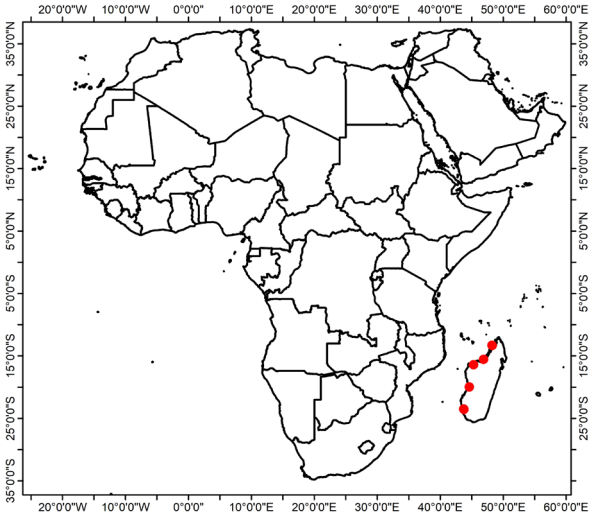


Figure 118. Distribution of *Paratriaenops furculus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Paratriaenops pauliani (Goodman and Ranivo, 2008)

1941. *[Triaenops] furinea* Tate, Am. Mus. Novit., 1140: 3. Type locality: Seychelles: Aldabra. - Comments: Goodman and Ranivo (2008: 685) mention that Tate (1941: 3) used the name "*Triaenops furinea* Trouessart" for the species on Aldabra. To their knowledge Trouessart never named the form occurring on Aldabra; the use of "*furinea*" is presumably a misreading of the name furcula and is considered a *nomen nudum* (Hayman and Hill, 1971: 30; Hill, 1982b).

*2008. *Triaenops pauliani* Goodman and Ranivo, Zoosystema, 30 (3): 681, 685, figs 2, 3. Type locality: Seychelles: Aldabra Atoll: Picard Island [c 09 24 S 46 12 E] [Goto Description]. Holotype: BMNH 1913.2.18.1: ad ♂, skull and alcoholic. Collected by: J.C.F. Fryer. Based on the itinerary of the Percy Sladen Trust Expedition to the Seychelles, Fryer was in the western Seychelles (Astove, Cosmoledo, Assumption, and Aldabra) from 13 September1908 to 24 January 1909 (Gardiner *et al.*,1910), see Goodman and Ranivo (2008). Paratype: BMNH 1913.2.18.2: ad ♀, skull and alcoholic. Collected by: J.C.F. Fryer. Paratype: BMNH 1978.185: ad ♀, alcoholic (skull not removed). Collected by: J.J. Whitelaw; collection date: 04 May 1977. Picard Island, Aldabra Station [09 24 04.4 S 46 12 21.4 E, 5 m]. Paratype: CUMZ E5609.A: ad ♀. Collected by: J.C.F. Fryer. Picard Island, between 13 September 1908 and 24 January 1909. Paratype: CUMZ E5609.B: ad ♂. Collected by: J.C.F. Fryer. Picard Island, between 13 September 1908 and 24 January 1909. Paratype: FMNH 185795: sad ♂, skull and alcoholic. Collected by: U. Samedi; collection date: 09 April 2004. Picard Island, Aldabra Station [09 24 04.4 S 46 12 21.4 E, 5 m]. - Etymology: The name *pauliani* is a patronym after the late Prof. Renaud Paulian, who conducted extensive research in the western Indian Ocean islands and was responsible for a major synthesis of the bio-geography of Madagascar and neighbouring islands (Paulian 1961, see Goodman and Ranivo (2008: 685).

2009. *Paratriaenops pauliani:* Benda and Vallo, Folia Zool., 58: 33. (Name Combination, Current Combination)

TAXONOMY:
Benda and Vallo (2009) placed it into the genus *Paratriaenops*.

COMMON NAMES:
Czech: cíponos aldabránský. French: Triaenops de Paulian. German: Aldabra- Dreizahnblattnase.

GENERAL DISTRIBUTION:
Is endemic to the Aldabra Atoll, specifically Picard Island (Goodman and Ranivo, 2008).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
The noseleafs of *P. pauliani* are shorter than those in individuals of *P. auritus* or *P. furculus*, and the external lancets are shorter than the internal lancet, and outer margins of the external lancets are distinctly arc-shaped, while in members of the *P. auritus*/*furculus* group the external lancets are distinctly spear-shaped and the difference in length of the external and internal lancets is less marked (Goodman and Ranivo, 2008).
In overall external measurements, *P. pauliani* is smaller than *P. auritus*/*furculus* group.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
The cranial measurements are similar to those of *P. auritus* and *P. furculus* and fall within the range of size variation of these latter two taxa. There is an elongation of the anterior portion of the upper toothrow, with the I^1-M^3 measurements falling outside the range for *P. furculus* and *P. auritus* (see Goodman and Ranivo, 2008).

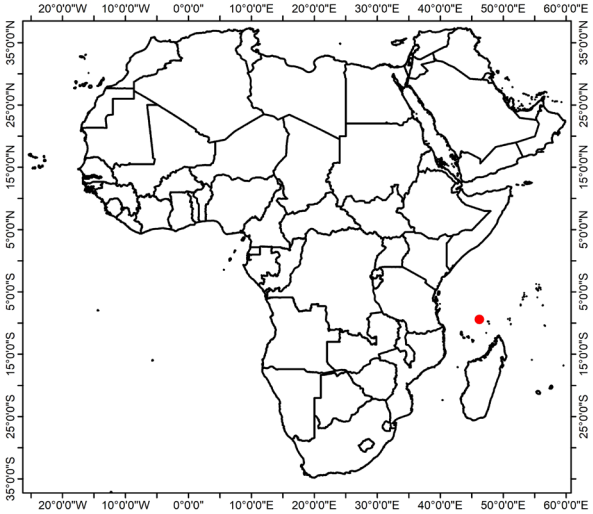


Figure 119. Distribution of *Paratriaenops pauliani*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Seychelles.

Genus ***Triaenops*** Dobson, 1871

*1871. *Triaenops* Dobson, J. Asiatic Soc. Bengal, 40 (2): 455, pl. 28. Publication date: 28 December 1871. - Comments: Type species: *Triænops persicus* Dobson, 1871. - Etymology: From the Greek "*τρίαινα*" (trìaina), meaning trident and "*ώφ*", meaning face (or "*ὄφις*" (ópsis), meaning "aspect, appearance"), referring to the posterior part of the nose-leaf, which terminates in three pointed projections (see Palmer, 1904: 687); Lanza *et al.*, 2015: 155). (Current Combination)
1995. *Triaenopus:* Yoshiyuki, Bull. Nat. Sci. Mus., Tokyo, Ser. A (Zool.), 21 (2): 119. Publication date: 22 June 1995. (Lapsus)
2002. *Trienops:* Paniutina, Plecotus et al., pars spec.: 36. (Lapsus)
? *Triaenops sp.:*

TAXONOMY:
Hill (1982b) and Garbutt (1999) suggested that *T. rufus* and *T. persicus* be synonymized. This is not supported by Russell *et al.* (2007). The Madagascan species are reviewed by Ranivo and Goodman (2006).

Known species of *Triaenops*: †***goodmani*** Samonds, 2007; ***afer*** Peters, 1871; ***menamena*** Goodman and Ranivo, 2009, *parvus* Benda and Vallo, 2009, *persicus* Dobson, 1871.

COMMON NAMES:
Czech: velcí cíponosi. English: Greater Trident Bats, Trident Bats, Trident Leaf-nosed Bats, Triple nose-leaf bats. French: Triaenops. German: Dreizahn-Blattnasen. Italian: Triènopi.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Samonds (2007: 55 - 57) found *Triaenops* sp. Within the deposits (NCC-1 locality) dating estimated as 69,600 to 86,800 years old within the Anjohibe cave, Madagascar.

GENERAL DISTRIBUTION:
Is broadly distributed in Africa, portions of the Middle East, and islands in the western Indian Ocean.

BIOGEOGRAPHY:
Russell *et al.* (2007)'s data reject a single-dispersal hypothesis (single origin hypothesis), which predicts that linages endemic to Madagascar form an exclusive clade. Russell *et al.* (2007) found that Malagasy *Triaenops* are paraphyletic with respect to the mainland African species *T. persicus*, indicating that the distribution of Malagasy and African *Triaenops* involved at least two independent dispersal events.
Russell *et al.* (2008a) estimate that at 2.25 Mya *Triaenops* still formed a single ancestral population between *T. rufus*/*P. auritus*, while the timing of the later *T. rufus* dispersal to Madagascar is less clear (about 148 kya and 660 kya).

†***Triaenops goodmani*** Samonds, 2007

*2007. *Triaenops goodmani* Samonds, Acta Chiropt., 9 (1): 46, fig 3 A-B. Type locality: Madagascar: Anjohibe cave [Goto Description]. Holotype: UADBA 9010:. Partial left dentary: see Samonds (2007: 46). - Etymology: Specific name for Dr. Steven M. Goodman, in recognition of his significant contributions to the field of modern Malagasy bat research (see Samonds, 2007). (Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Samonds (2007: 46 - 49) found samples in deposits (OLD SE) dated at 10,000 yrs old or younger within the Anjohibe cave, Madagascar.

Time frame: Pleistocene.

Triaenops afer Peters, 1877

*1877. *Triænops afer* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 913 (for 1876). Publication date: 1877. Type locality: Kenya: Mombassa [04 03 S 39 40 E]. Holotype: ZMB 5074: ♂, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt. See Turni and Kock (2008: 40). (Current Combination)
1968. *Triaenops persicus majusculus* Aellen and Brosset, Rev. suisse Zool., 75 (14): 450. Type locality: Congo: Loudima: Grotte de Doumboula [04 15 S 13 00 E] [Goto Description]. Holotype: MNHN ZM-MO-1968-412: ad ♂, alcoholic (skull not removed). Collected by: Jean-Paul Adam; collection date: 19 June 1964. 18 paratypes.
2017. *Tr[iaenops] affer:* Waruhiu, Ommeh, Obanda, Agwanda, Gakuya, Ge, Yang, Wu, Zohaib, Hu and Shi, Virol. Sin., 32 (2): 4. Publication date: 6 April 2017. (Lapsus)
2017. *Triaenops affer:* Waruhiu, Ommeh, Obanda, Agwanda, Gakuya, Ge, Yang, Wu, Zohaib, Hu and Shi, Virol. Sin., 32 (2): 5. Publication date: 6 April 2017. (Lapsus)
? *Triaenops afer:* (Current Spelling)
? *Triaenops persicus afer:* (Name Combination)
? *Triaenops persicus:*

TAXONOMY:
Benda and Vallo (2009: 26) found differences in the structure of the skull, baculum and Cyt. *b* of *Triaenops persicus* occurring in the Middle East and those in East Africa.

COMMON NAMES:
Chinese: 非洲三叉蝠. Czech: cíponos africký, vrápenec cíponosý. English: African Trident Bat, Peter's Trident Bat. German: Afrikanische Dreizahn-Blattnase. Italian: Triènope àfro.

GENERAL DISTRIBUTION:
Native: Ethiopia (Kruskop *et al.*, 2016: 58); Mozambique (Monadjem *et al.*, 2010c: 381).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Lucati and López-Baucells (2016: Suppl.) refers to Howell (1980), who mentioned two piebald (all-white fur/skin patches, eyes always normally coloured) *T. persicus* specimens from a mine in Tanzania.

DETAILED MORPHOLOGY:
Brain:
Adult hippocampal neurogenesis was studied by Chawana R. *et al.* (2016: 1551) [as *Triaenops persicus*].

ECHOLOCATION:
From Mozambique, Monadjem *et al.* (2010c: 381) reported that the echolocation calls are sexually dimorphic, peak frequencies of males ranged

between 71 - 75 kHz (ANABAT) and those of females, between 82 - 85 kHz (ANABAT).

The calls of nine Kenyan bats were reported by Webala *et al.* (2019: 15) with F_{max}: 88.2 - 91.2 kHz (5 ??), 82.5 - 83.9 kHz (2 FF) and 75.2 - 75.7 kHz (2 MM). Three calls of a third male had a F_{max} of 30.1 kHz and a duration of 8.4 - 12.2 msec.

REPRODUCTION AND ONTOGENY:
Martin and Bernard (2000: 32) indicate that the corpus luteum is only present for the first part of the pregnancy after which complete regression occurs.

PARASITES:
BACTERIA
Bartonellae
Bartonella - Kosoy *et al.* (2010: 1877) and Bai and Kosoy (2012: 58) reported a prelevence of *Bartonella* spp. cultered from blood samples of 7/8 (87.5 %) *T. persicus* specimens from Kenya. Seven *Bartonella* spp. *gltA* sequences were identified, and formed a monophyletic geogroup (Kosoy *et al.*, 2010: 1878). See also Kosoy (2010: 719) for further information.

HAEMOSPORIDA
Garnham (1973: 237) refers to Adam and Landau for a record of *Polychromophilus ? murinus* in a "*Triaenops persicus*" from Africa.

SIPHONAPTERA
Ischnopsyllidae: *Araeopsylla scitula* Rothschild, 1909 was reported by Beaucournu and Kock (1996) from "*Triaenops persicus*" bat from Kenya.

DIPTERA:
Streblidae: *Raymondia aspera* Maa, 1968 from Mozambique (Shapiro *et al.*, 2016: 254). *Raymondia huberi huberi* Frauenfeld, 1855 (Shapiro *et al.*, 2016: 254). *Raymondia seminuda* Jobling, 1954 (Shapiro *et al.*, 2016: 255). *Raymondia waterstoni* Jobling, 1931 (Shapiro *et al.*, 2016: 256).

ACARI:
Trombiculidae: Stekolnikov (2018a: 50, 173) found *Whartonia oweni* Vercammen-Grandjean and Brennan, 1957 and *Microtrombicula tanzaniae* Goff, 1982 on "*Triaenops persicus afer*".

VIRUSES:
Astroviridae
These viruses were found by Waruhiu *et al.* (2017) in their country-wide survey of Kenyan bats. Hoarau *et al.* (2018: 2) found them in 35 of the 51 Mozambican bats they tested.

Coronaviridae
Of the 30 *T. afer* specimens Tao *et al.* (2017: 3) tested in Kenay, eight (26.7 %) were positive for CoV.

Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that 12 out of 16 examined *T. afer* specimens from Kenya tested positive for *Paramyxovirus* sequences.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Horton *et al.* (2014: Table S1) tested 12 Kenyan "*T. persicus*" specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

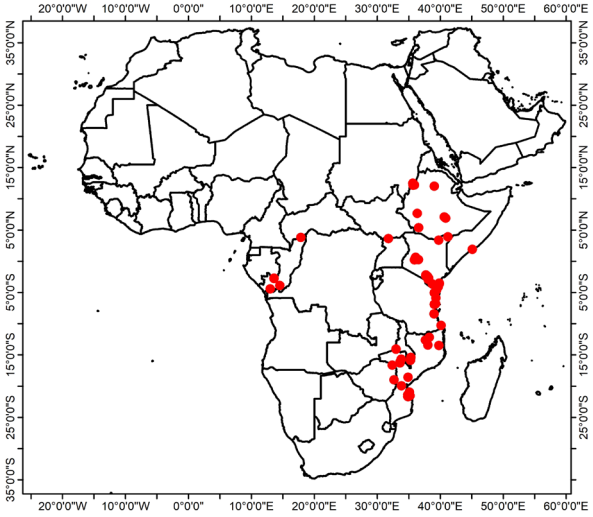


Figure 120. Distribution of *Triaenops afer*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Central African Republic, Congo, Ethiopia, Kenya, Malawi, Mozambique, Somalia, Tanzania, Uganda, Zambia, Zimbabwe.

Triaenops menamena Goodman and Ranivo, 2009

1881. *Triænops Humbloti* A. Milne-Edwards. Type locality: : "Africa": Aden (Yemen) or Somalia.. Holotype: MNHN ZM-MO-1985-836 (184): ♂, alcoholic (skull missing). Collected by: Léon Humblot; collection date: 1880; original number: 184 or 184A. See Peterson *et al.* (1995: 82). The type series (184 and 184A) contains 3 MM + 3 FF) (Peterson *et al.*, 1995). Rode (1941: 239) refers to the holotype (184) and six paratypes (184a). Paratype: MNHN 184A [a]: ♀. Collected by: Léon Humblot; collection date: 1880; original number: 184 or 184A. See Peterson *et al.* (1995: 82). Paratype: MNHN 184A [b]: ♀. Collected by: Léon Humblot; collection date: 1880; original number: 184 or 184A. See Peterson *et al.* (1995: 82).

Paratype: MNHN 184A [c]: ♀. Collected by: Léon Humblot; collection date: 1880; original number: 184 or 184A. See Peterson *et al.* (1995: 82). Paratype: MNHN ZM-MO-1985-838: ♂. Collected by: Léon Humblot; collection date: 1880; original number: 184 or 184A. See Peterson *et al.* (1995: 82). Paratype: MNHN ZM-MO-1985-839: ♂. Collected by: Léon Humblot; collection date: 1880; original number: 184 or 184A. See Peterson *et al.* (1995: 82). - Comments: See Goodman and Ranivo (2009) for futher discussion on the type locality. According to Ranivo and Goodman (2006: 974) the skull of the holotype has been mixed up with the skulls of the paratypes (MNHN 1985-838 and 1985-839). *T. humbloti* is retained as a synonym for both *T. persicus* and *T. menamena* due to the fact that purely taxonomically it is a synonym of *T. persicus*, but most of the specimens from Madagascar were erroneously assigned this name. In general, the authorship for the Madagascan use would be assigned to a subsequent author or to the same author in a later publication, but in this case, the author already made the error in the original publication.

1881. *Triænops rufus* A. Milne-Edwards, C. R. séances Acad. Sci., Paris, 91: 1035. Publication date: 1881. Type locality: "Africa": Aden (Yemen) or Somalia [Goto Description]. Holotype: MNHN ZM-MO-1997-1854 (185): ♀, skull and alcoholic. Collected by: Léon Humblot; collection date: 1880. Presented/Donated by: ?: Collector Unknown. See Peterson *et al.* (1995: 82). Ranivo and Goodman (2006: 974) indicate that the skull is still present, but in very bad shape. Specimen labled "Holotype no. 185" (see Goodman and Ranivo, 2009). Paratype: MNHN ZM-MO-1997-1855 (185A): ♀, alcoholic (skull not removed). Collected by: Léon Humblot; collection date: 1880. Presented/Donated by: ?: Collector Unknown. See Peterson *et al.* (1995). Paratype: MNHN ZM-MO-1997-1856 (185A): ♀, alcoholic (skull missing). Collected by: Léon Humblot; collection date: 1880. Presented/Donated by: ?: Collector Unknown. See Peterson *et al.* (1995). Paratype: MNHN ZM-MO-1997-1857 (185A): ♀, alcoholic (skull missing). Collected by: Léon Humblot; collection date: 1880. Presented/Donated by: ?: Collector Unknown. See Peterson *et al.* (1995). - Comments: (see Goodman and Ranivo, 2009).

*2009. *Triaenops menamena* Goodman and Ranivo, Mammalia, 73 (1): 48, 54, fig 1. Publication date: 31 March 2009. Type locality: Madagascar: Mahajanga province: Réserve Naturelle Intégrale de Namoroka, 4 km SSW Namoroka village: Grotte d'Ampidiranamhaja [16 25.957 S 45 17.180 E, 120 m] [Goto Description]. Holotype: FMNH 178563: ♂, skull and alcoholic. Collected by: Julie Ranivo and Fania H. Ratrimomanarivo; collection date: 25 September 2003; original number: S.M. Goodman 13825. - Etymology: From the Malagasy word "mena" meaning "red", which, in common usage, when repeated twice, means "reddish" (see Goodman and Ranivo, 2009: 54). (Current Combination)

? *Triaenops humbloti:*

? *Triaenops rufus:*

TAXONOMY:

These Madagascan specimens were previously included in *persicus* by Hayman and Hill (1971: 30), Hill (1982b), Koopman (1993a: 175), probably based on the type specimens, which are now believed to be collected either in Yemen or Somalia (see Goodman and Ranivo, 2009: 52). Based on actual Madagascan material, Peterson *et al.* (1995: 82), Russ *et al.* (2001), Hutson *et al.* (2001: 18), Goodman *et al.* (2005a: 158), and Simmons (2005: 379) recognized the specimens as representing a separate species.

See also the phylogentic analysis by Russell *et al.* (2007: 847).

Goodman and Ranivo (2009) extensively discuss the origin of the type specimens of *Triænops Humbloti* Milne-Edwards, 1881 and *Triænops rufus* Milne-Edwards, 1881. Their conclusion is that both forms were not from Madagascar but from Yemen or Somalia. Therefore, from a strict taxonomical view, these two names are synonyms of *Triaenops persicus* Dobson, 1871. However, we are also retaining these names in the synonymy of *Triaenops menamena* Goodman and Ranivo, 2009 since these names were always used to identify Madagascan forms, which are currently assigned to *T. menamena*.

COMMON NAMES:

Czech: cíponos madagaskarský. English: Rufous Trident Bat, Red Madagascan Trident Bat. French: Triaenops roux. German: Rötliche Dreizahn-Blattnase.

CONSERVATION STATUS:

Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution across Madagascar. It can tolerate some degree of habitat transformation, is relatively common, and is not thought to be declining fast enough to

place it in a category of higher threat (Andriafidison *et al.*, 2008p; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Triaenops rufus*] (Andriafidison *et al.*, 2008p; IUCN, 2009).
2000 - DD ver 2.3 (1994) [assessed as *Triaenops rufus*] (IUCN, 2000).

MAJOR THREATS:
There are no significant threats to this species even though it is occasionally hunted for food (Goodman, 2006) and is often associated with forests that are subject to ongoing degradation (Russell *et al.*, 2007).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008p) [in IUCN (2009)] report that this species is known to occur in many protected areas: Réserve Spéciale d'Ankarana, Réserve Spéciale d'Analamerana, Parc National du Tsingy de Bemaraha, Parc National de Namoroka, Parc National de Tsimanampetsotsa, Parc National d'Ankarafantsika, Parc National d'Isalo, Réserve Spéciale d'Ambohitantely, Parc National de Masoala and Réserve Naturelle Intégrale de Tsaratanana (Ranivo and Goodman, 2006; Russ *et al.*, 2003; Russell *et al.*, 2007).

GENERAL DISTRIBUTION:
Triaenops menamena is endemic to the island of Madagascar. It is restricted to the western dry habitats and extreme northeastern and southeastern Madagascar in humid habitats (Goodman and Ranivo, 2009).

Papers prior to 2009 refer to *T. rufus*; see taxonomy section above for more details.

Native: Madagascar (Peterson *et al.*, 1995; Russ *et al.*, 2003; Goodman *et al.*, 2005a; Simmons, 2005; Ranivo and Goodman, 2006; Russell *et al.*, 2007; Rakotoarivelo *et al.*, 2007; Goodman and Ranivo, 2009).

BIOGEOGRAPHY:
See Russell *et al.* (2007).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 57) indicate that the baculum is 'stick-like' with a bifid distal tip and straight mid-shaft. Its basal part is triangular with two distinct lateral projections; length: 1.67 ± 0.12 (1.50 - 1.80) mm, width: 0.71 ± 0.07 (0.61 - 0.79) mm.

ECHOLOCATION:
Kofoky *et al.* (2009: 379) reported the calls from 15 individuals, which produced relatively short CF component followed by brief FM components, the duty cycle was high (25.5 %), with the second harmonic generally contained most energy at about 93.2 kHz, a maximum of three harmonics were also observed. Bambini *et al.* (2011: 84) reported the frequency of maximum amplitude (FMA) to be 95.8 ± 0.1 kHz (n = 21).

Ramasindrazana *et al.* (2013: 434) reported the following data for 11 ♂♂: Resting frequency: 82.3 ± 1.43 (79.6 - 84.0) kHz, F_{max}: 83.6 ± 1.26 (81.4 - 85.2) kHz, F_{min}: 79.5 ± 3.21 (72.2 - 82.3) kHz, duration: 7.5 ± 0.97 (5.5 - 9.4) msec, interpulse interval: 38.3 ± 30.15 (9.8 - 107.4) msec, and for 20 ♀♀: Resting frequency: 93.5 ± 1.47 (90.0 - 96.8) kHz, F_{max}: 94.7 ± 1.49 (91.8 - 98.3) kHz, F_{min}: 91.3 ± 2.00 (87.6 - 95.4) kHz; duration: 7.8 ± 1.54 (5.1 - 10.6) msec, interpulse interval: 35.6 ± 24.75 (14.9 - 127.4) msec.

MOLECULAR BIOLOGY:
DNA - Russell *et al.* (2007).
Karyotype - Unknown
Protein / allozyme - Unknown

HABITAT:
There are no significant threats to this species even though it is occasionally hunted for food (Goodman, 2006) and is often associated with forests that are subject to ongoing degradation (Russell *et al.*, 2007).

Dammhahn and Goodman (2013: 108) mention that this species' foraging habitat is the lower portion of forest. Ravelomanantsoa *et al.* (2019: 111) captured this bat near a marshy area near Ambereny.

ROOST:
Wilkinson *et al.* (2012: 160) indicate that caves are the typical roosts for this species on Madagascar.

DIET:
On Madagascar Rakotoarivelo *et al.* (2007) found *T. menamena* (reported as *T. rufus*) mainly consumed Lepidoptera. Bambini *et al.* (2011: 87) reported that *T. menamena* showed a high preference for Hemiptera, and less for Lepidoptera.

The numbers reported by Ramasindrazana *et al.* (2012: 120-121) from the Tsimanampetsotsa NP confirmed that Lepidoptera formed the major food source of this bat with 67.2 ± 4.5 volume percentage. The Coleoptera formed the second food source with 26.9 ± 4.1. The other insect orders contributed only small amounts: Hymenoptera (3.3 ± 1.0), Psocoptera (0.9 ± 0.2), Neuroptera (0.6 ± 0.2), Diptera (0.4 ± 0.2), Homoptera/Hemiptera (0.4 ± 1.9), Blattaria (0.1 ±

0.0); and Aranea (0.1 ± 0.0). During the dry season, however, Coleoptera contributed the most to the bats diet: 69.0 ± 5.1, whereas Lepidoptera counted for 18.7 ± 4.1 volume percentage. During the wet seaon, the Lepidoptera dominated the diet with 90.5 ± 2.1 volume percent versus 6.7 ± 2.0 for the Coleoptera.

Rakotondramanana *et al.* (2015: 77) present the following volume percentages of prey types from the faeces of 16 bats: Coleoptera: 11.6 ± 19.46; Hymenoptera: 11.7 ± 24.20; Lepidoptera: 64.1 ± 32.64; Trichoptera: 0.6 ± 2.25; Isoptera: 11.5 ± 26.32; Homoptera: 0.5 ± 1.55; Arachnida: 0.06 ± 0.25. In frequency percentages, the values are: Coleoptera: 35.0 ± 43.51; Hymenoptera: 42.5 ± 40.58; Lepidoptera: 88.8 ± 30.96; Trichoptera: 3.8 ± 15.00; Isoptera: 17.5 ± 37.86; Homoptera: 3.75 ± 10.88; Arachnida: 1.2 ± 5.00.

POPULATION:
Structure and Density - The species is thought to be locally common in many parts of western Madagascar. A single roost in deciduous forest near the Onilahy River in southern Madagascar contained over 40,000 individuals (Olsson *et al.*, 2006).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008p; IUCN, 2009).

PARASITES:
Lagadec *et al.* (2012: 1696) reported that 8 out of 10 bats they examined, tested positive for *Leptospira* sp. bacteria, and Gomard *et al.* (2016: 5) found 27 out of 42 bats (64.3 %) to be positive for this bacterium. Dietrich *et al.* (2018a: 3) identified these further as *L. interrogans, L.* sp. and a third form having sequences closely related to *L. borgpetersenii*.

VIRUSES:
Astroviridae
Eight out of 13 specimens tested by Lebarbenchon *et al.* (2017: Suppl.) were positive for Astroviridae.

Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 10 individuals from the Madagascar using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 2 positive results for viral nucleic acids. Wilkinson *et al.* (2014) tested 30 individuals from Madagascar with a Respiro-, Morbilli- and Henipavirus specific RT-PCR assay, 19 samples tested positive for paramyxovirus RNA.

In their extensive study, Mélade *et al.* (2016b: 3) found this species to be the most infected by paramyxoviruses of all Madagascan bats (21 out of 42 specimens = 50 %).

Rhabdoviridae
Two out of 11 bats tested by Mélade *et al.* (2016a: 6) showed a seroreaction against *Lagos bat lyssavirus*.

UTILISATION:
Goodman (2006) describes the hunting method used by local inhabitants. See also Jenkins *et al.* (2007b), Goodman *et al.* (2008d) and Jenkins and Racey (2008), who refer to *T. rufus*.

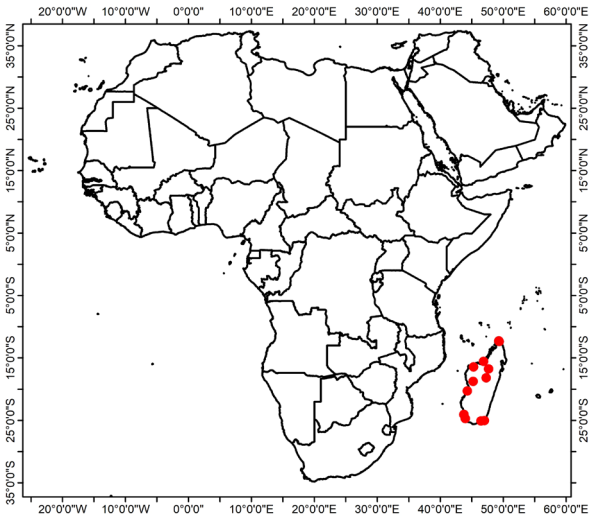


Figure 121. Distribution of *Triaenops menamena*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Superfamily RHINOPOMATOIDEA Dobson, 1872

*1872. *Rhinopomatoidea* Dobson. - Comments: The name of the Superfamily is based on Rhinopomatidae Dobson, 1872. (Current Combination)

TAXONOMY:
Based on morphological data, the family Rhinopomatidae was placed in the superfamily Rhinopomatoidea by Simmons (1998) and Simmons and Geisler (1998), but more recent molecular studies have contradicted many groupings based on morphological data and, pending resolution of the controversies, for this reason Simmons (2005) did not recognize any chiropteran superfamilies.

Family RHINOPOMATIDAE Dobson, 1872

1838. *Rhinopomina* Bonaparte, Syn. Vert. Syst., in Nuovi Ann. Sci. Nat., Bologna, 2: 111 (sep. p. 7). - Comments: .
*1872. *Rhinopomatidae* Dobson, J. Asiatic Soc. Bengal, 41 (3): 221. (Current Combination)
1907. *Rhinopomidae* Miller, Bull. U.S. natl. Mus., 57: 80. Publication date: 29 June 1907. - Comments: Type genus *Rhinopoma* Geoffroy St.-Hilaire, 1818.

TAXONOMY:
This is a monotypic family, with all extant species belonging to the genus *Rhinopoma*.
Koopman (1993a) and Simmons (2005) assigned the name Rhinopomatidae to Bonaparte, 1838 - Syn. Vert. Syst. In Nuovi Ann. Sci. Nat., Bologna, 2: 111; but see Corbet and Hill (1992: 81) and Van Cakenberghe and De Vree (1994). Miller (1907) proposed the name Rhinopomidae and this was adopted by several authors: however, the original name is most commonly used (Aulagnier, 2013d:409).
The family was reviewed by Hill (1977a) and more recently by Van Cakenberghe and De Vree (1994) and Hulva *et al.* (2007b).

Known genera of the family Rhinopomatidae: †***Qarunycteris*** Gunnell, Simmons and Seiffet, 2008; ***Rhinopoma*** E. Geoffroy, 1818.

COMMON NAMES:
Czech: víkonosovití. Dutch: Langstaartvleermuizen, Muisstaartvleermuizen. English: Mouse-tailed bats. French: Rhinopomes, Chauves-souris à queue de souris, Rhinopomatidés. German: Mausschwanzfledermäuse, Mausschwanz-Fledermäuse. Italian: Rinopormàtidi, Pipistrèlli a códa di tòpo. Norwegian: Langhalete flaggermus, klaffneser.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The oldest remains of extant rhinopomatids were collected from Egyptian tombs, which have been inhabited by these bats for ca. 3000 years (Aulagnier, 2013d: 410).

The family-level stem and crown ages were calculated by Shi and Rabosky (2015: 1537) to be respectively 51.9 and 26.9 mya.

GENERAL DISTRIBUTION:
The family is distributed from Africa (north of the Equator) to southern Asia through Arabia, the Middle East and India, mainly in semi-arid and arid habitats (Aulagnier, 2013d: 409).

The three species of rhinopomatids occuring in Africa occur in the tropics; two also extend northwards into temperate habitats. In Africa, one species is found in semi-desert vegetation zones, and the remaining two are found in both desert and semi-desert vegetation zones. Two species have also been found in montane habitats (but not above ca. 1200 m) (Aulagnier, 2013d:409-410).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
These bats of primitive structure are characterized by a tail that is exceptionally long and has at least half of its length projecting beyond the narrow interfemoral membrane, slit-like valvular nostrils that can be closed, and a small triangular nose leaf surmounting a hog-shaped muzzle (that gave the name to the genus) (Aulagnier, 2013d:409).
Rhinopomatids are small to medium-sized with moderately long pelage that is generally more or less sepia grey (but varying in colour and tone across the geographic range), and usually paler ventrally. The face, rump and posterior portion of the abdomen are naked and medium brown. A thickened narial pad is present on the end of the muzzle, surmounted by a distinct ridge-like dermal outgrowth (a rudimentary noseleaf). The ears are more or less triangular and joined across the forehead by a connecting band of skin; each ear has a simple but moderately long and erect tragus. Eyes are relatively large (Aulagnier, 2013d:409).
Wings rather narrow; second finger with two bony phalanges (like all other African families); all of the fingers are shorter, relative to the length of the forearm, than in any other bats. The tip of the wing can be shortened by folding to facilitate cursorial locomotion, but not to the same extent as in the Emballonuridae and Molossidae. This is achieved by the terminal phalanx of the third finger bending round, but not fully, upon the ventral surface of the wing (Rosevear, 1965). The hindlimbs are moderately long; the toes (except the hallux) have three phalanges. The tail has sensitive hairs at its distal end (Aulagnier, 2013d: 409).

DENTAL FORMULA:
$^{1113}/_{2123}$ = 28.
The upper incisor (I^2) is very small, barely emerging from the gum. The canines are conical and simple. The first and second upper molars are lacking distinct hypocones.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
The skull is relatively short and broad; there are no postorbital processes. Separate nasal swellings

are present on each side of the rostrum. The sagittal crest is low and sharp. The auditory bullae are rather large. The premaxillae are separate from each other and from the adjacent part of the skull.

DETAILED MORPHOLOGY:
Rhinopomatids can accumulate fat in the lower abdominal region; this is metabolized when food is scarce (Aulagnier, 2013d: 410). Their water metabolism reflects extreme adaptations to desert habitats; the concentration of urea in the blood is high, and the skin is poorly vascularized so that loss of water through evaporation is minimal, even at high temperatures (Aulagnier, 2013d: 410).

FUNCTIONAL MORPHOLOGY:
Their wings are adapted for fast flight in open areas, gliding or rapid wing-flapping, but are poor fliers and tire quickly (Aulagnier, 2013d: 410).

SEXUAL DIMORPHISM:
Sexes similar in colour, and males are often slightly larger than females (Aulagnier, 2013d: 409).

ECHOLOCATION:
When echolocating, ultrasound pulses are emitted through the mouth; the echolocation calls are loud with little modulation of frequency when the bats are foraging, and become more frequency-modulated when the bats are approaching prey or when they are emerging from their day-roosts in groups (Schmidt and Joermann, 1986, Aulagnier, 2013d:410).

ROOST:
Rhinopomatids roost in dry caves, crevices, various underground structures and buildings including tombs and pyramids; their day- roosts are impregnated with a characteristic smell (Aulagnier, 2013d: 409).
They sometimes share day-roosts with other species of bats, including other species of rhinopomatids, but the different species do not roost in exactly the same places (Aulagnier, 2013d: 409). Rhinopomatids sometimes roost in clusters numbering up to many thousands of individuals, but most of the groups are smaller (10 - 100 bats) (Aulagnier, 2013d: 410).

MIGRATION:
Some populations are suspected to migrate (Aulagnier, 2013d: 410).

ACTIVITY AND BEHAVIOUR:
The sexes segregate for at least part of the year (Aulagnier, 2013d: 410).
These bats do not hibernate, but they can remain torpid for several days (Aulagnier, 2013d: 410).

MATING:
Little is known of their breeding habits in Africa (Aulagnier, 2013d: 410).

†Genus ***Qarunycteris*** Gunnell, Simons and Seiffert, 2008

*2008. *Qarunycteris* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 6. - Comments: Type species - *Qarunycteris moerisae*. - Etymology: Combination of *Qarun* for Birket Qarun, a large lake near BQ-2 Quarry with *Nykteris*, Greek for bat (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

Known species of the genus *Qarunycteris*: †***moerisae*** Gunnell, Simons and Seiffert, 2008.

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

†***Qarunycteris moerisae*** Gunnell, Simons and Seiffert, 2008

*2008. *Qarunycteris moerisae* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 3, 6, fig. 4F. Type locality: Egypt: Fayum Depression: Quarry BQ-2: Umm Rigl Member of the Birket Qarun Formation. Holotype: CGM 83671:. M2. - Etymology: For Lake Moeris, the ancient name of Birket Qarun (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Timeframe:
Earliest late Eocene, Priabonia.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

Genus ***Rhinopoma*** E. Geoffroy St.-Hilaire, 1818

*1818. *Rhinopoma* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 113. Publication date: 1818. - Comments: Type: *Vespertilio microphyllus* Brünnich, 1782. - Etymology: From the Greek "*ρις*" (rhís) or "*ρινός*" (rhinós), meaning "nose or snout", and "*πώμα*" (pomatòs), meaning "lid, cover", referring to the valvular nostrils, which open through a narrow, transverse slit (see Palmer, 1904: 607; Lanza *et al.*, 2015: 180). (Current Combination)
1821. *Rhynopoma* Bowdich, Anal. Nat. Class. Mamm, : 30. - Comments: Type: Vespertilio microphyllus Brünnich, 1782.
1854. *Rhinopomus:* Gervais, Histoire Naturelle des Mammifères, 202. - Comments: Lapsus (Allen, 1939a: 64). (Lapsus)
2017. *Rhinopona:* Loumassine, Allegrini, Bounaceur, Peyre and Aulagnier, Mammalia, xx (x): xxx. Publication date: 23 February 2017. (Lapsus)

TAXONOMY:
Revised by Hill (1977a) and Van Cakenberghe and De Vree (1994).
Allen (1939a: 64) assigned *Rhinopoma* to Oken, 1816, Lehrbuch d. Naturgesch., pt. 3, zool., Sect. 2, p. 926, but this name was rendered "Not Available" by Opinion 417 (International Commission on Zoological Nomenclature, 1956).

A key of the genus is given in Van Cakenberghe and De Vree (1994: 21).

Known species of the genus *Rhinopoma*: ***cystops*** Thomas, 1903; *hardwickii* Gray, 1831; ***macinnesi*** Hayman, 1937; ***microphyllum*** (Bünnich, 1782); *muscatellum* Thomas, 1903 – United Arab Emirates, Oman, Yeman, southwestern Iran, southern Afghanistan, western Pakistan, southwestern India (Simmons, 2005: 381).

Ethiopian records of *Rhinopoma muscatellum* Thomas, 1903, mentioned by Koopman (1993a) represent *Rhinopoma macinnesi* Hayman, 1937 (see Van Cakenberghe and De Vree, 1994: 20), therefore *R. muscatellum* is no longer included in the list of African species.

COMMON NAMES:
Czech: víkonosi, nosalecové, klaponosové. English: Mouse-tailed bats. French: Rhinopomes. German: Mausschwanz-Fledermäuse. Italian: Rhinopòma.

PARASITES:
Streblidae: *Brachytarsina alluaudi* (Falcoz, 1923) (Haeselbarth *et al.*, 1966: 101).

Rhinopoma cystops Thomas, 1903

1816. *Rhinopoma brevicaudatum* Oken, Lehrbuch Naturgeschichte, Jena, 3 (2): 926. Type locality: Egypt: "Egypt". - Comments: Not available, ICZN Opinion 417, 1956 (Van Cakenberghe and De Vree, 1994: 14).
1866. *Rhinopoma longicaudatum* Fitzinger, in: Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 547. Type locality: Sudan: Sennaar [15 35 N 33 38 E, 425 m]. - Comments: Nomen nudum: Kock (1969a: 35), Van Cakenberghe and De Vree (1994: 14).
1866. *Rhinopoma sennaariense* Fitzinger, in: Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 547. Type locality: Sudan: Anglo-Egyptian Sudan, near Roseires: Sennaar and Fazoglo [=Fazughli] [ca. 11 20 N 34 45 E]. - Comments: Type locality restricted to Fazughli by Kock (1969a: 35). Nomen nudum: see Harrison and Bates

(1991: 29), Van Cakenberghe and De Vree (1994: 14). Validated by Kock (1969a) according to Qumsiyeh and Jones (1986: 1).

1868. *Rhinopoma sennarense* Hartmann, Z. Gesel. f. Erdk., 3 (28/29): 44. - Comments: Nomen nudum: Van Cakenberghe and De Vree (1994: 14).

1877. *Rhinopoma senaarense, potius senarense:* Heuglin, Reise in Nordost Afrika, 2: 24. Publication date: 1877. - Comments: Emendation of *sennariense* Fitzinger 1866 (see Kock, 1969a: 35); Lapsus: Van Cakenberghe and De Vree (1994: 14). (Lapsus, Emendation)

*1903. *Rhinopoma cystops* Thomas, Ann. Mag. nat. Hist., ser. 7, 11 (65): 496. Publication date: 1 May 1903. Type locality: Egypt: Qena province: Luxor [25 41 N 32 39 E] [Goto Description]. Holotype: BMNH 1902.1.17.2: ad ♀, skull and alcoholic. Collected by: Nathanial Charles Rothschild. Presented/Donated by: Nathanial Charles Rothschild. See Thomas (1903b: 497); Kock (1969a: 35); Qumsiyeh (1985: 20). Paratype: BMNH 1902.1.17.1: ad ♂. Collected by: Nathanial Charles Rothschild. Presented/Donated by: ?: Collector Unknown. - Etymology: From the Greek substantive "*κύστις*" (kystis) meaning "bladder" and "*ὄφις*" (ópsis) meaning "eye-ball", referring to the large eyes (see Lanza *et al.*, 2015: 182, Lanza *et al.*, 2015: 182). (Current Combination)

1917. *Rhinopoma longicaudum:* Geyr von Scheppenburg, J. Ornithol., 65 (3): 283. Publication date: July 1917. (Lapsus)

1954. *Vespertilio brevicauda* Stresemann, Abh. d. Akad. Wiss., Berlin, 1: 172. Type locality: Egypt: Giza province: Saqqara [29 51 N 31 13 E]. Holotype: ZMB 46211: ♂, skull and alcoholic. Collected by: Friedrich Wilhelm Hemprich and Christian Gottfried Ehrenberg; collection date: April 1821; original number: A.1.6.69. Formerly ZMB 564.3 "Sendung Nr 69-71"; see Kock (1969a: 35); Turni and Kock (2008). Holotype: ZMB 564.c: ♂. Collected by: Friedrich Wilhelm Hemprich and Christian Gottfried Ehrenberg; collection date: April 1821. Presented/Donated by: ?: Collector Unknown. - Comments: Label name from Hemprich, without nomenclatural status, see Kock (1969a: 35), Van Cakenberghe and De Vree (1994: 14).

1954. *Vespertilio ferox* Stresemann, Abh. d. Akad. Wiss., Berlin, 1: 172. Type locality: Egypt: Giza province: Saqqara [29 51 N 31 13 E]. Holotype: ZMB 46210: ♂, skull and alcoholic. Collected by: Friedrich Wilhelm Hemprich and Christian Gottfried Ehrenberg; collection date: April 1821; original number: A.1.6.68. Formerly ZMB 564.2 "Sendung nr 67-68"; see Kock (1969a: 35), Turni and Kock (2008). Holotype: ZMB 564.b: ♂. Collected by: Friedrich Wilhelm Hemprich and Christian Gottfried Ehrenberg; collection date: April 1821. Presented/Donated by: ?: Collector Unknown. - Comments: Label name from Hemprich, without nomenclatural status, see Kock (1969a: 35), Van Cakenberghe and De Vree (1994: 14).

1956. *Rhinopoma hardwichei cystops:* Möhres and Kulzer, Verh. D. zool. Ges., 19: 60. - Comments: Lapsus (see Van Cakenberghe and De Vree, 1994: 15). (Lapsus)

1961. *Rhinopoma lardwickei cystops:* Madkour, Bull. Zool. Soc. Egypt, 16: 50. - Comments: Lapsus (see Kock, 1969a: 35; Van Cakenberghe and De Vree, 1994: 15). (Lapsus)

1969. *Rhinopoma hardwickei sennaariense* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 40, 51. Type locality: Sudan: Blue Nile province: Fazogli [=Fazughli] [11 20 N 34 45 E] [Goto Description]. - Comments: Validation of *sennaariense* Fitzinger, 1866, *nomen nudum*. Hill (1977a) pointed out that *sennaariense* Kock, 1969 is a synonym of *arabium* (see Harrison and Bates, 1991: 30).

1971. *Rhinopoma hardwickei sennaarinese:* Hill and Morris, Bull. Br. Mus. (nat. Hist.) Zool., 21 (2): 30. - Comments: Lapsus (see Van Cakenberghe and De Vree, 1994: 15). (Lapsus)

1975. *Rhinopoma senaariense:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 367. - Comments: Lapsus (see Van Cakenberghe and De Vree, 1994: 15). (Lapsus)

1985. *R[hinopoma] h[ardwickei] sinaariense:* Qumsiyeh, Spec. Publ. Mus. Texas Tech. Univ., 23: 22. - Comments: Lapsus: attributed to Kock (1969a) by Qumsiyeh (1985: 22). (Lapsus)

2015. *Rhinopoma cytops:* Kangoyé, Ouéda, Granjon, Thiombiano, Guenda, and Fahr, Biod. J., 6 (2): 613. Publication date: 30 June 2015. (Lapsus)

2015. *Rhinopoma hardweickei:* Mohammed, Endocrinol. Metab. Synd., 4: 1. Publication date: 5 January 2015. - Comments: *Rhinopoma hardweickei* for *R. harwickei* [= *R. cystops*]. (Lapsus)

? *Rhinopoma hardwickei arabium:* (Alternate Spelling)

? *Rhinopoma hardwickei cystops:* (Name Combination)

? *Rhinopoma hardwickei hardwickei:* - Comments: Only for the African specimens.

? *Rhinopoma hardwickei:*, . - Comments: Emendation of *hardwickii*, since the species was named after Maj. Gen. Hardwicke, but according to Hill (pers. comm.) this was unjustified since Gray latinized the name. Only for the African specimens. (Emendation)
? *Rhinopoma hardwickii arabium:* (Lapsus)
? *Rhinopoma hardwickii cystops:* (Name Combination)
? *Rhinopoma Hardwickii:*, . - Comments: Not of Gray (1831), which is restricted to Asia (see Hulva *et al.*, 2007b), but when used for the African specimens.

TAXONOMY:
See Schlitter and Qumsiyeh (1996, Mammalian Species, 263), Van Cakenberghe and De Vree (1994: 20) as *Rhinopoma hardwickii*.

Hulva *et al.* (2007b) restrict *R. hardwickii* to Asia (Iran to Indonesia) and reinstate *cystops* as the species name for the African and Western Asian representatives.

Ahmim and Tahri (2017: 71) indicate that in Algeria, Niger, and Egypt, two forms of "*R. Hardwickii*" differing in size are known, which casts doubt on the recent taxonomic discrimination of the genus *Rhinopoma*, implying that besides *R. cystops* another small sized species might need to be recognized in northern Africa.

COMMON NAMES:
Arabian: Khafash abu danab saghir, Khaffash. Czech: víkonos africký. Dutch: Kleine klapneusvleermuis. English: Hardwicke's Mouse-tailed Bat, Lesser Mouse-tailed Bat, Small mouse-tailed bat, Lesser Rat-tailed Bat, Egyptian Mouse-tailed bat. French: Petit Rhinopome, Rhinopoma moyen, Rhinopome de Hardwicke, Chauve-souris à queue de souris. German: Hardwickes Mausschwanz-Fledermaus, Kleine Mausschwanzfledermaus. Hebrew: Yaznuv Katan. Italian: Rhinopòma àfro-ovestasiàtico.

CONSERVATION STATUS:
Global - "*Rhinopoma hardwickii*" is listed as least concern because it is a widespread and common species with no major threats (Benda *et al.*, 2008e; IUCN, 2009). Due to the recent status change of *R. cystops*, most of the African data for this taxon were reported under *R. hardwickii*.

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as part of *Rhinopoma hardwickii*] (Benda *et al.*, 2008e; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessed as part of *Rhinopoma hardwickii*] (Benda, 2004b; IUCN, 2004). 1996 - VU [assessed as *R. hadithaensis*] (Baillie and Groombridge, 1996); LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
Human disturbance in roost sites and pesticide use against locusts are the main threats. In arid areas of Iran which can not support high numbers of colonies, they aggregate in a few large groups which increases their vulnerability (M. Sharifi *pers. comm.,* 2005). These are not thought to be major threats to the species as a whole at present (Benda *et al.*, 2008e; IUCN, 2009).

Aerial hawking and water stress are considered to be the major risk factors related to climatic change (Sherwin *et al.*, 2012: 174 as *Rhinopoma hardwickei*).

CONSERVATION ACTIONS:
Benda *et al.* (2008e) [in IUCN (2009)] reported that no specific measures are known or are in place, but presumably occurs in protected areas across the range. A study on the impacts of pesticides is required, especially ways in which the impact might be minimised.

GENERAL DISTRIBUTION:
Rhinopoma cystops occurs across central and northern Africa; from Morocco to Israel, Palestine, Jordan Iraq and Afghanistan and south to Kenya. Occurs up 1,100 m asl in Morocco and Algeria.

The Kenyan material mentioned by Koopman (1993a) belongs to *R. macinnesi*, see Van Cakenberghe and De Vree (1994: 17 - 18).

Native: Afghanistan; Algeria (Horácek *et al.*, 2000: 97); Burkina Faso (Kangoyé *et al.*, 2015a: 613); Cameroon; Chad; Djibouti (Pearch *et al.*, 2001: 392); Egypt (Sinai; first record; see Benda *et al.*, 2008e: 1; Carpenter *et al.*, 2014: 180); Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 147); India; Iran, Islamic Republic of; Iraq; Israel; Jordan; Kenya (but see note above); Kuwait; Libyan Arab Jamahiriya; Mali; Mauritania (Brito *et al.*, 2010: 452, as *R. hardwickei*, Allegrini *et al.*, 2011: 3); Morocco (Benda *et al.*, 2004d; Benda *et al.*, 2010a: 154; El Ibrahimi and Rguibi Idrissi, 2015: 358, as *R. hardwickei*); Niger; Nigeria; Oman; Saudi Arabia; Somalia; Sudan; Syrian Arab Republic; Tunisia (Horácek *et al.*, 2000: 97; Dalhoumi *et al.*, 2016b: 866); Western Sahara; Yemen (Socotra).

DETAILED MORPHOLOGY:
Mohammed (2015) extensively discuss the pituitary gland of Egyptian "*R. hardwickei*".

SEXUAL DIMORPHISM:
Kangoyé *et al.* (2015a: 613) indicate that most of the average body measurements are larger in females than in males, but that the average cranial measurements are larger in males.

ECHOLOCATION:
Frequency of CF-component (second harmonic) during pursuit of insect (Egypt): 36 - 40 kHz; call-duration 6 - 10 ms; call-repetition rate ca. 10 call/s. Darting flight is accompanied by shortening the signals to 1 ms or less and increasing the call-repetition rate to ca. 100 calls/s; laboratory tests indicated that Doppler shift compensation is probably not used by this species (Simmons *et al.*, 1984). When three individuals flew together in the laboratory, each used a different CF-frequency suggesting that they regulate the CF-frequency to avoid jamming each other (Habersetzer, 1981). After landing, CF calls of mean duration 74 ms are emitted and these have maximum energy in fundamental harmonic; the purpose of these calls (echolocation and/or communication) is not known (ibid.). The first harmonic frequencies (18 - 20 kHz; Simmons *et al.*, 1984) of calls made in a roost in Morocco were audible to humans (Aulagnier and Destre, 1985).

In Jordan, Benda *et al.* (2010b: 204) reported the following parameters for 59 calls: Start frequency: 36.4 ± 1.5 (33.2 - 39.6) kHz, End frequency: 32.5 ± 1.4 (29.5 - 35.8) kHz, Peak frequency: 34.3 ± 1.2 (32.0 - 37.1) kHz, Call duration: 8.0 ± 1.6 (4.5 - 12.0) msec, Inter-pulse interval: 116.0 - 29.9 (60.0 - 210.0) msec.

From Tunisia, Dalhoumi *et al.* (2016b: 866) reported an almost constant frequency with three or four harmonics and maximum energy in the second harmonic (at 32 kHz).

Moores and Brown (2017: 612) recorded the following parameters in southern Morocco: F_{start}: 34.6 ± 0.5 (33.6 - 35.6) kHz, F_{max}: 33.6 ± 0.4 (32.8 - 34.4) kHz, F_{end}: 33.0 ± 0.5 (32.5 - 34.1) kHz, duration: 9.4 ± 0.8 (8.6 - 11.1) msec, interpulse interval: 260 ± 122 (69 - 520) msec.

MOLECULAR BIOLOGY:
DNA - Giannini and Simmons (2005); Ali (2011).
Karyotype - Ray-Chaudhuri *et al.* (1968) and Rushton (1970: 463) reported 2*n* = 36, FN = 68, BA = 34, a submetacentric X chromosome and an acrocentric Y chromosome for specimens from India, this data now relates to *Rhinopoma hardwickii*. Qumsiyeh and Baker (1985) reported an identical karyotype for specimens from Palestine, which are now referred to *Rhinopoma cystops* see Hulva *et al.* (2007a). Sayed (2011: 659) also reported 2*n* = 36 and FN = 68 for *R. hardwickei* specimens from Egypt, with a medium-sized submetacentric X chromosome and an acrocentric Y chromosome. Pairs 13 and 15 show a broad G-negative region around their centromere, and complete heterochromatin in the short and long arm. Pair 5 also shows a broad G-negative region around its centromere, and the Y chromosome has complete heterochromatin.

Protein / allozyme - Unknown.

Mansour *et al.* (2016: 66) examined the occurrence of heavy metals in bats from two caves in the Saqqara region of Egypt and found that cobalt was not detected in any sample analyzed. Cd, Mo, Ni and Pb were found in low concentrations (generally less than 1.0 µg/g tissue). In the livers, moderate concentrations of Ba, Cr, Cu and Mn and very high concentrations of Ca, Fe and Mg were recorded. Liver tissue from males contained much higher levels of Al and Ba than those from females.

ROOST:
In Israel, Levin *et al.* (2015: 1, 3) found that *R. cystops* hibernates during five months in winter in caves that were geothermally heated to a stable temperature of 20 °C, with almost 100 % relative humidity. They also found that the bat's skin temperature was 1 - 3 °C above the average cave temperature, and that during the same period, the outside temperatures fluctuated between 4 and 22 °C. During the hibernation, no period arousal or periods of normothermy were observed.

Benda *et al.* (2014c: 10) observed a colony of about 40 specimens in two ground floor rooms of a ruin of an Italian fortress in the Al Jaghbub oasis (Libya).

DIET:
Benda *et al.* (2014c: 14) examined 40 faecal pellets of *R. cystops* from the Al Jaghbub oasis (Libya). The diet consisted primarily of ants (Hymenoptera: Formicoidea; 81 % of volume) and furthermore of beetles (Coleoptera, mostly of the family Tenebrionidae).

POPULATION:
Structure and Density - Appears to be particularly abundant near oases. However, both distribution and abundance are undoubtedly insufficiently investigated because the roosts and suitable habitats are often unreachable. Colonies range in size from a few individuals up to several hundred. Up to 500 individuals have been reported in colonies in Jordan (Amr, 2000). Loumassine *et al.* (2017c:28) reported on a colony of about 100 animals in an old mine in Algeria.

Occurs with other species in the genus, in Iran it is normally found in low numbers and low densities and it feeds on coleoptera (M. Sharifi pers. comm., 2005). Assumed stable throughout the southwest Asia region (D. Kock *pers. comm.,* 2005). Population information remains unknown for its African distribution (Benda *et al.*, 2008e; IUCN, 2009).

Trend - 2008 - Stable (Benda *et al.*, 2008e; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Gharaibeh (1997: 47) reported two pregnant females captured in Tunisia on 26 May 1996.

MATING:
Khajuria (1972: 307) report on the mating behaviour of the closely related Indian *R. h. hardwickei*, but whether this is also applicable for *R. cystops* is uncertain.

PARASITES:
TREMATODA
Morsy *et al.* (2018: 319) reported the presence of *Urotrema scabridum* (Braun, 1900) and *Renschetrema indicum* Kifune, 1984 in "*R. hardwickii*" specimens collected in Cairo.

ACARI
Argasidae: *Argas vespertilionis* was reported from Libyan bats by Benda *et al.* (2014c: 15), and two larvae of *Argas confusus* (Argasidae) on *R. cystops* specimens in Jordan (Benda *et al.*, 2010b: 212).

Trombiculidae: *Grandjeana mauritanica* Kalúz and Ševcík, 2014 on *R. cystops* specimens from Mauritania (Kalúz and Ševcík, 2014: 31; Stekolnikov, 2018a: 136).

Bendjeddou *et al.* (2017: 15) reported the following ectoparasites from Algeria: *Nycteribia (Listropoda) schmidlii schmidlii* Schiner, 1853 (Nycteribiidae) and *Argas vespertilionis* (Latreille, 1802) (Arachnida).

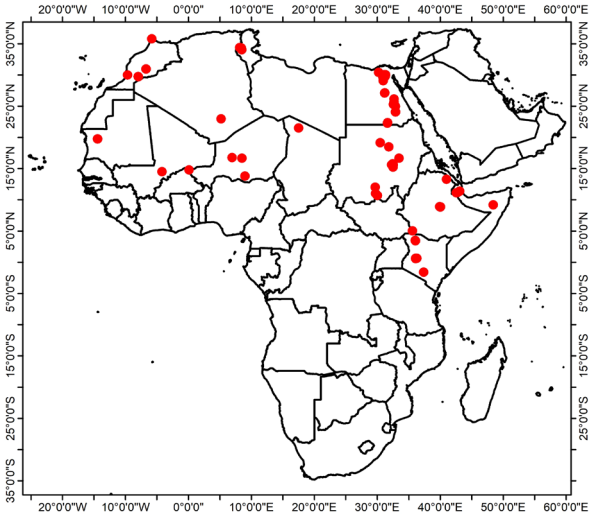


Figure 122. Distribution of *Rhinopoma cystops*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Burkina Faso, Chad, Djibouti, Egypt, Ethiopia, Israel, Kenya, Libya, Mali, Mauritania, Morocco, Niger, Senegal, Somalia, South Sudan, Sudan, Tunisia.

Rhinopoma macinnesi Hayman, 1937

*1937. *R[hinopoma] cystops macinnesi* Hayman, in: St. Leger, Ann. Mag. nat. Hist., ser. 10, 19 (113): 530. Publication date: 1 May 1937. Type locality: Kenya: Lake Rudolf, near Central Island: Bat Island [03 27 N 36 04 E, 700 m] [Goto Description]. Holotype: BMNH 1936.11.4.45: ad ♂, skull and alcoholic. Collected by: D.G. MacInnes; collection date: 24 April 1934. - Etymology: In honour of Mr. Donald Gordon MacInnes, eminent English palaeontologist, who worked in eastern Africa and collected of the type specimen (see Lanza *et al.*, 2015: 189).
? *Rhinopoma macinnesi:* (Name Combination, Current Combination)

TAXONOMY:
Considered a synonym of *hardwickei* by Koopman (1993a), but see Van Cakenberghe and De Vree (1994: 20).

COMMON NAMES:
Chinese: 麦氏鼠尾蝠. Czech: víkonos východoafrický. English: MacInnes's Mouse-tailed Bat. French: Rhinopome de MacInnes. German: MacInnes' Mausschwanz-Fledermaus. Italian: Rinopòma di MacÌnnes.

CONSERVATION STATUS:
Global - *Rhinopoma macinnesi* is listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Aulagnier, 2008; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Aulagnier, 2008; IUCN, 2009). 2004 - VU D1 ver 3.1 (2001) (Aulagnier,

2004a; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
Rhinopoma macinnesi may be threatened by habitat loss, although this requires confirmation (Aulagnier, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Aulagnier (2008) [in IUCN (2009)] reported that there appear to be no direct conservation measures in place. It is possible that the species is present in some protected areas. Further research is needed into the distribution, natural history and possible threats to this species.

GENERAL DISTRIBUTION:
Rhinopoma macinnesi is endemic to East Africa, where it has mostly been recorded from Kenya with additional records from the eastern edge of Uganda, Somalia, Ethiopia and possibly Eritrea (Aulagnier, 2008; IUCN, 2009).

Native: Ethiopia; Kenya; Somalia; Uganda
Presence uncertain: Eritrea

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species. It is believed to have a small population as several expeditions to the species range have not collected specimens (Aulagnier, 2008; IUCN, 2009).
Trend - 2008 - Unknown (Aulagnier, 2008; IUCN, 2009).

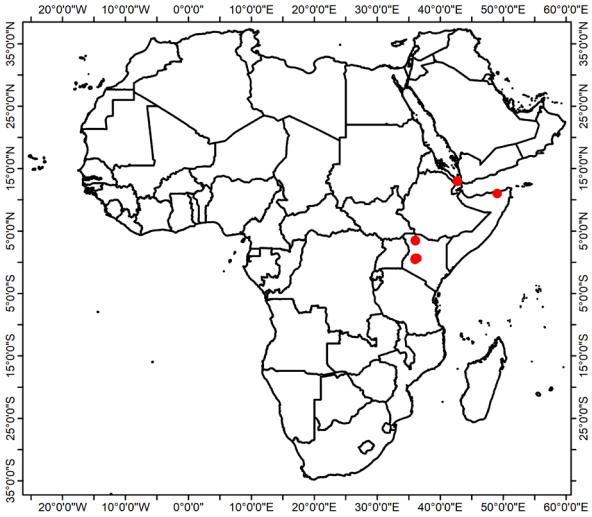


Figure 123. Distribution of *Rhinopoma macinnesi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Eritrea, Kenya, Somalia.

Rhinopoma microphyllum (Brünnich, 1782)

*1782. *Vespertilio Microphyllus* Brünnich, Dyrenes Historie, 1: 50, pl. 6; figs. 1 - 4. Type locality: Egypt: Giza province: Giza [30 01 N 31 13 E]. Holotype: MNHN A.121/T196: ♀, alcoholic (skull not removed). Number 196 in Rode (1941: 242), who calls this the holotype. Holotype: ZMUC. Collected by: Hasselquist. See Kock (1969a). Paratype: MNHN A.123/196B: ad, alcoholic (skull not removed). Number 196b in Rode (1941: 242). Paratype: MNHN A.124/196C: ad ♀, alcoholic (skull not removed). Number 196c in Rode (1941: 242). Paratype: MNHN A.125/196D: ad ♂, alcoholic (skull not removed). Number 196d in Rode (1941: 242). Allotype: MNHN A.122/196A: ♂, alcoholic (skull not removed). Number 196a in Rode (1941: 242). - Comments: Corbet and Hill (1992: 82) and Horácek *et al.* (2000: 96) mention "Arabia and Egypt" as type locality. Type locality fixed by Koopman (1975: 366) but also Aellen (1957), Anderson and de Winton (1902), Kock (1969a) - See Schlitter and Qumsiyeh (1996: 1). - Etymology: From the Greek "*μικρός*" (mikrós), meaning "small" and "*φύλλον*" (phýllon), meaning "leaf" (see Schlitter and Qumsiyeh, 1996: 4; Lanza *et al.*, 2015: 193).

1820. *Rhinopoma microphylla:* Desmarest, Encyclopédie Méthodique, (Zoologie, Mammalogie), 1: 129. Publication date: 1820. (Current Combination, Alternate Spelling)

1859. *Rhinopoma Lepsianum* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 222. Publication date: 1859. Type locality: Sudan: Khartoum [15 40 N 32 35 E] [Goto Description]. Lectotype: ZMB 2578: ad ♂, skull and alcoholic. Collected by: Lepsius; collection date: 1844?. Lectotype designated by Kock (1969a: 54, 57); skull extracted in the 1960's by D. Kock (see Turni and Kock (2008: 22). Paralectotype: ZMB A.3243: ad, skull only. Paralectotype designated by Turni and Kock (2008: 22). - Comments: Type locality mentioned as Blue Nile by Kock (1969a: 58); as White Nile by Koopman (1975: 366), Turni and Kock (2008: 22). See Turni and Kock (2008: 22) for a discussion on the fact that Peters possibly used this skull to describe *lepsianum*).

1877. *Rhinopoma cordofanicum* Heuglin, Reise in Nordost Afrika, 2: 24. Publication date: 1877. Type locality: Sudan: Jebel Arashkool: W bank of the White Nile [ca. 14 15 N 32 10 E]. - Comments: Allen (1939a: 64) mentions Heuglin and Fitzinger, 1866. Sitzb. K. Akad. Wiss.

Wien, 54, sec 1, 547 as author. Nomen Nudum. Included in *hardwickei* by Kock (1969a: 35).

1969. *Rhinopoma microphyllum tropicalis* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 58. Type locality: Sudan: Kordofan province: 2 km NE Kadugli: Jebel Talao [11 02 N 29 43 E, 550 m] [Goto Description]. Holotype: SMF 33265: sad ♂, skin and skeleton and skull. Collection date: 12 February 1963. See Kock (1969a: 58): [number 33216 possibly???]. Paratype: SMF 33198: ♂, skull and alcoholic. Collected by: Dr. Dieter Kock; collection date: 6 January 1965. Presented/Donated by: ?: Collector Unknown. Locality: Jebel Talao. Paratype: SMF 33199: ♂, skull and alcoholic. Collected by: Dr. Dieter Kock; collection date: 6 January 1965. Presented/Donated by: ?: Collector Unknown. Locality: Jebel Talao. Paratype: SMF 33200: ♂, skull and alcoholic. Collected by: Dr. Dieter Kock; collection date: 6 January 1965. Presented/Donated by: ?: Collector Unknown. Locality: Jebel Talao. Paratype: SMF 33214: ♂, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 22 October 1962. Presented/Donated by: ?: Collector Unknown. Locality: Jebel Talao. Paratype: SMF 33215: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 16 February 1963. Presented/Donated by: ?: Collector Unknown. Locality: Jebel Talao. - Comments: Most likely a synonym of *R. m. microphyllum*. If a valid subspecies, *lepsianum* or *cordofanicum* may have priority (see Schlitter and Qumsiyeh, 1996: 1).

1985. *Rhinopoma mircophylum kineari:* Bhatnagar and Parveen, Nat. Acad. Sci. Letters, 8 (2): 64. - Comments: Lapsus for *microphyllum*. (Lapsus)

? *Rhinopoma microphyllum microphyllum:* (Name Combination)

? *Rhinopoma microphyllum:* (Name Combination)

Taxonomy:

See Schlitter and Qumsiyeh (1996, Mammalian Species, 542).

Common Names:

Arabian: Khafash abu danab kabir, Khaffash. Bengali: Indur-lenji Chamchika. Czech: víkonos velký, nosalec malolupenný, klaponos egyptský, víkonos, víkonos egyptský, víkonos asijský. Dutch: Grote klapneusvleermuis. English: Larger Mouse-tailed Bat, Long-tailed Bat, Greater Mouse-tailed Bat, Rat-tailed Bat, Brunnich's Mouse-tailed Bat, Larger Rat-tailed Bat, Greater Rat-tailed Bat. French: Grand Rhinopome, Rhinopome microphylle. German: Ägyptische Mausschwanz-Fledermaus. Hebrew: Atalef Yaznuv Gadol. Indonesian: Kelelawar ekor lembing, Kelelawar Ekor-tikus. Italian: Rinopòma microfìllo.

Conservation status:

Global - *Rhinopoma microphyllum* is listed as Least Concern (LC ver 3.1 (2001)) as it is widespread and common in at least parts of its range, with no known major threats (Aulagnier and Palmeirim, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Aulagnier and Palmeirim, 2008b; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Aulagnier, 2004b; IUCN, 2004). 1996 - LR: lc (Baillie and Groombridge, 1996).

Major threats:

Human disturbance in roost sites and use of pesticides for locusts affect the species but are not considered major threats at present (Aulagnier and Palmeirim, 2008b; IUCN, 2009).

Conservation actions:

Aulagnier and Palmeirim (2008b) [in IUCN (2009)] reported that no specific measures are known for this species, but presumably it occurs in some protected areas. A study on the impacts of pesticides is required, especially ways in which the impact might be minimised.

General distribution:

The distribution range of *Rhinopoma microphyllum* extends from northern Africa through southwest Asia to Afghanistan, Pakistan and India. In southeast Asia, there are single old records from Thailand and Sumatra. Recorded from sea level in Egypt up to 1,200 m in Morocco (Aulagnier and Palmeirim, 2008b; IUCN, 2009).

Native: Afghanistan; Algeria (Loumassine *et al.*, 2017b: 85); Bangladesh; Benin; Burkina Faso (Kangoyé *et al.*, 2015a: 613); Central African Republic; Chad; Côte d'Ivoire; Djibouti (Pearch *et al.*, 2001: 393); Egypt; Eritrea; Ethiopia; Ghana; Guinea; India; Indonesia; Iran, Islamic Republic of; Iraq; Israel; Jordan; Lebanon; Liberia; Mali; Mauritania (Benda *et al.*, 2004a: 105); Morocco (El Ibrahimi and Rguibi Idrissi, 2015: 358); Myanmar (see Corbet and Hill, 1992); Niger; Nigeria; Oman; Pakistan; Saudi Arabia; Senegal; Sierra Leone; Sudan; Sumatra; Syrian Arab Republic; Togo; Western Sahara; Yemen.
Presence uncertain: Libyan Arab Jamahiriya; Thailand; Tunisia.

ECHOLOCATION:
Search-phase call-shape (locality not given): CF (multiharmonic) (Schmidt and Joermann, 1983). Frequency of CF-component (second harmonic): 27 - 31 kHz (but each individual emits only one frequency); call-duration "long". When flying in a flight-tunnel, this species emits shorter and slightly frequency-modulated calls (as does *R. hardwickii*). However, if 3 individuals fly together in the flight-tunnel, instead of avoiding jamming by changing to three different frequencies (see *R. hardwickii*), the main response of these bats is to greatly increase the intensity of their calls (ibid.). Cvikel *et al.* (2014: 2) showed that *R. microphyllum* doesn't show the classical jamming avoidance response: they altered their signals as if they were responding to a nearby (silent) object. They also found that individuals exhibit sufficient frequency spread to allow individual recognition without any jamming avoidance response.

In Jordan, Benda *et al.* (2010b: 204) recorded the following parameters for 9 calls: F_{start}: 29.6 ± 0.3 (28.9 - 30.0) kHz, F_{end}: 25.7 ± 0.6 (25.2 - 26.7) kHz, F_{peak}: 28.0 ± 0.7 (27.0 - 29.0) kHz, Pulse duration: 11.7 ± 0.8 (10.5 - 13.0) msec, and Inter-pulse Interval: 202.3 ± 46.8 (110.0 - 267.0) msec.

Benda *et al.* (2012a: 182) reported the following values from Iran (hand released): F_{start}: 29.8 ± 0.6 (29.0 - 30.4) kHz, F_{end}: 25.3 ± 0.2 (25.0 - 25.5) kHz, F_{peak}: 27.1 ± 0.4 (26.8 - 27.7) kHz, Pulse duration: 7.9 ± 0.3 (7.6 - 8.3) msec, and inter-pulse interval: 114.6 ± 7.9 (106.5 - 127.2) msec.

From Israel the following parameters were reported by Hackett *et al.* (2016: 223): 116 calls: Pulse duration: 8.37 ± 2.51 msec, F_{start}: 30.21 ± 1.95 (28.0 - 31.2) kHz, F_{end}: 28.99 ± 1.72 (27.0 - 30.2) kHz, F_{peak}: 29.42 ± 1.72 (28.0 - 30.2) kHz.

From Algeria, Loumassine *et al.* (2017b: 87) reported on four harmonics, of which the second one had the most energy: F_{start}: 31.9 - 37.9 Khz, F_{max}: 28.2 - 31.2 kHz, F_{end}: 23.1 - 25.2 kHz, and pulse duration: 3.2 - 6.1 msec.

Davies *et al.* (2013b: Table S8) report a peak-frequency of 28 kHz and a range between 27 and 30 kHz.

Boonman *et al.* (2013b: 6) determined the detection range to be between 2 and 6.5 m at 20 dB and 5.5 and 14 m at 0 dB.

MOLECULAR BIOLOGY:
DNA - Hulva *et al.* (2007a).
Karyotype - Handa and Kaur (1979), and Qumsiyeh and Baker (1985) reported $2n$ = 42, FN = 66, BA = 26, a metacentric X and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

ROOST:
From northern Israel, Levin *et al.* (2013: 1) report that *R. microphyllum* forms sexually-segregated colonies composed of 3,000 to 5,000 individuals during the summer (June to September). At the end of August non-reproductive males left their roost and were occasionally observed in the southern female roosts between September and October.

Also in Israel, Levin *et al.* (2015: 1, 3) found that *R. microphyllum* hibernates during five months in winter in caves that were geothermally heated to a stable temperature of 20 °C, with almost 100 % relative humidity. The bat's skin temperature was 1 - 3 °C above the average cave temperature. During the same period, the outside temperatures fluctuated between 4 and 22 °C.

DIET:
In July from Israel, more than 50 % of the bats diet comprised queen carpenter ants (*Camponotus felah* Dalla Torre, 1893), while other insect groups in the faces comprised mainly Coleoptera and Heteroptera (Levin *et al.*, 2012). This suggests that the gradual increase in the proportion of queen carpenter ants in the diet during summer results from an increase in this insect's availability, combined with a high preference for this prey item.

Benda *et al.* (2012a: 196) analyses faeces from two localities in Iran, and found in the pellets from one of the localities only remains from ants (Hymenoptera, Formicoidea), whereas the other sample contained Coleoptera (60 % of volume), Heteroptera (30 %) and small nematoceran Diptera (10 %).

POPULATION:
Structure and Density - According to Aulagnier and Palmeirim, 2008b) [in IUCN (2009)], *Rhinopoma microphyllum* is uncommon in the western part of the Mediterranean range, but populations probably occur in areas not yet surveyed. Colonies of several thousands have been reported in Egypt. Very rare in Jordan, found in the same caves as *R. hardwickei* but in much lower numbers (Amr, 2000). In Iran the species is common, the most populated cave is in the Mesopotamian plain and has around 20,000 individuals; the total population of Iran is approximately 30,000 and is considered stable (M. Sharifi *pers. comm.,* 2005). In Africa there are large colonies of up to 5,000 individuals in several areas (GMA Africa Workshop, 2004).
Trend - 2008 - Stable (Aulagnier and Palmeirim, 2008b; IUCN, 2009). *R. microphyllum* populations

within the Asia Minor and Levant region are predicted to have a stable population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

ACTIVITY AND BEHAVIOUR:
A sharp increase in body mass was observed from mid-July (Levin *et al.*, 2012). Levin *et al.* (2012) also found that the fatty acids composition of *R. micophyllum* body fat reflects the composition of their main prey item-queen carpenter ants. They accumulate significant fat reserves towards the end of summer (Levin *et al.*, 2012). Levin *et al.* (2012) found white adipose tissue accumulates in pre-hibernating *R. micophyllum*.

Cvikel *et al.* (2015: 206) used miniature GPS devices that allowed simultaneous ultrasonic recording and found that one of their tracked bats flew continuously for over 5 hours and that another on flew more than 90 km. All of the bats spent a substantial proportion of their time in high conspecific density. They estimated that bats spent at least 41 ± 14 % of their foraging at less than 150 m from a conspecific and even 8 ± 2 % at less than 12 m from a conspecific

PARASITES:
Hirst (1923: 979) indicates that Kolenati stated that either *R. microphyllum* or *Pteropus ægyptiacus* [=*Rousettus aegyptiacus*] is the host for *Ancystropus zelebori* Kolenati, 1856 (Acari).

In Iran, Benda *et al.* (2012a: 196) found the following parasites to be present: bat flies *Brachytarsina flavipennis* Macquart, 1851 and *B. alluaudi* (Falcoz, 1923) [= *diversa* (Frauenfeld, 1857)]. They also refer to Maa (1965), who reported the presence of streblid bat flies *Ascodipteron namrui* Maa, 1964 and *A. rhinopomatos* Jobling, 1952 from Israel and Egypt, and to Dusbábek (1970), who reported the Macronyssid mites *Macronyssus leucipe* (Domrow, 1959) and *Steatonyssus afer* Radovsky and Yunker, 1963 from Afghanistan (but these came from a mixed collection of *R. microphyllum* and *R. hardwickii*). Furthermore, the presence of the chigger mites *Sasatrombicula rhinopoma* (Vercammen-Grandjean, 1963) and *S. multisternalae* (Vercammen-Grandjean, 1963) was reported from Afghanistan too.

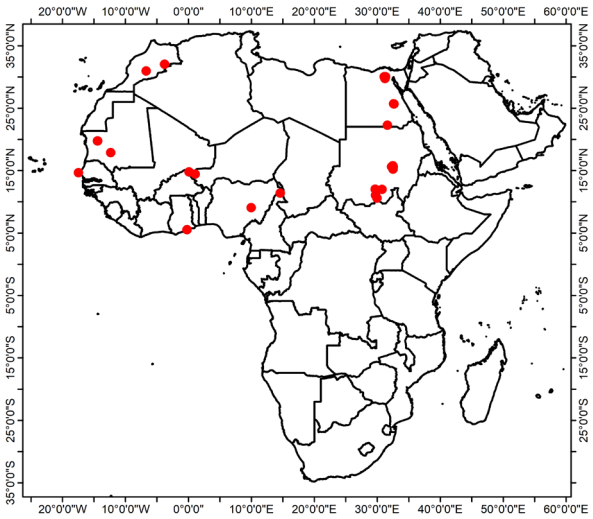


Figure 124. Distribution of *Rhinopoma microphyllum*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Burkina Faso, Cameroon, Egypt, Ghana, Mauritania, Morocco, Niger, Nigeria, Senegal, Sudan.

†Family TANZANYCTERIDIDAE Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003

*2003. *Tanzanycteridida*e Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, Pal. Electr., 5(3): 3. (Current Combination)
2013. *Tanzanycteridae:* Habersetzer, Engels, Gunnell and Simmons, 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013, 64. (Lapsus)

TAXONOMY:
Known genera of the family Tanzanycteridida: †***Tanzanycteris*** Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003.

†Genus ***Tanzanycteris*** Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003

*2003. *Tanzanycteris* Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, Pal. Electr., 5(3): 3. (Current Combination)

TAXONOMY:
Using micro-CT scans, Habersetzer *et al.* (2013: 64) examined the inner ear morphology of *T. mannardi* and found that this was very similar to the highly sophisticated echolocation system found in current days *Hipposideros*. They suggest that *Tanzanycteris* might actually be a Hipposiderid rather than a member of a family by its own.

Known species of the genus *Tanzanycteris*: **†*mannardi*** Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003.

†*Tanzanycteris mannardi* Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, 2003

*2003. *Tanzanycteris mannardi* Gunnell, Jacobs, Herendeen, Head, Kowalski, Msuya, Mizambwa, Harrison, Habersetzer and Storch, Pal. Electr., 5(3): 5. Type locality: Tanzania: Mahenge: approximately 50 km west of Singida [044750.2S 341554.5E]. Holotype: TNM MP-207: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Partial skeleton including skull, axial skeleton anterior to sacrum, partial left and right humeri, and partial left radius. - Etymology: For George W. Mannard who explored the Singida Kimberlite Field and made the first excavation at the type locality in 1957. (Current Combination)

TAXONOMY:
Ravel *et al.* (2011: 403) indicate that the phylogenetic position of *T. mannardi* is still uncertain due to its poor state of preservation, but that it shows many similarities with the Hassianycteridae.

Phillips (2015: 9) refers to Gunnell *et al.* (2003), who identified characters that put *T. mannardi* within the Yinpterochiroptera, more specifically the Rhinolophoidea. These characters include: extremely enlarged cochlea, broadened first rib, and a dorsally flared iliac blade. However, it remains unclear whether *Tanzanycteris* is directly linked to the Rhinolophoidea or to the Yinpterochiroptera (which also include the Pteropodidae). Phillips (2015) estimates the Hard Minimum Age for this taxon to be 45.0 miilion years ago and the Soft Maximum Age at 58.9 mya. Ravel *et al.* (2016: 356) place it in the Middle Eocene.

SUBORDER VESPERTILIONIFORMI Van Cakenberghe, Kearney and Seamark, 2007

1821. *INSECTIVORAE* Gray, 299. - Comments: Proposed as an order of bats, for the same content as that of MICROCHIROPTERA Dobson 1875. Originally included the families Noctilionidae J. Gray, 1821 and Vespertilionidae J. Gray, 1821. Not Insectivora Bowdich, 1821 (Mammalia, Lipotyphla) (see Jackson and Groves, 2015: 252).

1855. *Gymnorhina* Giebel, Die Säugethiere in Zoologischer, anatomischer und palaeontologischer Beziehung umfassend dargestellt., xii, 926. - Comments: Originally included the genera *Furia* F. Cuvier, 1828 [= *Furipterus* Bonaparte, 1837 [1832–1841]]; *Nycticejus* [sic = *Nycticeius*] Rafinesque, 1819; *Vespertilio* Linnaeus, 1758; *Thyroptera* de Spix, 1823; *Dysopes* Illiger, 1811 [= *Molossus* É. Geoffroy, 1805]; *Emballonura* Kuhl [= Temminck, 1838]; *Diclidurus* Wied-Neuwied, 1820; *Noctilio* (Geoff) [= Linnaeus, 1766]; *Taphozous* É. Geoffroy, 1818; and *Mormops* [sic = *Mormoops*] Leach, 1821] (see Jackson and Groves, 2015: 252).

1866. *Entomophaga* A. Murray, The Geographical Distribution of Mammals., xiv. - Comments: Originally included the Istiophora Giebel, 1855 [= Phyllostomidae Gray, 1825] and Gymnorhini Giebel, 1855 [= Yangochiroptera Koopman, 1985; part]. Not Entomophaga Owen, 1839 (Mammalia, Dasyuromorphia [= Marsupialia Illiger, 1811], nor Entomophaga Owen, 1859 (Mammalia, Didelphimorphia) (see Jackson and Groves, 2015: 252).

1866. *ENTOMOPHAGA:* Murray, xiv. - Comments: Not ENTOMOPHAGA Owen 1859, used for didelphoid marsupials.

1979. *PHYLLOSTOMATIA* Van Valen, Evol. Theory, 4 (3): 103, 109. Publication date: July 1979. - Comments: Proposed as infraorder and originally included the superfamilies Rhinopomatoidea Bonaparte, 1838 (containing of the families Rhinopomatidae Bonaparte, 1838, Emballonuridae Gervais, 1855 and Craseonycteridae Hill, 1974); Rhinolophoidea J. Gray, 1825 (containing the families Rhinolophidae J. Gray, 1825, Nycteridae Van der Hoeven, 1855 and Megadermatidae H. Allen, 1864); and Noctilionoidea J. Gray, 1821 (containing the families Noctilionidae J. Gray, 1821, Mormoopidae de Saussure, 1860, Phyllostomatidae Coues and Yarrow, 1875 [= Phyllostomidae J. Gray, 1825] and Desmodontidae Bonaparte, 1845: 5). Jackson and Groves (2015: 252) considered the name as a synonym of the Yangochiroptera Koopman, 1985, but the listing suggests it might rather be a synonym of the Chiroptera.

1979. *VESPERTILIONIA* Van Valen, Evol. Theory, 4 (3): 103, 109. Publication date: July 1979. - Comments: Proposed as infraorder and originally included the superfamily Vespertilionoidea J. Gray, 1821, containing the families Natalidae J. Gray, 1866, Vespertilionidae J. Gray, 1821, Mystacinidae Dobson, 1875 and Molossidae Gervais, 1855 (see Jackson and Groves, 2015: 252).

1985. *YANGOCHIROPTERA* Koopman, Bat Res. News, 25 (3/4): 26. - Comments: Proposed as Infraorder in the suborder Microchiroptera and originally included the superfamilies Phyllostomoidea J. Gray, 1825 and Vespertilionoidea J. Gray, 1821 (see Jackson and Groves (2015: 252).

1995. *VESPERTILIIFORMES* Zagorodniuk, Godovanets, Pokynchereda and Kyseliuk, Rakhiv (Proceed. Intern. Conf. "ACANAP-1995" 18 - 21 October 1995). - Comments: also Zagorodniuk *et al.* (1995); Zagorodniuk and Pokynchereda (1997).

1997. *VESPERTILIFORMES* Zagorodniuk.

1998. *Microchiropteraformes* Simmons and Geisler, Bull. Am. Mus. Nat. Hist., 235: 136. - Comments: Originally included the fossil genus *Eppsinycteris* Hooker, 1996; the fossil families Palaeochiropterygidae Revilliod, 1917 and Hassianycteridae Habersetzer and Storch, 1987; and the suborder Microchiroptera Dobson, 1875 [= Chiroptera Blumenbach, 1779; part] (see Jackson and Groves, 2015: 253).

1998. *Microchiropteramorpha* Simmons and Geisler, Bull. Am. Mus. Nat. Hist., 235: 135, 136. - Comments: Originally included the fossil genus *Australonycteris* Hand et al., 1994; the fossil families Icaronycteridae Habersetzer and Storch, 1987 and Archaeonycteridae Revilliod, 1917; and the unranked Microchiropteraformes (see Jackson and Groves, 2015: 253).

1998. *VESPERTILIONIFORMES* Zagorodnyuk. - Comments: Zagorodnyuk (1998a, b and c); Zagorodniuk (1999, 2001a and b, 2002, 2003a and b, 2004). Jackson and Groves (2015: 228) assigned this name to Hutcheon and Kirsch (2004b: 44), who included the families

Phyllostomidae J. Gray, 1825: 242, Mormoopidae de Saussure, 1860, Noctilionidae J. Gray, 1821, Mystacinidae Dobson, 1875, Emballonuridae Gervais, 1855, Vespertilionidae J. Gray, 1821, Miniopteridae Dobson, 1875, Molossidae Gervais, 1855, Natalidae J. Gray, 1866 and Nycteridae Van der Hoeven, 1855.

2001. *YINPTEROCHIROPTERA* Springer, Teeling, Madsen, Stanhope, and De Jong, Proc. Natl. Acad. Sci. USA, 98 (11): 6423. - Comments: In part.

2004. *VESPERTILIONIFORMES* Hutcheon and Kirsch, J. mamm. Evolut., 11 (1): ???.

*2007. *VESPERTILIONIFORMI* Van Cakenberghe, Kearney and Seamark, African Chiroptera Report. Publication date: July 2007. - Comments: The name of the Infraorder is based on *Vespertilio* Linnaeus, 1758 (type of VESPERTILIONIDAE Gray, 1821). (Current Combination)

2008. *Microcheroptera:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 247. (Lapsus)

2014. *Vespertilionimorpha* Zagorodniuk, Proc. Theriol. School, 12: 8.

TAXONOMY:
The suborder name follows the typified name used by Zagorodniuk *et al.* (1995) - Vespertiliiformes, Zagorodniuk (1997) - Vespertiliformes, Zagorodniuk and Pokynchereda (1997) - Vespertiliiformes, Zagorodniuk (1998a, 1998b and 1998c) - Vespertilioniformes, Zagorodniuk (1999 (1999, 2001a and 2001b, 2002, 2003a and b, 2004) - Vespertilioniformes and Hutcheon and Kirsch (2004b,2006) - Vespertilioniformes, but with the ending changed to follow the format proposed for standardization of nomenclature of higher taxa by Alonso-Zarazaga (2005). '-formes' indicates ordinal level, while ending '-formi' indicates subordinal level.

Currently three Infraorders are recognized within the suborder VESPERTILIONIFORMI from Africa: **NOCTILIONIFORMACEI** Van Cakenberghe, Kearney and Seamark, 2007; **NYCTERIFORMACEI** Van Cakenberghe, Kearney and Seamark, 2007; **VESPERTILIONIFORMACEI** Van Cakenberghe, Kearney and Seamark, 2007.

MOLECULAR BIOLOGY:
Volleth (2010: 308) found no cytogenetic synapomorphy for Vespertilioniformes [= Vespertilioniformi], which indicates that this group has a monophyletic origin.

INFRAORDER NOCTILIONIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007

*2007. *NOCTILIONIFORMACEI* Van Cakenberghe, Kearney and Seamark, African Chiroptera Report. Publication date: July 2007. - Comments: The name of the Superfamily is based on *Noctilio* Linnaeus, 1766. (Current Combination)

TAXONOMY:
Currently a single superfamily is known from within the Infraorder NOCTILIONIFORMACEI for Africa: **NOCTILIONOIDEA** Gray 1821.

Superfamily NOCTILIONOIDEA Gray, 1821

*? *Noctilionoidea* - Comments: The name of the Superfamily is based on *Noctilio* Linnaeus, 1766. (Current Combination)

TAXONOMY:
The placement of the Family Myzodidae, with in the superfamily Noctilionoidea follows Teeling *et al.* (2005).
Simmons *et al.* (2013: 145) include seven families: Myzopodidae, Mystacinidae, Thyropteridae, Furipteridae, Noctilionidae, Mormoopidae, and Phyllostomidae, which were already distinct by the end of the Eocene.

COMMON NAMES:
Czech: vampýrovci.

Family MYZOPODIDAE Thomas, 1904

*1904. *Myzopodidae* Thomas, Proc. zool. Soc. Lond., 1904, II, I: 5. Publication date: 1 October 1904. - Comments: Type genus: *Myzopoda* A. Milne-Edwards and A. Grandidier, 1878. (Current Combination)

TAXONOMY:
Known extant genera: ***Myzopoda*** Milne-Edwards and Grandidier, 1878.

Known extinct genera: †***Phasmatonycteris*** Gunnell, Simmons and Seiffert, 2014.

COMMON NAMES:
Czech: přísavkovcovití, myzopodovití, netopýrkové ušatí. Dutch: Madagassische hechtschijfvleermuizen. English: Sucker-footed Bats. French: Myzopodidés. German: Madagassische Haftscheibenfledermaus, Madagaskar-Haftscheibenfledermäuse. Norwegian: Sugeskålflaggermus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Butler (1978: 67) suggests that the Myzopodidae are probably of African mainland origin, but survive only in Madagascar.
Simmons *et al.* (2013: 146) indicate that one fossil species is known in this family.
The family-level stem and crown ages were calculated by Shi and Rabosky (2015: 1537) as 54.1 and 1.1 mya, respectively.

Genus ***Myzopoda*** Milne-Edwards and A. Grandidier, 1878

*1878. *Myzopoda* A. Milne-Edwards and A. Grandidier, Bull. Sci. Soc. Philom. Paris, sér. 7, 2: 220. Publication date: 22 June 1878. - Comments: Type species: *Myzopoda aurita* A. Milne-Edwards and A. Grandidier, 1878. - Etymology: From the Greek "*μύξάω*", meaning to suck (not from "*μύξα*", meaning mucus) and "*πούς*", meaning foot, referring to the sectional disk on the thumbs and feet (see Palmer, 1904: 446). (Current Combination)

1879. *Myxopoda:* Dobson, Proc. zool. Soc. Lond., 1878, IV: 871. Publication date: April 1879. - Comments: Lapsus (see Allen, 1939a: 82; Schliemann and Maas, 1978: 1) or emendation (see Palmer, 1904: 445). - Etymology: From the Greek "*μύξα*", meaning mucus, and "*πούς*", meaning foot, referring to the sectional disk on the thumbs and feet (see Dobson, 1879a: 281; Palmer, 1904: 445). (Lapsus)

TAXONOMY:
Know species of the genus *Myzopoda*: ***aurita*** Miline-Edwards and Grandidier, 1878. ***schliemanni*** Goodman, Rakotondraparany and Kofoky, 2007.

COMMON NAMES:
Czech: přísavkovci, myzopody. English: Sucker-footed Bats. French: Chauves-souris à ventouses. German: Madagaskar-Haftscheibenfledermäuse.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Butler (1978) found a *Myzopoda* sp. at Olduvai, Kenya, in deposits of early Pleistocene age.

CONSERVATION STATUS:
Global - Assessed as *M. aurita* VU (World Conservation Monitoring Centre, 1993); LC ver 3.1 (2001) (Jenkins *et al.*, 2008h; IUCN, 2009).

Russell *et al.* (2008b: 219) suggests that *Myzopoda* sp. may be among the few Malagasy verterbrate species to benefit from rapid deforestation, due to the species utilizing *Ravenala* as a day roost. *Ravenala* is a dominating pioneering species, and dense stands are found in areas of primary lowland forest which have been cleared (Goodman *et al.*, 2007a).

BIOGEOGRAPHY:
Russell *et al.* (2008b) using coalescent analysis places the time of divergence of *M. aurita* and *M. schliemanni* at approximately 73,500 years ago.

DETAILED MORPHOLOGY:
Reproductive system - Carter and Enders (2016: 284) found *Myzopoda* sp. to have a smooth chorioallantois, suggesting that this genus belongs in the emballonurid clade.

†***Myzopoda africana*** Gunnell, Butler, Greenwood and Simmons, 2015

*2015. *Myzopoda africana* Gunnell, Butler, Greenwood and Simmons, Am. Mus. Novit., 3846: 1, 3, figs 2A, 2C, 3. Publication date: 16 December 2015. Type locality: Tanzania: Arusha province: Olduvai Gorge: Bed I, FLK NI, Layer 123. [Goto Description]. - Etymology: The name refers to the African continent as it is the only representative of the genus *Myzopoda* that is found on continental Africa.

SIMILAR SPECIES:
M. africana's humeri are on average 21 % larger than those of its living congeners (Gunnell *et al.*, 2015a: 5).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe: Pleistocene.

Myzopoda aurita Milne-Edwards and A. Grandidier, 1878

*1878. *Myzopoda aurita* A. Milne-Edwards and A. Grandidier, Bull. Sci. Soc. Philom. Paris, sér. 7, 2: 220. Publication date: 22 June 1878. Type locality: Madagascar: "Madagascar". Holotype: MNHN ZM-MO-1997-770: alcoholic (skull not removed). Number 223 in Rode (1941); see Peterson *et al.* (1995: 139). (Current Combination)
1879. *Myxopoda aurita:* Dobson, Proc. zool. Soc. Lond., 1878, IV: 879. Publication date: April 1879. (Lapsus)

TAXONOMY:
See Schliemann and Maas (1978: 116).

COMMON NAMES:
Czech: přísavkovec ušatý, netopýrek ušatý, myzopoda ušatá. English: Golden Bat, Old World Sucker-footed Bat, Sucker-footed Bat, Madagascar Sucker-footed Bat, Eastern Sucker-footed Bat. French: Chauve-souris malgache à pieds à ventouses, Chauve-souris à pieds à ventouses de Madagascar, Vespertilion Doré, Myzopoda oreillard. German: Östliche Haftscheibenfledermaus.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) because it is widespread, thought to be locally common in areas of anthropogenic disturbance, and there are no obvious major threats (Jenkins *et al.*, 2008h; IUCN, 2009).
Ralisata *et al.* (2010) refute the suggestion that this species is rare (Hutson *et al.*, 2001).

Assessment History -
2008 - LC ver 3.1 (2001) (Jenkins *et al.*, 2008h; IUCN, 2009). 1996 - VU A2c ver 2.3 (1994). 1994 - VU (Groombridge, 1994). 1990 - VU (IUCN, 1990).

MAJOR THREATS:
There are no known major threats to this species. It is occasionally eaten by people when harvesting *Ravenala madagascariensis* plants (Jenkins *et al.*, 2008h; IUCN, 2009). However, Ralisata *et al.* (2015: 95) do point out that this harvesting itself might lead to a loss of roosts, and as such has a negative impact on the bats.

CONSERVATION ACTIONS:
Jenkins *et al.* (2008h) [in IUCN (2009)] reported that *M. aurita* has only been recorded from a few protected areas: Parc National de Marojejy (Pont and Armstrong, 1990), Tampolo littoral forest (Ifticene *et al.*, 2005) and near to Parc National de Masoala (Russ and Bennet, 1999) and Réserve Spéciale d'Analamazaotra (Russ and Bennet, 1999). Additional study is needed to develop an understanding of local population densities and precise habitat requirements.
Ralisata *et al.* (2010) indicate that it used disturbed patches of vegetation and is not therefore threatened by deforestation, although it may be affected by loss of roosts for building materials.

GENERAL DISTRIBUTION:
Myzopoda aurita is endemic to the island of Madagascar (Goodman *et al.*, 2007a). It is found in the humid zone of eastern and north-eastern Madagascar and appears to be most common at elevations lower than 500 m (Schliemann and Goodman, 2003) although it has been recorded at Andasibe (ca. 970 m).

Native: Madagascar.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
For details, see a.o. Thomas (1904g).

DENTAL FORMULA:
Inc. $^{2-2}/_{4}$, c $^{1-1}/_{1-1}$, pm $^{3-3}/_{3-3}$, m $^{3-3}/_{3-3}$ (see Dobson, 1879a: 872).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 59) described the baculum from two specimens as being a small structure, triangular in shape, without a central shaft (length: 0.21, 0.26 mm; width: 0.15, 0.16 mm). In a third specimen they found a trace of a circular bone structure.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) and Russell *et al.* (2008b).
Karyotype - Richards *et al.* (2010) examined two females showing a 2*n*=26 and a Fna=48, with all chromosomes being bi-armed. FISH with *Myotis* probes revealed a X-autosome translocation. However, the autosome translocated to the X chromosome has not been counted for the Fna. The number of autosomal arms would then be 50 instead of 48.
Protein / allozyme - Unknown.

HABITS:
Compositional analysis revealed that *M. aurita* males selected coffee plantations, degraded humid forest and wooded grasslands more than other habitats (Ralisata *et al.*, 2010).

ROOST:
Ralisata *et al.* (2010) found 133 roosts consisting of the partially unfurled leaves of *Ravenala madagascarensis* (Sonn, 1782) and housing between nine and 51 individuals, which changed roosts every 1 - 5 days. Ralisata *et al.* (2015: 95) found that the leaves of the tree became available as roost between one and 19 days after the unfurling started and were inhabited between one and 12 days.

DIET:
Göpfert and Wasserthal (1995) noted that *M. aurita* - based on the analysis of fecal pellets of a single individual from north of Tolagnaro, southeast Madagascar - fed on smaller moths ("microlepidoptera"). Ralisata *et al.* (2010) found the diet comprised mainly of Lepidoptera and Coleoptera. The latter was confirmed by Rasoanoro *et al.* (2015: 64), who mention the following volume percentages: Aranea: 15.4 ± 2.38, Coleoptera: 26.7 ± 4.60, Diptera: 3.6 ± 3.59, Homoptera: 0.3 ± 0.33, Hymenoptera: 8.4 ± 3.58, Lepidoptera: 40.1 ± 7.31, and Neuroptera: 5.5 ± 5.07.

POPULATION:
Structure - See Russell *et al.* (2008b: 219).
Density - Russell *et al.* (2008b) estimated an effective population size of between 100,054 and 132,742 individuals. In some areas, *M. aurita* is locally common (P. A. Racey *pers. comm.*), but it is rarely trapped in large numbers during surveys (Russ and Bennet, 1999; Ifticene *et al.*, 2005; Rakotondraparany and Medard, 2005; Jenkins *et al.*, 2007b). Ralisata *et al.* (2010) caught on average of 5.7 (0 - 15) individuals per mist net night, at Kianjavato, where a total of 138 individiuals were captured on 24 nights of netting.
Trend - 2008 - Unknown (Jenkins *et al.*, 2008h; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Ralisata *et al.* (2010) found that the foraging areas used by male bats varied between 7 and 108 ha (100 % minimum convex polygon), where the bats foraged close to the roost for the first hour after emergence, then travelled up to 1.8 km away and returned after 03h00.

REPRODUCTION AND ONTOGENY:
See Carter *et al.* (2008).
Ralisata *et al.* (2010) suggest that juvenile males leave their mothers after weaning and join adult males. During October-November, the testes of males appeared larger than at other times of the year, although seasonal variation was not pronounced (Ralisata *et al.*, 2010).

PARASITES:
Ralisata *et al.* (2010) did not observe any parasties on the 138 individual males captured.

UTILISATION:
In the area around Tampolo forest, people collecting leaves of the Traveller's palm (*Ravenala madagascariensis*) for housing materials often encounter *M. aurita* roosting in the leaves, although no evidence that the bats were deliberately sought, they were collected and taken back to the village where they were cooked and eaten (Jenkins and Racey, 2008).

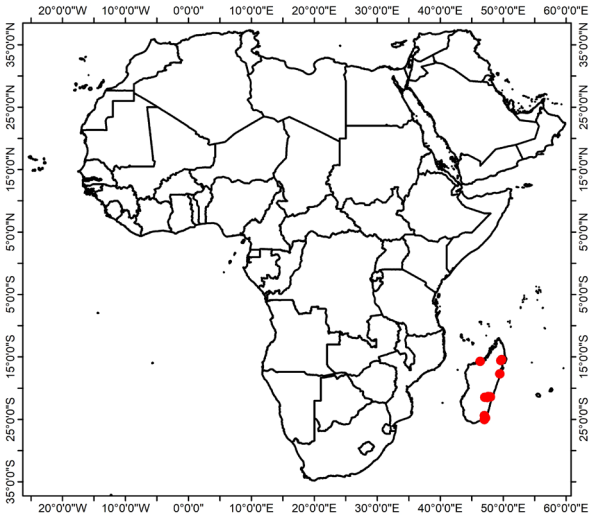


Figure 125. Distribution of *Myzopoda aurita*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Myzopoda schliemanni Goodman, Rakotondraparany and Kofoky, 2007

*2007. *Myzopoda schliemanni* Goodman, Rakotondraparany and Kofoky, Mamm. biol., 72 (2): 65, 68, figs. 2 - 5. Publication date: 26 March 2007. Type locality: Madagascar: Mahajanga province: Parc National d'Anarafantsika: Ampijoroa, forestry station: Jardin Botanique A [16 19.4 S 46 48.4 E, 160 m] [Goto Description]. Holotype: FMNH 177327: ad ♂, skin and skeleton and skull. Collected by: Steven M. Goodman; collection date: 18 April 2003; original number: SMG-13624. 3 male and 4 female paratypes listed. - Etymology: The species name was chosen to honour Professer Dr. Harald Schliemann, University of Hamburg, in recognition of his long interest in sucker-footed bats, including several important anatomical studies (e.g. Schliemann, 1971; 2003). (Current Combination)

2016. *Myz[opoda] schleimanni:* Cardiff and Jenkins, Less. Conserv., 6: 90. Publication date: January 2016. (Lapsus)

2016. *Myzopoda scliemanni:* Amador, Arévalo, Almeida, Catalano and Giannini, J. mamm. Evolut., 23 (4): Suppl.. (Lapsus)

TAXONOMY:
Described by Goodman *et al.* (2007a) using external measurements and pelage coloration and supported by population genetics (Russell *et al.*, 2008b).

COMMON NAMES:
Czech: přísavkovec bělobřichý. English: Schliemann's Sucker-footed Bat. French: Chauve-souris à ventouses de Schliemann. German: Schliemanns Haftscheibenfledermaus.

ETYMOLOGY OF COMMON NAME:
The species name was chosen to honour Professor Dr. Harald Schliemann, University of Hamburg, in recognition of his long interest in sucker-footed bats, including several important anatomical studies (e.g. Schliemann, 1970, 1971).

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) as it has a relatively large geographic range and population size, and like other *Myzopoda* is thought to do well in highly modified habitats. It is unlikely to have been negatively impacted by deforestation (Jenkins *et al.*, 2008I; IUCN, 2009).

Assessment Histroy -
2008 - LC ver 3.1 (2001) (Jenkins *et al.*, 2008I; IUCN, 2009). 2004 - Not assessed, but see Goodman *et al.* (2007a), who discuss the possible conservation status.

MAJOR THREATS:
The threats to this species are poorly known because of a lack of information on habitat preferences (Jenkins *et al.*, 2008I; IUCN, 2009). Russell *et al.* (2008b) consider bats of the genus *Myzopoda* to benefit from deforestation.

CONSERVATION ACTIONS:
Myzopoda schliemanni has been trapped in Parc National de Namoroka and Parc National d'Ankarafantsika (Goodman *et al.*, 2007a) as well as a recently created protected area in the Lac Kinkony - Mahavay area (Rakotoarivelo and Randrianandrianina, 2007). Based on current information this is a restricted-range species for which there are few data on natural history or ecology and basic field research is clearly needed to obtain information on the local abundance of this species (Jenkins *et al.*, 2008I; IUCN, 2009).
It was not found during surveys of Parc National du Tsingy de Bemaraha (Kofoky *et al.*, 2007), Parc National de Kirindy-Mité (Goodman *et al.*, 2005a; Andriafidison *et al.*, 2006a) or Kirindy CFPF (Goodman *et al.*, 2005a).

GENERAL DISTRIBUTION:
Myzopoda schliemanni is known from central western Madagascar in lowland areas from Ankaboka in the north (Goodman *et al.*, 2007a) to Andranomanintsy in the south (Russell *et al.*, 2008b). Goodman *et al.* (2007a) suggested that the distribution of range of *M. schliemanni* is broader than currently known and may extend north as far as Ambanja.

Native: Madagascar.

GEOGRAPHIC VARIATION:
See Goodman *et al.* (2007a).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Goodman *et al.* (2007a).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Goodman *et al.* (2007a).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 59) found in four specimens a triangular-shaped baculum, which was slightly more elongated than in *M. aurita* (length: 0.26 ± 0.078 mm, width: 0.12 ± 0.017 mm) and in a fifth specimen, the baculum was morphologically similar to that of the latter species.

For a description of the crania, teeth, postcranial skeleton, ears and tragus see Goodman *et al.* (2007a).

SEXUAL DIMORPHISM:
Goodman *et al.* (2007a) found there is no sexual dimorphism in *M. schliemanni*.

MOLECULAR BIOLOGY:
DNA - Russell *et al.* (2008b).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
There are few accounts of its foraging habitats, although Rakotoarivelo and Randrianandrianina (2007) mist-netted 16 individuals in relatively disturbed forest.

HABITS:
See Goodman *et al.* (2007a).

ROOST:
Kofoky *et al.* (2006) observed *M. schliemanni* roosting in a cave. There are no other published observations of this species' roosting preferences, although it is assumed to also use broad-leaved plants such as *Ravenala madagascariensis* (Strelitziaceae) (Goodman *et al.*, 2007a; Russell *et al.*, 2008b).

DIET:
Rajemison and Goodman (2007) collected feacal samples from 18 individuals during mid-October from Andranomanitsy Forest, western Madagascar, where they reported four different insect orders. Prey belonging to the orders Lepidoptera and Blattaria were the most common in the samples and were more or less equally represented (Rajemison and Goodman, 2007).

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of one individual in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

POPULATION:
Structure - In Andranomanintsy forest, 8 of the 18 bats captured were males indicating a sex ratio of 1 : 1.25 (Goodman *et al.*, 2007a: 312).
Density - Estimated effective population size using demographic models from two sites was between 61,453 and 134,630 individuals (Russell *et al.*, 2008b). A roosting colony of 4 individuals was reported from a cave in Parc National de Namoroka (Kofoky *et al.*, 2006).
Trend - 2008 - Unknown (Jenkins *et al.*, 2008l; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Rajemison and Goodman (2007) suggest that *M. schliemanni* is capable of gleaning prey from vegetation (see Diet).

REPRODUCTION AND ONTOGENY:
See Goodman *et al.* (2007a) and Carter *et al.* (2008).

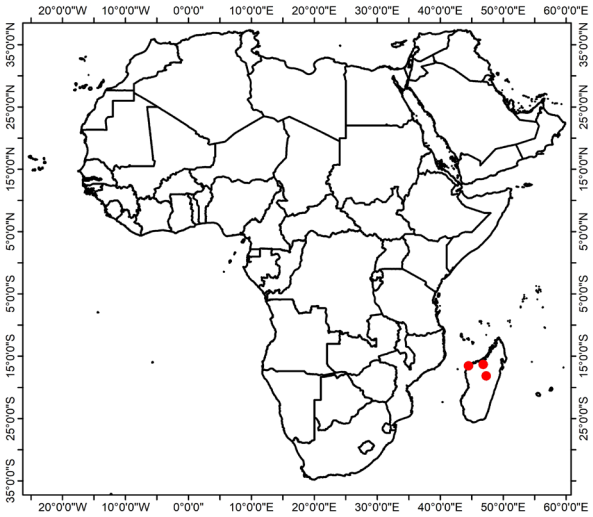


Figure 126. Distribution of *Myzopoda schliemanni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

†Genus ***Phasmatonycteris*** Gunnell, Simmons and Seiffert, 2014

*2014. *Phasmatonycteris* Gunnell, Simmons and Seiffert, PLoS ONE, 9 (2): e86712: 6. Publication date: 4 February 2014 [Goto Description]. - Etymology: From the Greek "Phasma(to)" for apparition or spectre, in reference to the long ghost lineage connecting Fayum myzopodids with extant forms, and the Greek "Nykteris" for bat (see Gunnell *et al.*, 2014: 7). - ZooBank: 693EEE77-DD52-408B-B404-B689A43706AC. (Current Combination)

TAXONOMY:
Known species for *Phasmatonycteris*: ***butleri*** Gunnell, Simmons and Seiffert, 2014. ***phiomensis*** Gunnell, Simmons and Seiffert, 2014.

ZOOBANK:
693EEE77-DD52-408B-B404-B689A43706AC

†***Phasmatonycteris butleri*** Gunnell, Simmons and Seiffert, 2014

*2014. *Phasmatonycteris butleri* Gunnell, Simmons and Seiffert, PLoS ONE, 9 (2): e86712: 1, 7, figs 3A, 4. Publication date: 4 February 2014. Type locality: Egypt: Western Desert: Fayum Depression: Birket Qarun Formation: Fayum Quarry BQ-2 (23 meter level) [Goto Description]. - Etymology: In honour of Percy Butler, in recognition of his work on fossil bats from Africa and of his 75 year publishing career (see Gunnell *et al.*, 2014: 7). - ZooBank: E6B5FFD8-5250-4C2A-B83F-CC469DD32557. (Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The type specimen was found in the 23 meter level layer at Fayum Quarry BQ-2. This layer is about 37 million year old (Late Eocene, Priabonian).

GENERAL DISTRIBUTION:
Egypt

ZOOBANK:
E6B5FFD8-5250-4C2A-B83F-CC469DD32557

†***Phasmatonycteris phiomensis*** Gunnell, Simmons and Seiffert, 2014

*2014. *Phasmatonycteris phiomensis* Gunnell, Simmons and Seiffert, PLoS ONE, 9 (2): e86712: 1, 6, figs 2A–D, 3C, E–G. Publication date: 4 February 2014. Type locality: Egypt: Western Desert: Fayum Depression: Fayum Quarry I (242 m level) [Goto Description]. - Etymology: From "Phiom," Greek for the Fayum Region of Egypt's Western Desert (see Gunnell *et al.*, 2014: 7). - ZooBank: 94812861-7911-438E-BD80-AB849541605B. (Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The type material was found in the 242 meter level Fayum Quarry I, in a layer of about 30 million years old (Early Oligocene, Rupelian).

GENERAL DISTRIBUTION:
Egypt.

ZOOBANK:
94812861-7911-438E-BD80-AB849541605B

INFRAORDER NYCTERIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007

*2007. *NYCTERIFORMACEI* Van Cakenberghe, Kearney and Seamark, African Chiroptera Report. Publication date: July 2007. - Comments: The name of the Infraorder is based on *Nycteris* G. Cuvier and E. Geoffroy, 1797 (type Family NYCTERIDAE Van der Hoeven, 1855). (Current Combination)

GENERAL COMMENTS:
We followed the format proposed for standardization of nomenclature of higher taxa by Alonso-Zarazaga (2005), then for typified names this would be standardized, using the connector -acei and the ending -iformacei. But, for those without typified names there may well be occasions where incertae-sedis is used.

TAXONOMY:
Currently a single superfamily is known from within the Infraorder NYCTERIFORMACEI for Africa: **NYCTEROIDEA** Van der Hoeven, 1855.

Superfamily NYCTEROIDEA Van der Hoeven, 1855

*1855. *Nycteroidea* Van der Hoeven. - Comments: The Superfamily name is based on *Nycteris* G. Cuvier and E. Geoffroy, 1797 (type Family NYCTERIDAE Van der Hoeven, 1855). (Current Combination)

2005. *Emballonuroidea* Teeling, Springer, Madsen, Bates, O'Brien, and Murphy, Science, 307: 581.

TAXONOMY:
This name is used contrary to the superfamily name, EMBALLONURIDEA, used by Teeling *et al.* (2005), Ravel *et al.* (2016: 377), and Amador *et al.* (2016: 22) because, the oldest, typified name is *Nycteris* G. Cuvier and E. Geoffroy, 1795, rather than *Emballonura* Temminck, 1838 (or even Emballonuridae Gervais, 1855).

Family EMBALLONURIDAE Gervais, 1855

*1855. *Emballonuridae* Gervais, in: F. Comte de Castelnau, Exped. Partes Cen. Am. Sud., Zool, (Sec. 7), Vol. 1, pt. 2 (Mammifères): 62 footnote. Publication date: 23 July 1855. - Comments: Type genus: *Emballonura* Temminck. - Etymology: The name of this family is derived from the Greek "*ἐμβάλλω*", meaning to throw in and "*οὐρά*", meaning tail, referring to the tail structure of all its members, which resembles a spear thrown into the ground at an angle (see Palmer, 1904: 257; Taylor, 2005). (Current Combination)

1865. *Brachyura* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 257. - Comments: Originally included the genera *Mystacina* J. Gray, 1843; *Noctilio* Linnaeus, 1766; *Taphozous* É. Geoffroy, 1818; *Emballonura* Temminck, 1838; *Diclidurus* Wied-Neuwied, 1820; and *Furia* F. Cuvier, 1828 [= *Furipterus* Bonaparte, 1837 [1832–1841] (see Jackson and Groves, 2015: 253). Pavlinov *et al.* (1995: 74) mentioned it "In part". Simmons (*pers. comm.*): "This name is a tough one, no type genus was noted and taxa now placed in 5 families were included. I have left it out because it is not clear just what it would be a junior synonym of. There seems no point in restricting it since it is not the oldest name for any of the family groups now recognized. Fixed".

1866. *Diclidurina* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 92. Publication date: 1 February 1866.

1866. *Emballonurina* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 92. Publication date: 1 February 1866. - Comments: Type genus: *Emballonura* Temminck, 1838. Proposed as tribe, and originally including the genera *Urocryptus* Temminck, 1838 [= *Saccopteryx* Illiger, 1811]; *Diclidurus* Wied-Neuwied, 1820; *Saccopteryx* Illiger, 1811; *Emballonura* Temminck, 1838; *Proboscidea* Spix, 1823 [= *Rhynchonycteris* Peters, 1867]; *Centronycteris* J. Gray, 1838; and *Furia* F. Cuvier, 1828 [= *Furipterus* Bonaparte, 1837 [1832–1841] (see Jackson and Groves, 2015: 253).

1875. *Emballonuridae* Dobson, Ann. Mag. nat. Hist., ser. 4, 16 (95): 349. Publication date: 1 November 1875. - Comments: Type genus: *Emballonura* Temminck, 1838. Originally included the subfamilies Emballonurinae Gervais, 1855 and Molossinae Gervais, 1855 (see Jackson and Groves, 2015: 253).

1893. *Emballonurini* Winge, Samling af Afhandlinger. E Museo Lundii, 2 (1): 24. - Comments: Proposed as tribe (?), and originally including the genera *Mosia* J. Gray, 1843; *Emballonura* Temminck, 1838; *Coleura* Peters, 1867; *Saccopteryx* Illiger, 1811; *Rhynchonycteris* Peters, 1867; *Vespertiliavus* Schlosser, 1887; *Diclidurus* Wied-Neuwied, 1820; and *Taphozous* É. Geoffroy, 1818 (see Jackson and Groves, 2015: 253).

1907. *Diclidurinae* Miller, Bull. U.S. natl. Mus., 57: 94. Publication date: 29 June 1907. - Comments: Type genus: *Diclidurus* Wied, 1819.

1928. *Emballonuroidea* Weber, Die Säugetiere., 154. - Comments: Originally included the families Rhinopomatidae Bonaparte, 1838, Emballonuridae Gervais, 1855 and Noctilionidae J. Gray,

1821. Jackson and Groves (2015: 253) considered this name a synonym of the Emballonuridae.

2013. *Emballanuridae:* Taylor, Sowler, Schoeman and Monadjem, S. Afr. J. Wildl. Res., 43 (1): 18. Publication date: April 2013. (Lapsus)

TAXONOMY:
Koopman (1993a: 156) mentions Gervais, 1856 as author, whereas Corbet and Hill (1992: 83) mention Dobson, 1875e: 349. Simmons (2005) recognises two subfamilies: Emballonurinae (including the African genera *Coleura* and *Emballonura*), and Taphozoinae (including the African genera *Saccolaimus* and *Taphozous*). Goodwin (1942: 120) considers Diclidurinae to be a valid subfamily.

Known extant genera: *Balantiopteryx* Peters, 1867; *Centronycteris* Gray, 1838; ***Coleura*** Peters, 1867; *Cormura* Peters, 1867; *Cyttarops* Thomas, 1913; *Diclidurus* Wied-Neuwied, 1820; *Emballonura* Temminck, 1838; *Mosia* Gray, 1843; ***Paremballonura*** Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, 2012; *Peropteryx* Peters, 1867; *Rhynchonycteris* Peters, 1867; *Saccopteryx* Illiger, 1811; ***Saccolaimus*** Temminck, 1838; ***Taphozous*** E. Geoffroy, 1818.

COMMON NAMES:
Czech: pochvorepovití, netopýři hladkonosí, embalonurovití. Dutch: Schedestaartvleermuizen. English: Sheath-tailed Bats, Tomb Bats, Sac-winged Bats. Finnish: Hautalepakot. French: Emballonuridés. German: Flattnasenfreischwänze, Sackflügel-Fledermäuse, Glattnasen-Freischwänze. Italian: Emballonùridi. Norwegian: Frihalete flaggermus, gravflaggermus. Russian: Футлярохвостые. Spanish (Castillian): Murciélagos de cola envainada. Vietnamese: Họ dơi bao.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The Emballonuridae are known from the early Miocene (Butler and Hopwood, 1957; Butler, 1969; 1978).
The stem and crown ages for this family were reported as 52.8 and 47.7 MYA by Shi and Rabosky (2015: 1537), and 51 and 45 MYA by Amador *et al.* (2016: 22).

Ravel *et al.* (2016: 416) indicate that *Chambinycteris pusilli* is the most basal taxon of this family.

PARASITES:
The Old World Emballonuridae are host for the genus *Ugandobia* (Acari: Myobiidae), containing nine species (Fain, 1994: 1280). Two additional species were described from Hipposideridae and Pteropodidae, but Fain (1994: 1280) suggests this was due to contamination of the jars in which they were found, and that the representatives of this genus are actually restricted to the Emballonuridae.

Genus ***Coleura*** Peters, 1867

*1867. *Colëura* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 479. - Comments: Type species: *Emballonura afra* Peters. - Etymology: From the Greek "*κολεόν*" (coleon), meaning "sheath, scabbard" and "*oúρά*" (urá), meaning tail, referring to the tail being enveloped in the interfemoral membrane as far as the last caudal vertebra (see Palmer, 1904: 195; Lanza *et al.*, 2015: 201).
1939. *Coleura:* Allen, Bull. Mus. comp. Zool., 83: 65. (Current Spelling)

TAXONOMY:
Key provided in Dunlop (1997, Mammalian Species, 566).

Known species of the genus *Coleura*: ***afra*** (Peters, 1852); ***kibomalandy*** Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, 2012; †***muthokai*** Wesselman, 1984; ***seychellensis*** Peters, 1868.

COMMON NAMES:
Czech: buldočí pochvorepi. English: Sheath-tailed bats, Peters's sheath-tailed bats. French: Chauves-souris à queue gainée. German: Schiebeschwanz-Fledermäuse.

†*Coleura muthokai* Wesselman, 1984

*1984. *Coleura muthokai* Wesselman, Contributions to vertebrate evolution, 7: 52. - Etymology: The taxon is named in honor of Muthoka, son of Kivingo, a Wakamba tribesman from Kikoko, Kenya, who worked with H.B. Wesselman as his assistant during the field seasons of 1972 and 1973 (Wesselman, 1984: 52). (Current Combination)

TAXONOMY:
Closely resembles the extant and larger species *C. afra* (Wesselman, 1984; Lim, 2007).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Late Pliocene (2.58 Mya) of southwestern Ethiopia (Lim, 2007).

Coleura afra (Peters, 1852)

*1852. *Emballonura afra* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 51, pl. 12, pl. 13, fig. 18, 19. Publication date: 1852. Type locality: Mozambique: Lower Zambesi River: Tete [16 10 S 33 35 E, 230 m] [Goto Description]. Syntype: BMNH 1858.6.18.12: ad ♀, alcoholic (skull not removed). Collected by: Prof. Wilhelm Carl Hartwig Peters. See Dobson (1878: 366) and Turni and Kock (2008: 23). Syntype: BMNH 1907.1.1.703:. See Turni and Kock (2008: 23). These latter specimens might possibly be the missing ZMB ones, but I did not find any proof of this (Van Cakenberghe, *pers com*). Syntype: RMCA [number unknown]:. See Jentink (1888b: 196) in Turni and Kock (2008: 23). These latter specimens might possibly be the missing ZMB ones, but I did not find any proof of this (Van Cakenberghe, *pers com*). Syntype: ZMB 429:. See Turni and Kock (2008: 23) [missing]. Syntype: ZMB 430:. See Turni and Kock (2008: 23) [missing]. Syntype: ZMB 54845: skull and alcoholic. (Skull damaged) see Turni and Kock (2008: 23). Syntype: ZMB 571: skull and alcoholic. M + F, see Turni and Kock (2008: 23). Syntype: ZMB 67559: skull and alcoholic. See Turni and Kock (2008: 23). Syntype: ZMB 67561: skull and alcoholic. See Turni and Kock (2008: 23). Syntype: ZMB 67562: skull and alcoholic. See Turni and Kock (2008: 23). Syntype: ZMB 85667: ♂, complete skeleton. See Turni and Kock (2008: 23). Syntype: ZMB 85668: skin only. See Turni and Kock (2008: 23). Syntype: ZMB 85669: ♀. See Turni and Kock (2008). - Etymology: From the feminine Latin adjective *àfra* meaning "African" (see Lanza *et al.*, 2015: 156).

1915. *C[oleura] g[allarum] nilosa* Thomas, Ann. Mag. nat. Hist., 8, 15 (90): 576, 577. Publication date: 1 June 1915. Type locality: Sudan: Upper Nile: Bahr-el-Zeraf, near mouth of [ca. 14 42 N 31 14 E] [Goto Description]. Holotype: BMNH 1915.3.6.76: ad ♂, skin only. Collected by: Willoughby P. Lowe; collection date: 3 February 1914; original number: 77. - Comments: Thorn *et al.* (2009: 41), however, mention 09 25 N 31 10 E for the coordinates. May be valid as a subspecies (Kock, 1969a; Koopman, 1975). In the key presented in the original description on p. 576, the name is given as *C. g. nilosa*, on the description itself (p. 577) it is mentioned as *Coleura gallarum nilosa*.

1915. *C[oleura] gallarum* Thomas, Ann. Mag. nat. Hist., 8, 15 (90): 576, 577. Publication date: 1 June 1915. Type locality: Somalia: Zeyla [=Zsyla] [sea level] [Goto Description]. Holotype: BMNH 1911.8.2.4: ad ♀. Collected by: Dr. Ralph Evelyn Drake-Brockman; collection date: 29 October 1910; original number: 336. Presented/Donated by: Dr. Ralph Evelyn Drake-Brockman. - Comments: In the key presented in the original description on p. 576, the name is given as *C. gallarum*, on the description itself (p. 577) it is mentioned as *Coleura gallarum*.

1939. *Coleura kummeri* Monard, Arq. Mus. Bocage, 10: 55, fig. 1. Publication date: March 1939. Type locality: Guinea-Bissau: Madina Boé [11 45 N 13 13 W] [Goto Description]. Syntype: MHNG 1326.003: Collected by: Dr. Albert Monard. Presented/Donated by: ?: Collector Unknown. Syntype: MNHN ZM-MO-1940-1209 - 201: ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard. Mentioned ad paratype by Rode (1941: 244). This is either number 879, 884, 886 or 887 from Monard (1939: 55). Syntype: NMBA 5277: ad ♀, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 5 March 1938; original number: 881. See http://www.nmb.bs.ch/NaturmuseumBasel/LinksNMB/Sammlung/Kataloge/Mammalia.pdf . Syntype: NMBA 5278: ad ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 5 March 1938; original number: 890. See http://www.nmb.bs.ch/NaturmuseumBasel/LinksNMB/Sammlung/Kataloge/Mammalia.pdf . Syntype: RMCA 15313: ad ♀, alcoholic (skull not removed). Collected by: Dr. Albert Monard; original number: 883. Presented/Donated by: ?: Collector Unknown. - Comments: Monard (1939: 55) used 13 specimens and three skulls for the description on this taxon. The whereabouts of specimens 879 ♂, 880 ♀, 882 ♀, 884 ♂, 886 ♂, 887 ♂, 888 ♀, 889 ♂, 891 ♀, 892 (3 skulls) has not yet been determined, although one of the male specimens is the syntype in the Paris Museum.

? *Coleura afra afra:* (Name Combination)
? *Coleura afra gallarum:* (Name Combination)
? *Coleura afra kummeri:* (Name Combination)
? *Coleura afra nilosa:* (Name Combination)
? *Coleura afra:* (Name Combination, Current Combination)
? *Coleura gallarum nilosa:* (Name Combination)

TAXONOMY:
See Dunlop (1997, Mammalian Species, 566). The recently discovered population in Madagascar could prove to be a distinct species (Goodman *et al.* (2005a).

Vallo *et al.* (2018: 73) investigated the genetic and morphological variation of various African and Arabian populations and found that specimens from Kenya, Tanzania and Ghana could be assigned to the nominotypical subspecies. The (smaller) specimens from Yemen and Gabon represented two different lineages. Morphologically, these seemed to correspond with *gallarum/nilosa* (NE Africa + Arabia) and *kummeri* (W Africa), but this was not confirmed by their molecular analyses.

COMMON NAMES:
Afrikaans: Skedestertvlermuis. Chinese: 非洲鞘尾蝠. Czech: pochvorep buldočí, netopýr buldočí. English: Southern Sheath-tailed Bat, African Sheath-tailed Bat, Sheath-tailed Bat, Mozambique Sheath-tailed Bat. French: Chauve-souris à queue gainée d'Afrique, Emballonure d'Afrique, Chauve-souris à queue en fourreau d'Afrique. German: Afrikanische Schiebeschwanz-Fledermaus. Italian: Còleura africàna. Portuguese: Morcego de cauda.

ETYMOLOGY OF COMMON NAME:
The colloquial name refers to the peculiar situation of the tail, which is enclosed by the interfemoral membrane between the back legs (Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008dq; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008dq; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004h; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not well understood. Disturbance of roost sites could potentially be a threat, but the effect of this on the population is not well known (Mickleburgh *et al.*, 2008dq; IUCN, 2009).

Kioko *et al.* (2015: 19) report a roadkill on the Arusha Highway (Tanzania).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dq) [in IUCN (2009)] indicate that on the African continent, there are no species-specific conservation measures in place, but there are some protected areas within its range. Both of the known sites for this species in Madagascar are within protected areas (the Ankarana Special Reserve and Namoroka National Park).

GENERAL DISTRIBUTION:
Coleura afra is found in much of east and eastern-central Africa, with an isolated record from central Mozambique. It is also found in West Africa, with records from Guinea and Guinea Bissau, Sierra Leone, northern Côte d'Ivoire, Ghana, Togo, Benin, and western Nigeria. There is also a small distribution in western Angola. This species was recently discovered in Madagascar (Goodman *et al.*, 2005a) and is known only from the Ankarana Special Reserve in the north of the island and the Namoroka National Park in the west.

Harrison (1967: 166) reported a specimen collected in the Strait of Bab el Mandeb, at the southern approach of the Red Sea.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 535; Taylor *et al.*, 2018b: 62); Benin; Burkina Faso (Kangoyé *et al.*, 2012: 6024; 2015a: 614); Cameroon (Lebreton *et al.*, 2014: 2); Central African Republic; Congo (The Democratic Republic of the); Côte d'Ivoire; Djibouti (Pearch *et al.*, 2001: 394); Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 147); Ghana; Guinea; Guinea-Bissau (Monard, 1939; Rainho and Ranco, 2001: 39); Kenya; Madagascar (Goodman *et al.*, 2005a); Mozambique Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 535) ; Nigeria (Happold, 1987); Sierra Leone (Weber *et al.*, 2019: 25 - first record); Somalia; Sudan; Tanzania (including the island of Pemba [see O'Brien, 2011: 287]); Togo (Capo-Chichi *et al.*, 2004: 161); Uganda; Yemen (Harrison and Bates, 1991: 34; Benda *et al.*, 2011b: 31).

Presence uncertain: Burundi; Rwanda.
Possibly extinct: Congo (Mickleburgh *et al.*, 2008dq; IUCN, 2009).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Lucati and López-Baucells (2016: Suppl.) report on a piebald (all-white fur/skin patches, eyes always normally coloured) specimen from a cave in Kenya (https://www.inaturalist.org/observations/877909).

DETAILED MORPHOLOGY:
Baculum - Unknown.
Brain - Based on three brains from Kenya, using immunohistochemical methods, Kruger *et al.* (2010a) describe the nuclear organization of the cholinergic, catecholaminergic and serotonergic systems, and Kruger *et al.* (2010b) also describe the distribution of Orexin-A immunoreactive cell bodies and terminal networks.

SEXUAL DIMORPHISM:
Kangoyé *et al.* (2015a: 614) confirm the sexual dimorphism found by Goodman *et al.* (2008b): in both body and cranial measurements, the females are larger than the males.

ECHOLOCATION:
See Pye (1980) and Taylor *et al.* (2005).

Musila *et al.* (2018c: 43) [referring to Monadjem *et al.* (2010d: 246)] mention a narrow band, low-duty pulse call, composed of constant frequency, with peak frequency of 32.9 kHz and a bandwidth of 2.4 kHz.

HABITAT:
In Nigeria, the African sheath-tailed bat is found in localised rocky habitats in southern Guinea savanna (Happold, 1987). Rosevear (1965) stated that they occur in woodland but only where there are acceptable roosting places. It is likely that other colonies occur in suitable rocky habitats in the southern Guinea savanna of western Nigeria (Mickleburgh *et al.*, 2008dq).
On Madagascar this bat taxon appears to be more varied in its habits, with some roost sites typically very dark and others quite close to the cave entrance. The two known sites on Madagascar are within dry deciduous tropical forest on a karst substrate (Goodman *et al.*, 2005a).

ROOST:
On mainland Africa, the African sheath-tailed bat is found in well illuminated caves, rocky crevices and cellars of houses (Rosevear, 1965). It preferentially roosts in caves along the sea and lake shores (Kingdon, 1974).
Lebreton *et al.* (2014: 2) report on a colony of about 5,000 specimens roosting in a cave in a rocky, forest-covered hill in Cameroon, which was also occupied by *Rousettus aegyptiacus*. Kangoyé *et al.* (2015a: 614) observed thousands of individuals in a cave on a hill at Néguéni, Burkina Faso.

MIGRATION:
Some authours suggest that *Coleura afra* migrates (Happold, 1987; Skinner and Smithers, 1990).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Dark chanting goshawk (*Melierax metabates* Heuglin, 1861) as diurnal avian predator.

POPULATION:
Structure and Density - In the African portion of *Coleura afra* distribution, it roosts in large colonies (in the 1,000s of animals) (Mickleburgh *et al.*, 2008dq; IUCN, 2009). The population and local abundance of this species in Madagascar is not known, but there is a minimum estimate of 500 individuals in one cave complex in Ankarana, Madagascar.
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008dq; IUCN, 2009). 2004 - Unknown (Mickleburgh *et al.*, 2004h; IUCN, 2004).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 113) indicates that *C. afra* is monoestrous in parts of their range and polyoestrous in others. McWilliam (1987b) observed that this species has two reproductive cycles per year in Kenya. He also showed that early postnatal growth rates in *C. afra* were higher during the short rainy season than during the long rainy season which followed an extended dry period. This can be attributed to the poor condition of females following a pregnancy when food resources were low.

PARASITES:
BACTERIA
Bartonellae
Bartonella - Kosoy *et al.* (2010: 1877) and Bai and Kosoy (2012: 58) reported a prelevence of *Bartonella* spp. In *C. afra* from Kenya of 4/9 (44.4 %) cultured from blood samples. Four genotypes of *Bartonella* spp. Identified in *C. afra* differed slightly from one another but clustered tightly within a genogroup (Kosoy *et al.*, 2010: 1878). See also Kosoy (2010: 719) for further information.

ACARI
Fain (1959b: 249, 254) described *Chirnyssus africanus* (Sarcoptidae) from a *C. afra* specimen collected on Mount Wago, near Bukwa, Haut-Ituri, DRC and from a "*Coleura gallarum*" from Moba,

DRC. In a subsequent paper, Fain (1959d: 150, 159) described *Notoedres (Notoedres) benoiti* (Sarcoptidae) from the same hosts and localities.

HEMIPTERA
Polyctenidae: *Eoctenes coleura* Maa, 1964 from Sudan (Haeselbarth *et al.*, 1966: 16, host as *Coleura gallarum*).

DIPTERA
Streblidae: *Raymondia huberi* Frauenfeld, 1856 from Mozambique and Ethiopia (Haeselbarth *et al.*, 1966: 102; Shapiro *et al.*, 2016: 254). *Raymondi seminuda* Jobling, 1954 from Tanzania (Jobling (1954) in Haeselbarth *et al.* (1966: 104)).
Nycteribiidae: *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114, host as *Coleura gallarum*; Obame-Nkoghe *et al.*, 2016: 5, Gabon); *Nycteribia schmidlii scotti* Falcoz, 1923 (Obame-Nkoghe *et al.*, 2016: 5, Gabon), which was infected by the blood parasite *Polychromophilus melanipherus* (Szentiványi *et al.*, 2019; Suppl.).

VIRUSES:
Conrardy *et al.* (2014) tested 2 individuals from Kenya for the presence of adenoviruses, rhabdoviruses and paramyxoviruses, none of which tested positive. Maganga *et al.* (2014b) tested 94 *C. afra* samples collected from the Belinga caves of Gabon of which 14 tested positive to an unclassified paramyxovirus named Belinga bat virus (BelPV), one individual presented with haemorrhagic legions at necropsy.

In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Coleura afra*: Adenoviruses, Astroviruses, Paramyxoviruses.

Coronaviridae - Coronaviruses
SARS-CoV - During Febuary 2008, Pfefferle *et al.* (2009) tested 33 fecal samples from two localities in Ghana, and these were negative for coronavirus (CoV) RNA. None of the 85 Kenyan bats tested by Tao *et al.* (2017: Suppl.) were positive for CoV.

Nairoviridae
Orthonairovirus
Six out of 14 *C. afra* specimens from Gabon tested by Müller *et al.* (2016: 3) were positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Paramyxoviridiae
Drexler *et al.* (2012a: 4) report that morbili-related viruses found in *Myotis myotis* in Germany were also found in one *Coleura afra* specimen from Ghana (out of 96 examined).
Maganga *et al.* (2014b) described a new Paramyxovirus (Belinga bat virus, BelPV) from 14 *C. afra* specimens from the Belinga caves (Gabon). One of these bats died due to several hemorrhagic lesions. None of the other bat species inhabiting the same caves were infected by this virus (*Hipposideros* cf. *ruber, Hipposideros gigas, Miniopterus inflatus, Rousettus aegyptiacus, Rhinolophus alcyone*).

Rhabdoviridae
Lyssavirus - Rabies related viruses
Horton *et al.* (2014: Table S1) tested 30 Kenyan *C. afra* specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

In their overview table, Maganga *et al.* (2014a: 8) reported that the following viruses were already found on *C. afra*: Morbillivirus unclassified. Fagre and Kading (2019: 4) also reported that serologic evidence was found for Crimean-Congo Hemorrhagic Fever Virus (CCHF).

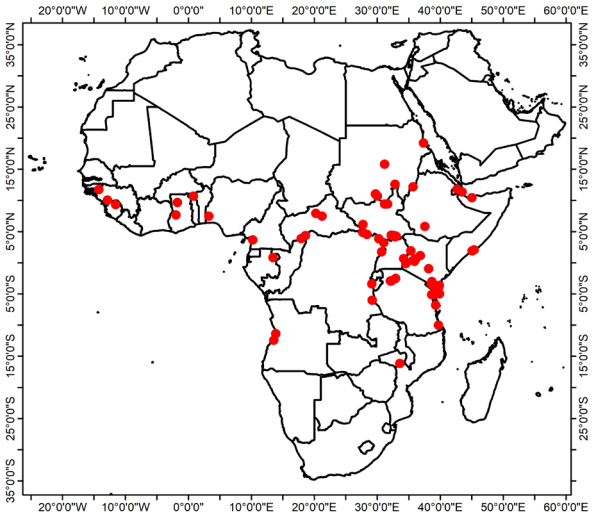


Figure 127. Distribution of *Coleura afra*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Djibouti, Egypt, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Mozambique, Nigeria, Sierra Leone, Somalia, South Sudan, Sudan, Tanzania, Uganda.

Coleura kibomalandy Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, 2012

*2012. *Coleura kibomalandy* Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, J. Mamm., 93 (6): 1442, 1446, figs 3, 4. Publication date: December 2012. Type locality: Madagascar: Antsiranana province: Ankarana National

Park, 2.2 km ESE Amboandriky: Ambatoharanana cave (Crocodile cave) [12.98838S 49.02178E, 20 m] [Goto Description]. Holotype: FMNH 213598: ad ♀, skull and alcoholic. Collected by: Steven M. Goodman and Martinus Corrie Schoeman; collection date: 2 November 2010; original number: SMG 16954. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 183864: ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 183865: ♂, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 183866: ♂, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 183867: ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 183907: skull only. Collected by: Scott G. Cardiff. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213591: ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213592: ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213593: ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213594: ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213595: ♀, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213596: ♂, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213597: ♂, skull and alcoholic. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213599: ♀, alcoholic (skull not removed). Collected by: Steven M. Goodman and Martinus Corrie Schoeman. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213600: ♀, alcoholic (skull not removed). Collected by: Steven M. Goodman and Martinus Corrie Schoeman. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213601: ♀, alcoholic (skull not removed). Collected by: Steven M. Goodman and Martinus Corrie Schoeman. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213602: ♀, alcoholic (skull not removed). Collected by: Steven M. Goodman and Martinus Corrie Schoeman. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213603: ♀, alcoholic (skull not removed). Collected by: Steven M. Goodman and Martinus Corrie Schoeman. Presented/Donated by: ?: Collector Unknown. Paratype: UADBA 43497: ♂, alcoholic (skull not removed). Collected by: Richard K.B. Jenkins. Presented/Donated by: ?: Collector Unknown. - Etymology: The name *kibomalandy* is derived from a northern Malagasy dialect and means white (*malandy*) and belly (*kibo*) and refers to this species' distinctive underside, which distinguishes it from other described species of *Coleura, Paremballonura*, and *Emballonura* (see Goodman *et al.*, 2012a: 1446). (Current Combination)

TAXONOMY:
Goodman *et al.* (2012a) described a new species of *Coleura* based on morphology and molecular data.

COMMON NAMES:
English: Madagascar Sheath-tailed Bat. French: Emballonure de Madagascar. German: Madagaskar-Schiebeschwanzfledermaus.

CONSERVATION STATUS:
Goodman *et al.* (2012a: 1449) suggest that this is a species of conservation concern due to its restricted distribution and its apparent limited number of individuals.

GENERAL DISTRIBUTION:
This species is known from two sites on Madagascar: the Ankarana National Park and the Namoroka National Park.

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 57) described the baculum as a distinctly small structure, which, in dorsal view, has a sort of oblong shape. It is constricted along the mid-shaft and has a rounded tip that is smaller than the rounded basal portion. In lateral view, it tapers from the proximal to distal side, and it also is slightly constricted along the mid-shaft in this view. There is a slight hook to the tip. Length: 0.12 mm, width: 0.09 mm.

ECHOLOCATION:
Goodman *et al.* (2012a: 1448) mention the following parameters: low PF (< 35 kHz), narrow BW (< 7 ms), and short Dur (< 6 ms).

HABITAT:
Dammhahn and Goodman (2013: 108) indicate that the foraging habitat of this species is unknown, but probably is in open areas or in open forests.

POPULATION:
Goodman *et al.* (2012a: 1449) indicate that in July 2004, there were about 500 animals in the Ambatoharanana cave, and that no information is available on the population in the other cave.

PARASITES:
Gomard *et al.* (2016: 5) reported the presence of *Leptospira* bacteria in one out of three tested bats.

VIRUSES:
Mélade *et al.* (2016b: 4) found Paramyxoviruses in two out of six *C. kibomalandy* specimens they tested.

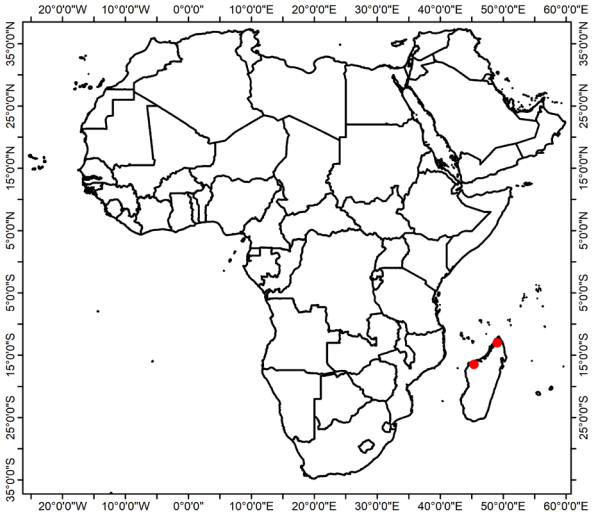


Figure 128. Distribution of *Coleura kibomalandy*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Coleura seychellensis Peters, 1868

*1868. *Coleura seychellensis* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 367. Publication date: 1869. Type locality: Seychelles. Syntype: ZMB 3470a: ♂. Presented/Donated by: Prof. Edward Percival Wright. University of Dublin, see Turni and Kock (2008: 22). Syntype: ZMB 3470b: ad ♂. Presented/Donated by: Prof. Edward Percival Wright. University of Dublin, see Turni and Kock (2008: 22). Cotype: BMNH 1869.2.19.2: ad ♂. See Thomas (1915b: 579); Turni and Kock (2008: 22) indicate that the BMNH specimen can not be a (co-)type since Peters only used the ZMB specimens for his description, therefore they also reject Thomas' restriction of the type locality to Mahé Island. - Comments: Allen (1939a: 65) mentions "1869, for 1868". - Etymology: Referring to the island group where the species occurs. (Current Combination)

1915. *C[oleura] silhouettæ* Thomas, Ann. Mag. nat. Hist., 8, 15 (90): 576, 578. Publication date: 1 June 1915. Type locality: Seychelles: Silhouette Island [Goto Description]. Holotype: BMNH 1906.3.18.2: ad ♂, skin and skull. Collected by: Prof. J. Stanley Gardiner. Presented/Donated by: Prof. J. Stanley Gardiner. - Comments: In the key on page 576 mentioned as *C. silhouettæ*, and in the description on p. 578 as *Coleura silhouettæ*.

TAXONOMY:
Two subspecies are recognized *Coleura seychellensis seychellensis* from Mahé and Praslin, and *C. s. silhouettae* from Silhouette and La Digue (Hill, 1971a: 575; Rocamora and Joubert, 2004; Simmons, 2005).

COMMON NAMES:
Creole: Sousouri banann. Czech: pochvorep seychelský, netopýr seychelský. English: Seychelles Sheath-tailed Bat. French: Chauve-souris à queue gainée des Seychelles, Emballonure des Seychelles, Chauve-souris à queue en fourreau des Seychelles. German: Seychellen Schiebeschwanz-Fledermaus.

CONSERVATION STATUS:
Global - Listed as Critically Endangered (CR C2a(i) ver 3.1 (2001)) because its population size is estimated to number fewer than 250 mature individuals, with no subpopulation greater than 50 individuals, and it is experiencing a continuing decline (Gerlach *et al.*, 2008; IUCN, 2009; Jones *et al.*, 2009b: 506). Bambini *et al.* (2005) reported that the bats may have become extinct on the island of Praslin within the first five years of the 21th century.

Assessment History -
2008 - CR C2a(i) ver 3.1 (2001) (Harrison and Lewis, 1961; IUCN, 2009). 2004 - CR C2a(I,ii) ver 3.1 (2001) (IUCN, 2004; Mickleburgh *et al.*, 2004g). 2002 - CR B1+2cde, C2b, D (Mickleburgh *et al.*, 2002a). 1996 - CR (Baillie and Groombridge, 1996). 1994 - EN (Groombridge, 1994). 1993 - EN (World Conservation Monitoring Centre, 1993). 1990 - EN (IUCN 1990). 1988 - EN (IUCN Conservation Monitoring Centre 1988).

Collen *et al.* (2011: 2615) put this species on position 26 of their top 100 mammals that need urgent conservation attention on the basis of a combination of high Evolutionary Distinctivness (ED) and high threat status.

MAJOR THREATS:
Gerlach (2004) reports that the most catastrophic decline of this species probably occurred in the late 1800s and early 1900s when lowland forests were cleared, converting the mosaic of woodland and open gaps to intensively managed coconut plantations with no shrub layer to support the invertebrate diet of this species. Invasive plants including the Kudzu vine (*Pueraria phaseoloides*) and coconut scrub from abandoned plantations threaten remaining suitable habitat for this species. Kudzu vine threatens to overgrow roost cave entrances or to change the temperature gradient within caves (Gerlach and Taylor, 2006). Senior *et al.* (2007: 9) also added that - upon leaving their roosts - all the bats follow the same route, which follows the line with the least vegetation cover. Any encroachment of vegetation will make entry and exit to the roosts more difficult and could be a reason for roost abandonment. The species is sensitive to disturbance of roosting caves and this remains a threat to any active roost sites. Other suggested threats have been the predation of bats by the barn owl, *Tyto alba*, introduced in 1949, and feral cats (Gerlach *et al.*, 2008; IUCN, 2009). Burgess and Lee (2004: 69) mention that pesticide contamination is probably not a significant threat.

CONSERVATION ACTIONS:
Gerlach *et al.* (2008) [in IUCN (2009)] report that Rocamora and Joubert (2004) recommend annual census of individuals along established transects; regular sensitive visits to all known roosting localities with additional surveys to locate any additional sites; reevaluation of the species distribution every three or four years; legal protection of all known roosting sites and their immediate surroundings; control of introduced predators (barn owl *Tyto alba* and cats); habitat protection within known feeding areas; public awareness campaigns; ongoing and additional research into the distribution, ecology and threats to this species. Gerlach and Taylor (2006) also outline the importance of removing invasive vegetation from existing and abandoned roost sites, and restoring lowland forests through the control of coconut and cinnamon, and replanting native vegetation.

GENERAL DISTRIBUTION:
This species is endemic to the Seychelles, and is currently found on the islands of Silhouette, Mahé (in the northwest of the island) and Praslin. It is thought to have become extinct on La Digue island and Praslin since 1980s (Gerlach *et al.*, 2008). Senior *et al.* (2007: 3), however, indicated that these bats were only found on Silhouette and Mahé, and that they were last seen on Praslin in 2001 and on La Dique in 1976.

The Zanzibar record is extremely dubious (Simmons, 2005).

Native: Seychelles,
Presence uncertain: Zanzibar.

SEXUAL DIMORPHISM:
Nicoll and Suttie (1982) [in Ball (2004: 136)] indicate that females are almost 10 % heavier than males: 10.2 grams versus 11.1 grams.

ECHOLOCATION:
Burgess and Lee (2004: 72) report ultrasounds of 28 to 29 kHz, produced when flying in and out the entrances of their roosting caves. Inside the caves, sounds with a frequency between 24 and 26 kHz were produced. However, Clark (2004: 77) mentions sounds at around 30 - 40 kHz. Joubert (2004: 58) indicates that two harmonic bands are present: one at 40 kHz and one at 25 - 30 kHz. Ball (2004: 136) mentions an echolocation range from 20 to 50 kHz, but that it is usually around 30 kHz when flying within the roost.

HABITAT:
This species has been recorded from coastal boulder field caves with stable cool temperatures and access into native palm woodland or marsh habitat (Gerlach and Taylor, 2006).

ROOST:
It appears to need boulder caves with horizontal ceilings; low, stable temperatures; and clear cave flyways not obscured by vegetation (Gerlach and Taylor, 2006). Abandoned roosts have been recorded from all four islands in the species historical distribution. A detailed study of the roosting site at La Passe is provided by Burgess and Lee (2004).

DIET:
Joubert (2004: 61) reports the following percentage of prey eaten by *C. seychellensis*: Diptera (30.5 %), Hymenoptera (25 %), Lepidoptera (19.5 %), Coleoptera (22 %), and Hemiptera (3 %).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention *C. seychellensis* to be predated upon by *Falco* sp. and an unidentified species of diurnal avian predator.

POPULATION:
Structure and Density - The species was noted by Wright (1868) to be 'very common in the neighborhood of the town of Port Victoria'. Joubert (2004) mentions that the species was seemingly still abundant up to the 1970s, and that the use of guano deposits as an indicator suggests that the magnitude of decline may have been as high as 90 %. The global population is now clearly very small, and although the precise number is not known, it is believed to be fewer than 100 mature individuals (Rocamora and Joubert, 2004; Gerlach *et al.*, 2008). The roosting cave at La Passe was recorded to contain 32 bats in total in 2003 (Gerlach, 2004; Gerlach *et al.*, 2008). More recently only 27 animals have been recorded roosting at this locality (Gerlach *et al.*, 2008), but Gerlach (2011: 54) mentioned that the size of this colony has increased to 40 in 2009, and that it split up in two parts of approximately 20 individuals in 2010, one remaining at La Passe and the second at Anse Lascars.

Senior *et al.* (2007: 16) indicate that the population might be higher than estimated IF this species has indeed a harem structure as was suggested by Nicoll and Suttie (1982) as non-harem males would not roost with mating groups. However, this might also have a negative influence due to greater levels of inbreeding.

Trend - 2008 - Decreasing (Gerlach *et al.*, 2008; IUCN, 2009). 2004 - Decreasing (Mickleburgh *et al.*, 2004g; IIUCN, 2004).

ACTIVITY AND BEHAVIOUR:
Joubert (2004) and Gerlach and Taylor (2006) provide specific details on the ecological requirements of this rare species.

Smotherman *et al.* (2016: 537) refer to Gerlach (2009b) in describing the song-like structure for *C. seychellensis* as consisting of different syllable types in series.

REPRODUCTION AND ONTOGENY:
Nicoll and Suttie (1982) [in Krutzsch (2000: 113)] indicate that *C. seychellensis* is a polyoestrous species.

MATING:
Burgess and Lee (2004: 69) indicate that a harem structure might exist, but their observations were inconclusive.

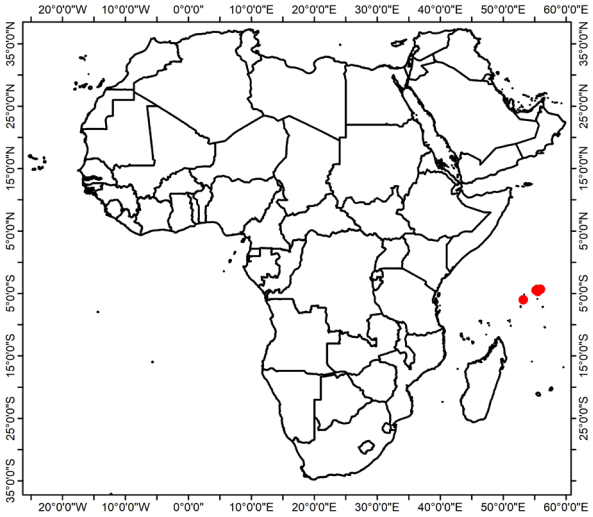


Figure 129. Distribution of *Coleura seychellensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Seychelles.

†Genus ***Dhofarella*** Sigé, Thomas, Sen, Gheerbrant, Roger, and Al-Sulaimani, 1985

*1994. *Dhofarella* Sigé, Thomas, Sen, Gheerbrant, Roger and Al-Sulaimani, Munch. Geowiss. Abh, (A) 26: 35 - 48. - Comments: See Gunnell *et al.* (2008: 5). (Current Combination)

TAXONOMY:
Morpholigally considered closer to *Taphozous* than to *Vespertiliavus* (Lim, 2007).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The oldest known emballonurid fossils from Africa. Early Oligocene age (33.9 Mya) (Lim, 2007).

Timeframe:
Late Eocene (Priabonian) - Early Oligocene (Rupelian) (33.9 Mya).

GENERAL DISTRIBUTION:
Oman (Sigé *et al.*, 1994; Lim, 2007).

†***Dhofarella sigei*** Gunnell, Simons and Seiffert, 2008

*2008. *Dhofarella sigei* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 5, fig. 6. Type locality: Egypt: Fayum Depression: Quarry L-41: Lower Sequence, Jebel Qatrani Formation. Holotype:

CGM 83670:. A left dentary series m1-m3. - Etymology: Named for Bernard Sigé, in recognition of his many contributions to the study of Cenozoic bats (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Timeframe:
Latest Eocene, Priabonian, Lower Sequence, Jebel Qatrani formation.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

†***Dhofarella thaleri*** Sigé et al., 1994

*1994. *Dhofarella thaleri* Sigé, Thomas, Sen, Gheerbrant, Roger and Al-Sulaimani, Munich. Geowiss. Abh., (A) 26: 35 - 48. Type locality: Oman. (Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe:
Early Oligocene (see Lim, 2007).

Genus ***Paremballonura*** Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, 2012

*2012. *Paremballonura* Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, J. Mamm., 93 (6): 1445. Publication date: December 2012 [Goto Description]. - Etymology: From the Greek prefix *para-*, meaning close to or besides, and the genus *Emballonura* Temminck, 1838 (see Goodman *et al.*, 2012a: 1445).
2018. *Paraemballonura:* Kemp, López-Baucells, Rocha, Wangensteen, Andriatafika, Nair and Cabeza, Agric. Ecosyst. Environ., 369: 90 (for 2019). Publication date: 1 October 2018. (Lapsus)

TAXONOMY:
Goodman *et al.* (2012a: 1440) found this genus to be paraphyletic, which resulted in the description of a new genus for the Malagasy *Emballonura* clade: *Paremballonura*.

Known species of the genus of *Paremballonura*: ***atrata*** (Peters, 1874); ***tiavato*** (Goodman, Cardiff, Ranivo, Russell, and Yoder, 2006).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
There are fossil *Paremballonura* (refered to as *Emballonura*) of probable Pleistocene age (1.81 Mya) from Madagascar (McKenna and Bell, 1997; Lim, 2007).

Paremballonura atrata (Peters, 1874)

*1874. *Emballonura atrata* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 693. Type locality: Madagascar: "Interior of Madagascar". Holotype: ZMB 4692: ♀. Collected by: Alfred Crossley. See Dobson (1878: 363) and Peterson *et al.* (1995: 56). Goodman *et al.* (2006a: 19) mention that the assumption by Peterson *et al.* (1995) that J.M. Hildebrandt is the collector, is wrong. Instead, Alfred Crossley is the collector, and they also indicate that the type locality remains unclear.
2012. *Paremballonura atrata* Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, J. Mamm., 93(6): 1445. (Name Combination, Current Combination)

TAXONOMY:
Following a recent taxonomic revision based on genetic and morphological comparisons, *Paremballonura atrata* is now confined to the east of Madagascar, with the smaller *P. tiavato* occurring in the west (Goodman *et al.*, 2006a). Reviewed by Peterson *et al.* (1995). *atata* species group Simmons (2005: 388).

COMMON NAMES:
English: Madagascar sheath-tailed bat, Peter's Sheath-tailed Bat, Peters's Sheath-tailed Bat. French: Chauve-souris malgache à queue en fourreau, Emballonure de Madagascar. German: Madagaskar-Freischwanzfledermaus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Sabatier and Legendre (1985: 23) and Gunnell *et al.* (2014: 3) refer to fossils material from Tsimanampetsotsa, on Madagascar.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) because it is relatively widespread in eastern Madagascar and although its population is certainly decreasing as the humid forest is converted into agricultural areas there is no evidence that the decrease has been rapid enough to warrant Near Threatened or threatened status (Jenkins *et al.*, 2008d; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jenkins *et al.*, 2008d; IUCN, 2009). 1996 - VU A2c ver 2.3 (1994) (IUCN, 1996).

MAJOR THREATS:
Paremballonura atrata is collected by people for bushmeat in one part of eastern Madagascar (D. Andriafidison *pers comm.,* in Jenkins *et al.*, 2008d). Otherwise, forest clearance for expanding agriculture threatens the foraging and roosting sites for this species (Jenkins *et al.*, 2007b; Jenkins *et al.*, 2008d; IUCN, 2009). Jenkins *et al.* (2007b: 219) also point out that fire (started by farmers?) is a potential threat, as traces of fire were found at the entrances of their roosting caves.

CONSERVATION ACTIONS:
Jenkins *et al.* (2008d) [in IUCN (2009)] note that *P. atrata* has been recorded from Parc National de Mantadia (Randrianandriananina *et al.*, 2006) and Parc National de Midongy du Sud (Goodman *et al.*, 2006a) as well as from a network of protected sites around the Baie de Antogil (Goodman *et al.*, 2006a). It probably does not require specific conservation action as long as forest vegetation is protected, but local populations should be monitored at roosting sites (Jenkins *et al.*, 2008d; IUCN, 2009).

GENERAL DISTRIBUTION:
This species is restricted to the humid zone of eastern Madagascar and has been recorded from around Maroantsetra in the north to Tolagnaro (Fort Dauphin) in the south (Goodman *et al.*, 2006a). It is known from a wide elevational range, from as low as 30 m (Goodman *et al.*, 2006a) to at least 900 m (Randrianandriananina *et al.*, 2006).

Native: Madagascar (Goodman *et al.*, 2006a) - Ile Sainte-Marie (Rakotonandrasana and Goodman, 2007: 6).

DETAILED MORPHOLOGY:
Baculum:
The baculum is small and circular in shape (Rakotondramanana and Goodman, 2017: 58); length: 0.09, 0.12 mm; width: 0.09, 0.12 mm.

ECHOLOCATION:
Kofoky *et al.* (2009: 379) reported the call from two individuals flown in a flight cage as FM/CF/FM with the most energy in the second harmonic at 52.9 kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) and Goodman *et al.* (2006a).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
It is considered to be dependent on relatively intact forest (Goodman *et al.*, 2005a; 2006a).

ROOST:
Paremballonura atrata is usually found roosting in caves and small crevices in or near to relatively intact humid forest (Goodman *et al.*, 2006a; Randrianandriananina *et al.*, 2006; Kofoky *et al.*, 2007; Jenkins *et al.*, 2007b).

DIET:
Based on droppings from five specimens, Rasoanoro *et al.* (2015: 64) report the following volume percentages of prey types: Coleoptera: 26.7 ± 8.09, Diptera: 40.9 ± 12.55, Hemiptera: 12.0 ± 1.16, and Hymenoptera: 31.3 ± 8.76.

POPULATION:
Structure and Density - There is no information on population size. This species is rarely trapped in flight or detected acoustically and information on populations and distribution is mainly from bats found in caves (Jenkins *et al.*, 2008d). Colony size in caves rarely exceeds 20 individuals (Jenkins *et al.*, 2007b).

Trend - 2008 - Unknown (Jenkins *et al.*, 2008d; IUCN, 2009).

UTILISATION:
Paremballonura atrata is collected by people for bushmeat in one part of eastern Madagascar (D. Andriafidison *pers comm.* in Jenkins *et al.*, 2008d).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

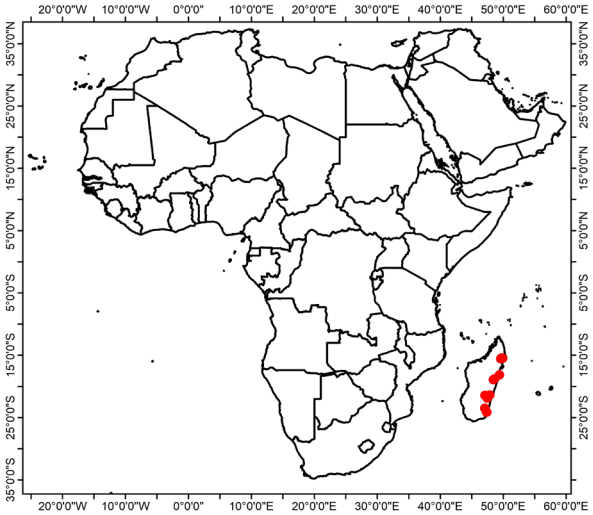


Figure 130. Distribution of *Paremballonura atrata*

Paremballonura tiavato (Goodman, Cardiff, Ranivo, Russell, and Yoder, 2006)

*2006. *Emballonura tiavato* Goodman, Cardiff, Ranivo, Russell and Yoder, Am. Mus. Novit., 3538: 1, 6, figs, 2, 3, 4, 5. Publication date: 19 October 2006. Type locality: Madagascar: Antsiranana province: Réserve Spéciale d'Ankarana, 2.6 km E Andrafiabe: Andrafiabe cave, in forest near [12 55.9 S 49 03.4 E, 50 m] [Goto Description]. Holotype: FMNH 169705: ad ♂, skin and skull. Collected by: Steven M. Goodman; collection date: 22 January 2001; original number: 11923a. - Etymology: From the Malagasy for "like rocks", referring to the tendency of this bat to occur in areas with exposed rock outcrops and caves (see Goodman *et al.*, 2006a: 6).

2012. *Paremballonura tiavato* Goodman, Puechmaille, Friedli-Weyeneth, Gerlach, Ruedi, Schoeman, Stanley and Teeling, J. Mamm., 93(6): 1445. (Name Combination, Current Combination)

TAXONOMY:
Described as a new species in a split from "*Emballonura atrata*" (Goodman *et al.*, 2006a).

COMMON NAMES:
Czech: pochvorep madagaskarský. English: Western Sheath-tailed Bat. French: Emballonure des rochers. German: Tsingy-Freischwanzfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) because although this species is declining due to the impacts of ongoing forest loss due to shifting agriculture and logging the reduction of suitable habitat is not thought to be sufficient to warrant listing in a higher category of threat. However, this species is not abundant within its range and requires close population monitoring and a reassessment may be needed in the near future (Jenkins *et al.*, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jenkins *et al.*, 2008e; IUCN, 2009).

MAJOR THREATS:
Paremballonura tiavato is threatened by habitat loss due to slash-and-burn agriculture (tavy) and from charcoal collecting and logging (Jenkins *et al.*, 2008e; IUCN, 2009). Other potential threats come from the disturbance of roosting caves from tourists (Kofoky *et al.*, 2007), fire (Jenkins *et al.*, 2007b) or mining (Cardiff, 2006).

CONSERVATION ACTIONS:
Jenkins *et al.* (2008e) [in IUCN, 2009)] report that it is known from three protected areas, Parc National Tsingy de Bemaraha, Réserve Spéciale d'Ankarana, Réserve Spéciale d'Analamerana (Goodman *et al.*, 2005a).

GENERAL DISTRIBUTION:
Endemic to Madagascar (Goodman *et al.*, 2006a). It is restricted to the karstic lowland areas in the western part of the island, extending from the drier areas in the north in Diana Region to Parc National Tsingy de Bemaraha in the west (Goodman *et al.*, 2005a). A record from Toliara in the extreme south has also been attributed to this species (Peterson *et al.*, 1995), but the specimen was not examined as part of the recent reassessment of *Emballonura*

taxonomy on Madagascar (Goodman *et al.*, 2006a). The distribution of this species would be significantly reduced if the Toliara specimen was omitted. It is currently known to range between 10 and 330 m elevation (Goodman *et al.*, 2006a).

Native: Madagascar (Goodman *et al.*, 2005a; Goodman *et al.*, 2006a) - Nosy Be (Peterson *et al.*, 1995: 57; Rakotonandrasana and Goodman, 2007: 6) and Nosy Komba (Rakotonandrasana and Goodman, 2007: 6).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Goodman *et al.* (2006a).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Goodman *et al.* (2006a).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 58) indicate that the baculum of this species is more elongated than the rounded form of *P. atrata*; length: 0.09 mm, width: 0.08 mm.

For a description of the crania, teeth, ears and tragus see Goodman *et al.* (2006a).

ECHOLOCATION:
Kofoky *et al.* (2009: 377) reported the call as a FM/CF/FM with up to five harmonics, produced short calls with a medium IPI and a low duty cycle, with a maximum energy at 55.2 kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
It appears to be associated with relatively intact forest and is believed to be forest dependent (Goodman *et al.*, 2005a; Goodman *et al.*, 2006a).

Dammhahn and Goodman (2013: 108) indicate that the lower portion of forest is this bat's foraging habitat.

HABITS:
At night it has been observed resting on buildings (Goodman *et al.*, 2006a). It feeds in forest understorey and over small streams with bank side vegetation (Robinson *et al.*, 2006).

ROOST:
Usually found roosting in the entrance to caves and rock overhangs that receive weak sunlight (Cardiff, 2006; Goodman *et al.*, 2006a; Kofoky *et al.*, 2007).

DIET:
Lepidoptera (Razakarivony *et al.*, 2005; Goodman *et al.*, 2006a).

POPULATION:
Structure and Density - Roosting colonies of *E. tiavato* are usually relatively small (< 20 individuals) (Jenkins *et al.*, 2008e; IUCN, 2009).
Trend - 2008 - Unknown (Jenkins *et al.*, 2008e; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
See Goodman *et al.* (2006a).

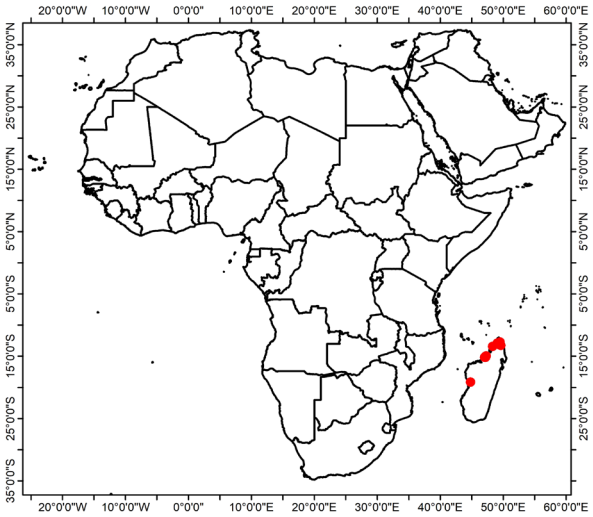


Figure 131. Distribution of *Paremballonura tiavato*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

†Genus *Pseudovespertiliavus* Ravel, 2016

*2016. *Pseudovespertiliavus* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 388. Publication date: 30 September 2016. - Etymology: The name refers to the multiple morphological similarities with the genus Vespertiliavus (see Ravel et al. 2016: 388).

†***Pseudovespertiliavus parva*** Ravel, 2016

*2016. *Pseudovespertiliavus parva* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 388, figs 16, 17. Publication date: 30 September 2016. Type locality: Algeria: Béchar province: Gour Labiz region (Sahara, Hammada du Dra).: Glib Zegdou [29 42 49 N 04 45 58 W] [Goto Description]. - Etymology: From the Latin *parva* meaning small, referring to the small size of this bat (see Ravel *et al.*, 2016: 388).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Timeframe: Late lower Eocene to early middle Eocene.

Subfamily Taphozoinae Jerdon, 1867

1867. *Taphozoinae* Jerdon, Mammals of India, 30. - Comments: Jackson and Groves (2015: 253) mention 1867 as year of publication. Other authors (e.g. Palmer, 1904: 773) mention 1874 or 1877. These latter dates represent reprints of the "Mammals of India", but the name was already published in the 1867 version. Considered a valid subfamily by McKenna and Bell (1997: 302), Simmons (2005: 381), Jackson and Groves (2015: 253).

1988. *Taphozoini* Robbins and Sarich, J. Mamm., 69 (1): 10. Publication date: 25 February 1988. - Comments: Proposed as tribe and originally included the genera *Taphozous* É. Geoffroy, 1818 and *Saccolaimus* Temminck, 1838 (see Jackson and Groves, 2015: 253).

Genus ***Saccolaimus*** Temminck, 1838

*1838. *Saccolaimus* Temminck, in: Van der Hoeven, Tijdschr. Nat. Gesch. Physiol., 5: 14. - Comments: Corbet and Hill (1992: 85), Grubb *et al.* (1998: 72) mention "1838: 6 (and 1841a: 277, 279) [C&H]". Type species: *Taphozous saccolaimus* Temminck, 1838. - Etymology: From the Greek "*σάκκος*", meaning sac and "*λαιμός*", meaning throat, gullet, referring to the well-developed gular sacs of the type species (see Palmer, 1904: 615; Flannery, 1995a: 328; 1995b: 401). (Current Combination)

1876. *Taphonycteris* Dobson, Proc. zool. Soc. Lond., 1875, IV: 548. Publication date: April 1876. - Comments: Type species: *Taphozous saccolaimus* Temminck, 1838, by subsequent designation by Palmer (1904: 661) (see Jackson and Groves, 2015: 254). - Etymology: From the Greek "*τάφος*", meaning grave and "*νυκτερίς*", meaning bat (see Palmer, 1904: 661).

TAXONOMY:
Considered a subgenus of *Taphozous* by Ellerman and Morrison-Scott (1951: 104), Corbet and Hill (1980: 45), Corbet and Hill (1992: 85), and Kock and Dobat (2000: 87), but see Barghoorn (1977: 5), Robbins and Sarich (1988) and Chimimba and Kitchener (1991).
Key to the species provided by Chimimba and Kitchener (1991).

Known species of the genus *Saccolaimus*: †***abitus*** Wesselman, 1984; *flaviventris* Peters, 1867 – Australia (except Tasmania), southeastern New Guinea (Simmons, 2005: 382); *mixtus* Troughton, 1925 – southeastern New Guinea, northeastern Queensland (Australia) (Simmons, 2005: 382); ***peli*** (Temminck, 1853). *saccolaimus* (Temminck, 1838) – Bangladesh, India and Sri Lanka through south east Asia (including Burma, Cambodia, Thailand and the Nicobar Islands) to the Philippines, Sulawesi and Borneo, Sumatra, Java, Bali and Timor (Indonesia); New Guinea; New Britain and Bougainville Islands (Papau New Guinea); northeastern Queensland (Australia); Guadalcanal Island (Solomon Islands) (Simmons, 2005: 382).

COMMON NAMES:
Czech: vakoví hrobkovci. English: Pouched Bats. French: Saccolaime. German: Taschenfledermäuse.

†***Saccolaimus abitus*** (Wesselman, 1984)

*1984. *Taphozous abitus* Wesselman, Contributions to vertebrate evolution, 7: 44. Type locality: Ethiopia: upper member B, Shungura Formation. - Etymology: From the Latin verb *abeo* meaning to go away, the past participle of which is *abitus* meaning vanished or departed (Wesselman, 1984).
2004. *Saccolaimus abitus:* Lim. (Name Combination, Current Combination)
2011. *Saccolaimus abditus:* Gunnell, Eiting and Geraads, N. Jb. Geol. Paläont. Abh., 260 (1): 70. Publication date: January 2011. (Lapsus)

TAXONOMY:
Closest affinity to the extant *Saccolaimus peli* (Wesselman, 1984; Lim, 2007).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Late Pliocene (2.58 Mya) of southwestern Ethiopia (Wesselman, 1984; Lim, 2007)

Saccolaimus peli (Temminck, 1853)

*1853. *Taphozous peli* Temminck, Esquisses zoologiques sur la Côte de Guiné. 1e partie, les Mammifères, 82. Type locality: Ghana: Boutry River [=Butre river] [ca. 04 49 N 01 55 W] [Goto Description].
? *Saccolaimus peli:* (Name Combination, Current Combination)
? *Taphozous (Saccolaimus) peli:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Chinese: 贝尔墓蝠. Czech: hrobkovec guinejský. English: Pel's Pouched Bat. French: Saccolaime de Pel, Chauve-souris à queue gainée de Pel. German: Pels Taschenfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bl; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bl; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004bn; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
Selective logging of large trees with cavities results in substantial roost destruction. Parts of *S. peli* range are fragmented by agricultural activities, but as it lives in clearings, it is not known whether or not this is having a significant negative impact on the species (Mickleburgh *et al.*, 2008bl; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bl) [in IUCN (2009)] report that it is found in several protected areas. Research is needed to determine the effects of habitat fragmentation on the species.

GENERAL DISTRIBUTION:
Saccolaimus peli ranges widely through the equatorial forest belt of west and central Africa. In the Upper Guinea region, it occurs in Liberia, Guinea, Côte d'Ivoire and Ghana. Its main range extends from southwestern Nigeria to western Uganda, with isolated records from western Kenya and eastern Angola.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 535); Cameroon; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 535); Côte d'Ivoire; Equatorial Guinea; Gabon; Ghana; Guinea; Kenya; Liberia; Nigeria (Capo-Chichi *et al.*, 2004: 161); Uganda.
Presence uncertain: Central African Republic; Sierra Leone.

Bates *et al.* (2013: 338) reject the presence of *S. peli* in the Republic of Congo because Malbrant and Maclatchy (1949) only mention it 'likely' to occur in that country.

FUNCTIONAL MORPHOLOGY:
Bahlman *et al.* (2016: 122) indicate that *S. peli* has long, cartilaginous distal phalanges with tendons running to the distal-most portion of the tip of digits IV and V. They speculate that the flexor muscles and tendons not only flex the terminal IP joint, but also may provide some additional curvature along the length of the cartilaginous phalanges.

HABITAT:
R.B. Woosnam [in Thomas, 1910b: 489] reported that vaste numbers were seen in the Congo Forest, but not anywhere else. He also indicated that they were seen hanging in trees, but never in houses.

POPULATION:
Structure and Density - *S. peli* occurs in low densities across its wide range (Mickleburgh *et al.*, 2008bl; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bl; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 113) assigned *S. peli* to the group of polyoestous species.

PARASITES:
Nycteribiidae: *Tripselia aequisetosa* Theodor, 1956 from Liberia and Congo (Haeselbarth *et al.*, 1966: 112).

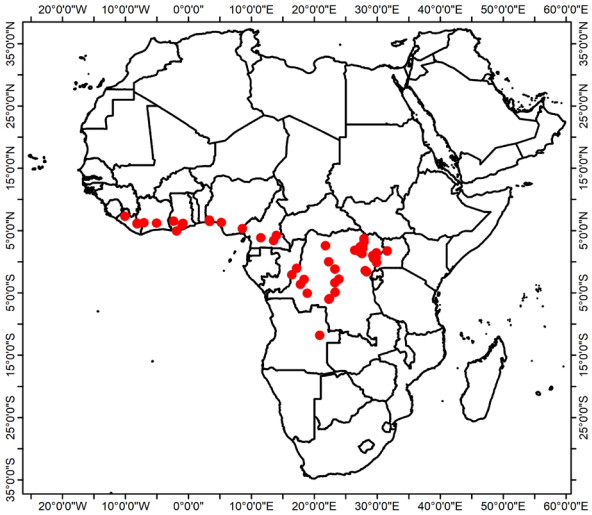


Figure 132. Distribution of *Saccolaimus peli*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Liberia, Nigeria, Uganda.

Genus ***Taphozous*** E. Geoffroy St.-Hilaire, 1818

*1818. *Taphozous* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 113. Publication date: 1818. - Comments: Type species: *Taphozous perforatus* E. Geoffroy, 1818, by monotypy (according to Colket and Wilson, 1998: 1) or subsequent designation by Miller (1907: 93) (according to Jackson and Groves, 2015: 255). Mahoney and Walton (1988a: 116) in Grubb *et al.* (1998: 72) considered the date of Geoffroy's publication to be 1813. Gardner and Hayssen (2004: 12) mention that the correct date should be 1818, not 1813 as mentioned on the publication itself. - Etymology: From the Greek "*τάφος*" (táfos), meaning "grave" or "tomb" and "*ξωός*" (zóos), meaning "living" (see Palmer, 1904: 662). (Current Combination)
1821. *Thaphosores:* Gray, London Med. Repos., 15 (1): 300. - Comments: Jackson and Groves (2015: 256) indicate that this is possibly an incorrect subsequent spelling as Gray refered to "Geoff." as author. Generally, the name is given as "*Taphosores*", but Gray (1821: 300) actually mentioned *Thaphosores*. (Lapsus)
1821. *Thaphozous:* Bowdich, An analysis of the natural classification of mammalia, for the use of students and travellers., 30. (Lapsus)
1822. *Thaphozus:* Fleming, The Phylosophy of Zoology, 179. (Lapsus)
1922. *Liponycteris* Thomas, Ann. Mag. nat. Hist., ser. 9, 9 (51): 267. Publication date: 1 March 1922 [Goto Description]. - Comments: Type species: *Taphozous nudiventris* Cretzschmar, 1830, by original designation (see Colket and Wilson, 1998: 1; Jackson and Groves, 2015: 256). Valid as a subgenus.
1998. *Tapozous:* Yom-Tov and Kadmon, Diversity Distrib., 4: 67. (Lapsus)
2018. *Thapozous:* Leopardi, Holmes, Gastaldelli, Tassoni, Priori, Scaravelli, Zamperin and De Benedictis, Infec. Gen. Evol., 58: 286. Publication date: 30 January 2018. (Lapsus)
? *Taphozous sp.:*

TAXONOMY:
Some authors (e.g. Allen, 1939a: 66) consider Oken (1816), Lehrbuch d. Naturg., pt. 3., zool., sect 2, p. 926 to be the author of this genus.

Meester *et al.* (1986): Barghoorn (1977), followed by Koopman (1982, and in litt.) regard *Saccolaimus* as generically distinct from *Taphozous*, but L.W. Robbins (Abstracts, 4th International Colloquium on Taxonomy and Ecology of African Small Mammals: 33, 1984) states that on the basis of protein electrophoresis and immunology *Taphozous* and *Saccolaimus* are closely related. Simmons (2005:382) recognized two subgenera *Taphozous* and *Liponycteris*. Only

the subgenus *Taphozous*, occurs in Africa and its associated islands.

Includes *Liponycteris* but not *Saccolaimus*; see Hayman and Hill (1971: 15) and Barghoorn (1977: 5), Robbins and Sarich (1988) and Chimimba and Kitchener (1991), though also see Corbet and Hill (1992). Corbet and Hill (1992: 85) include *Saccolaimus* as a subgenus. A key is provided by Colket and Wilson (1998: 1, Mammalian Species, 597).

Known species of the genus *Taphozous*: *achates* Thomas, 1915 – Kei, Savu, Roti, Semau and Nusa Penida Isls (Indonesia) (Simmons, 2005: 382). *australis* Gould, 1854 – northern Queensland (Australia), Torres Strait Isls, southeastern New Guinea (Simmons, 2005: 383). *georgianus* Thomas, 1915 – northern and western Australia (Simmons, 2005: 383). ***hamiltoni*** Thomas, 1920. ***hildegardeae*** Thomas, 1909. *hilli* Kitchener, 1980 – Western Australia, South Australia and Northern Territory (Simmons, 2005: 383). *kapalgensis* McKean and Friend, 1979 – Northern Territory (Australia) (Simmons, 2005: 383). *longimanus* Hardwicke, 1825 – Sri Lanka; India and Bangladesh to Burma, Cambodia and Thailand; Peninsular Malaysia; Sumatra, Borneo, Java, Bali, Sumbawa and Flores (Indonesia) (Simmons, 2005: 383). ***mauritianus*** E. Geoffroy, 1818. *melanopogon* Temminck, 1841 – Sri Lanka; India; Burma; Thailand; Laos; Cambodia; Vietnam; southern China; Malay Peninsula and adjacent islands; Borneo; Sumatra, Java, Lombok, Sumbawa, Moyo, Alor, Timor and Sulawesi (Indonesia), Philippines (Simmons, 2005: 384). ***nudiventris*** Cretzschmar, 1830. ***perforatus*** E. Geoffroy, 1818. *theobaldi* Dobson, 1872 – central India to Vietnam; Java, Borneo and Sulawesi (Simmons, 2005: 385). *troughtoni* Tate, 1952 – northwestern Queensland (Australia) (Simmons, 2005: 385).

COMMON NAMES:
Czech: praví hrobkovci, večerníkové, netopýři bradožlází. English: Tomb Bats, Pouched Bats. French: Chauve-souris des Tombes, Taphiens. German: Grabfledermäuse, Grabflatterer. Italian: Tafozòi, Pipistrèlli délle tómbe.

ETYMOLOGY OF COMMON NAME:
The type species of the genus, *T. perforatus*, was taken from a royal tomb in Egypt (see Taylor, 2005).

PARASITES:
HEMIPTERA
Polyctenidae: *Eoctenes intermedius* (Speiser, 1904) originally described from a *Taphozous* species from Egypt (Haeselbarth *et al.*, 1966: 16).

DIPTERA
Streblidae: *Brachytarsina alluaudi* (Falcoz, 1923) (Haeselbarth *et al.*, 1966: 101).

VIRUSES:
Flaviviridae
Pegivirus (BPgV)
2 out of 2 unidentified *Taphozous* specimens from Cameroon were infected by clade G type *Pegivirus*, and one of them also with clade K type *Pegivirus* (Quan *et al.*, 2013: Table S5).

Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that three out of 12 examined *Taphozous* sp. specimens from Cameroon tested positive for *Paramyxovirus* sequences.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Horton *et al.* (2014: Table S1) tested 1 Kenyan *Taphozous* sp. specimen, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

†*Taphozous incognita* (Butler & Hopwood, 1957)

*1957. *Saccolaimus incognita* Butler and Hopwood, Fossil Mammals of Africa, Insectivora and Chiroptera from the Miocene rocks of Kenya, 13: 29, fig. 9. Publication date: 1957. Type locality: Kenya: Koru. Holotype: BMGD M.14222:. The left half of a rostrum lacking much of the bone, but showing the interior of the orbit and part of the crowns of P4 and M2.

1978. *Taphozous incognita:* Butler, Evolution of African Mammals, 65. (Name Combination, Current Combination)

TAXONOMY:
Most similar to the extant *Taphozous nudiventris* (Butler and Hopwood, 1957; Butler, 1984; Lim, 2007).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Early Miocene (23.03 Mya) of the Legete Formation in Kenya (Lim, 2007), Koru (Butler, 1978).

Taphozous hamiltoni Thomas, 1920

*1920. *Taphozous hamiltoni* Thomas, Ann. Mag. nat. Hist., ser. 9, 5 (25): 142. Publication date: 1 January 1920. Type locality: Sudan: Equatoria province: Mongalla [05 10 N 31 50 E, 500 m] [Goto Description]. Holotype: BMNH 1919.12.18.1: ad ♀. Collection date: 13 June 1918. Presented/Donated by: The Wellcome Research Laboratories. Formerly Stevenson Hamilton collection, nr 118 (see Thomas, 1920: 143). - Etymology: In honour of Major James Stevenson-Hamilton (1867 - 1957), eminent British regular soldier and conservationist, born in Ireland, considered father of the Kruger National Park. The species is named in his honor as the type specimen came from his collection (see Lanza *et al.*, 2015: 210). (Current Combination)

? *Taphozous (Liponycteris) hamiltoni:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Chinese: 苏丹墓蝠. Czech: hrobkovec východoafrický. English: Hamilton's Tomb Bat, Hamilton's Naked-rumped Tomb Bat, Hamilton's Naked-bellied Tomb Bat, Kordofan Sheathtail-bat. French: Taphien de Hamilton. German: Hamiltons Grabfledermaus. Italian: Tafozòo di Hàmilton.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing uncertainties as to its extent of occurrence, status, trends and ecological requirements (Mickleburgh *et al.*, 2008x; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008x; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004x; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats facing this species are unknown. It could be declining due to habitat loss through agriculture, but the data to confirm this are lacking (Mickleburgh *et al.*, 2008x; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008x) [in IUCN (2009)] report that no specific conservation measures are in place. It probably occurs in some protected areas. The distribution and ecological requirements of this species require further investigation.

GENERAL DISTRIBUTION:
Taphozous hamiltoni is not well known, and there are very few records. It is known mainly from east Africa (including records from Sudan, Somalia, Kenya, and Tanzania), and there is one additional record from southern Chad.

Native: Chad; Kenya; Somalia; Sudan; Tanzania; Uganda.

POPULATION:
Structure and Density - There is no information, as there are few records of this species (Mickleburgh *et al.*, 2008x; IUCN, 2009).
Density - 2008- Unknown (Mickleburgh *et al.*, 2008x; IUCN, 2009).

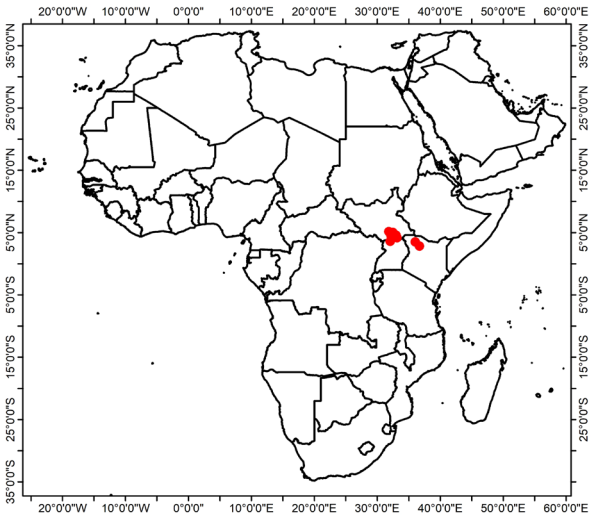


Figure 133. Distribution of *Taphozous hamiltoni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Kenya, South Sudan, Sudan.

Taphozous hildegardeae Thomas, 1909

*1909. *Taphozous hildegardeæ* Thomas, Ann. Mag. nat. Hist., ser. 8, 4 (20): 98. Publication date: 1 August 1909. Type locality: Kenya: Coast province: near Mombassa: Rabai [700 ft] [Goto Description]. Holotype: BMNH 1909.6.12.7: ad ♂, skull and alcoholic. Original number: 613. Collected and presented by Dr. and Mrs. Hinde, (see Thomas (1909a: 99).

- Etymology: In honour of Mrs. Hildegarde Beatrice Hinde, wife of the Dr. Sydney Hinde, collector of the type specimen (see Colket and Wilson, 1998: 3; Lanza *et al.*, 2015: 213).

? *Taphozous (Taphozous) hildegardeae:* (Name Combination)
? *Taphozous hidegardeae:* (Alternate Spelling)
? *Taphozous hildegardeae:* (Current Combination, Current Spelling)

TAXONOMY:
See Colket and Wilson (1998, Mammalian Species, 597).

COMMON NAMES:
Chinese: 肯尼亚墓蝠. Czech: hrobkovec východoafrický. English: Hildegarde's Tomb Bat. French: Taphien de Hildegarde. German: Hildegardes Grabfledermaus. Italian: Tafozòo di Hildegàrde.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU B1ab(iii) ver 3.1 (2001)) because its extent of occurrence is less than 20,000 km^2, its distribution is severely fragmented, and there is continuing decline in the extent and quality of its forest habitat (Mickleburgh *et al.*, 2008y; IUCN, 2009).

Assessment History -
2008 - VU B1ab(iii) ver 3.1 (2001) (Mickleburgh *et al.*, 2008y; IUCN, 2009). 2004 - VU C1 ver 3.1 (2001) (Mickleburgh *et al.*, 2004r; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
Disturbance of the caves on which it depends, and loss of forest habitat, could result in population declines (Mickleburgh *et al.*, 2008y; IUCN, 2009).

Sagot and Chaverri (2015: 1670) mention roost loss or disturbance, and habitat degradation or loss as major threats for this species.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008y) [in IUCN (2009)] report that it probably occurs in some protected areas, but stricter conservation of roosting and nesting sites is needed. Research into the cultural importance of the species is being carried out.

GENERAL DISTRIBUTION:
Taphozous hildegardeae is found on Pemba and Unguja [=Zanzibar] islands (Tanzania), and along the coast of south-east Kenya and north-east Tanzania (from the Lower Tana River south to Dar es Salaam). It has so far been recorded from fewer than ten coastal localities, but is probably present in some places where it has not yet been discovered.

The two central Kenya records collected by Harrison (1962), are questioned due to their location by Kock (1974a), as these points are not along the East African coast. The questioned locations do, however, coincide with coastal vegetation along the Tana River, which could afford this species suitable habitat (Colket and Wilson, 1998).

Native: Kenya; Tanzania.

ROOST:
McWilliam (1982: 208) found *T. hildegardeae* roosting in the larger caves of his study area (coastal Kenya), where they were found in smaller chambers or "erosion domes".

DIET:
In Kenya, McWilliam (1982: 248) reported that *T. hildegardeae* almost exclusively fed on large (> 10 mm) Lepidoptera and Orthoptera.

POPULATION:
Structure and Density - There are no overall population estimates. However, during a survey in Kenya and Tanzania in 1988, population estimates from three caves surveyed yielded more than 1,500 individuals (1,000+, 300+, 130+) (Susan M. Pont, *pers. Obs.,* in Mickleburgh *et al.*, 2008y [in IUCN, 2009]). It seems to be relatively common in caves.
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008y; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
For Kenya, McWilliam (1988b: 433) indicates that male *T. hildegardeae* have a bimodal reproductive cycle that corresponds to the rainfall-induced seasonality in the coastal area. He also mentioned, however, that the second period (during the short rains in October-December), did not result in reproduction, indicating that the male cycle might be a relict of ancestral polyoestry.

MATING:
T. hildegardeae has a polygonous mating system, where a successful male can father at least seven young per year (McWilliam, 1982: 258).

PARASITES:
HEMIPTERA
Cimicidae: *Loxaspis miranda* Rothschild, 1912, described from specimens collected at Kilidini,near Mombasa, Kenya, Haeselbarth *et al.* (1966: 9) suggests that these are from *T. hildegardeae*.

DIPTERA
Streblidae: *Brachytarsina alluaudi* (Falcoz, 1923) in Kenya and probably Tanzania (Haeselbarth *et al.*, 1966: 101).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Kenya, Tanzania.

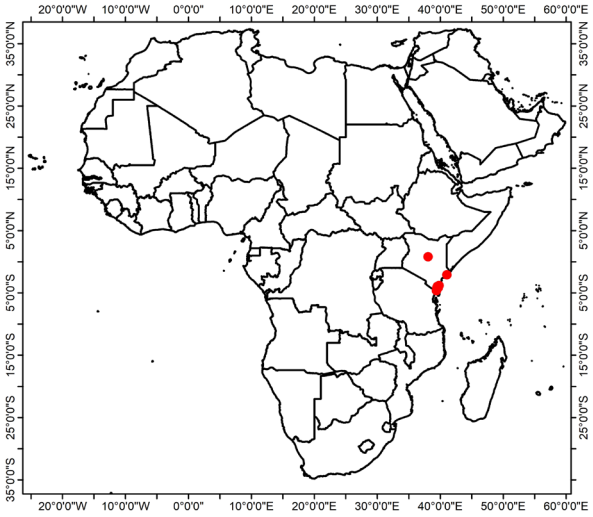


Figure 134. Distribution of *Taphozous hildegardeae*

Taphozous mauritianus E. Geoffroy St.-Hilaire, 1818

*1818. *Taphozous mauritianus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 127. Publication date: 1818. Type locality: Mauritius: "Mauritius". Holotype: MNHN A.381 - 199: ad ♀, alcoholic (skull not removed). Presented/Donated by: ?: Collector Unknown. - Comments: Mahoney and Walton (1988a: 116) in Grubb *et al.* (1998: 72) considered the date of Geoffroy's publication to be 1813. Gardner and Hayssen (2004: 12) mention that the correct date should be 1818, not 1813 as mentioned on the publication itself. - Etymology: From the masculine scientific Latin adjective *mauritiànus*, meaning "Maurician", as the type specimen was collected on the island of Mauritius (see Lanza *et al.*, 2015: 215). (Current Combination)

1835. *Taphozous leucopterus* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe. Tome Seconde, 2: 284, pl. 60, fig. 7. Type locality: South Africa: "Interior of South Africa" [Goto Description]. - Comments: Kock (1969a: 71), Meester *et al.* (1986: 31) and Dengis (1996: 1) mention "1838; Tijdschrift voor natuurlijke geschiedenis en physiologie, Amsterdam 5: 12".

1879. *Taphozous Dobsoni* Jentink, Notes Leyden Mus., 1 (1): 123, note 32. Publication date: April 1879. Type locality: Madagascar: Mohambo [Goto Description]. Holotype: RMNH ?: ♂, alcoholic (skull not removed). Collected by: Jean Baptiste Audebert.

1900. *Taphozous maritianus var. Cinerascens:* Seabra, J. Sci. mat. phys. nat., ser. 2, 6: 77. Publication date: August 1900. Type locality: Angola: Benguela [12 34 S 13 24 E, 160 m]. (Lapsus)

1978. *Taphozous mauvitanius:* Arata and Johnson, Ebola Virus Haemorrhagic Fever, 135. (Lapsus)

2017. *T[aphozous] mauritiana:* Waruhiu, Ommeh, Obanda, Agwanda, Gakuya, Ge, Yang, Wu, Zohaib, Hu and Shi, Virol. Sin., 32 (2): 5. Publication date: 6 April 2017.

? *Taphozous (Taphozous) mauritianus:* (Name Combination)

? *Taphozous mauritianus mauritianus:* (Name Combination)

TAXONOMY:



Figure 135. *Taphozous mauritianus* caught at Sudwala Caves Resort, Mpumalanga, South Africa.

Koopman (1975) believed that a number of subspecies that have been described are of doubtful value.
See Dengis (1996, Mammalian Species, 522).

COMMON NAMES:
Afrikaans: Witlyfvlermuis. Azande (DRC): Fulo. Chinese: 南非墓蝠. Czech: hrobkovec mauricijský, netopýr mauricijský, netopýr hrobkový. English: Mauritian Tomb Bat, Tomb Bat, Taphozous bat of Mauritius. French: Taphien de l'Ile Maurice, Taphien de l'Ile de France, Taphien de Maurice, Chauve-souris mauritienne des tombeaux, Chauve-souris des tombes. German: Mauritius-Grabfledermaus. Italian: Tafozòo mauriziàno. Kenya Ruanda: Mokombe. Kiluba (DRC): Katutu. Kinande (DRC): Kahazo-komule, Kakorokombe. Portuguese: Morcego das sepulturas das Mauricias. Spanish (Castillian): Spa: Murciélago de las Tumbas. Swahili: Popo.

ETYMOLOGY OF COMMON NAME:
The specimen from which the species was described came from the island of Mauritius (see Taylor, 2005: 274).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Evans and Mourad (2018: 81; Fig. 4, 5) provide images of wall paintings of bats, which look like *Taphozous*, on the walls of an Egyptian tomb at Beni Hassan, dating back from the Middle Kingdom (c. 2050 - 1650 BC).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Hutson *et al.*, 2008f; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Hutson *et al.*, 2008f; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004bl; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016u). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
Overall, this species is not significantly threatened. It is locally hunted (by children) in parts of its range (Hutson *et al.*, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Hutson *et al.* (2008f) [in IUCN (2009)] report that this species is known from protected areas within Madagascar including Zombitse National Park and Ankarafantsika National Park, as well as from many protected areas on the African continent.

GENERAL DISTRIBUTION:
Taphozous mauritianus is found throughout much of subsaharan Africa and is also on several islands (including the Tanzanian island of Unguja [=Zanzibar] [see O'Brien, 2011: 287]), Bioko and Pagalu (Equatorial Guinea), and Sao Tomé and Principe). The most northerly records are from the border area between Senegal and Mauritania and at the head of the Nile River in Sudan. It is present throughout southern and eastern Madagascar, but it usually only occurs at lower altitudes and there are no records from the central plateau or above 900 m. It is known from Aldabra (von Brandis (2004: 135), Mauritius, the Comoros and Réunion. Records from the Western Cape region in southern Africa are unverified, with known records extending as far south as Mossel Bay. It is also recorded in an isolated location in the Northern Cape, near Hartwater (Taylor, 2000; Skinner and Chimimba, 2005). In the RSA, the species' distribution is linked with land use/land cover (Babiker Salata, 2012: 50).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,454,841 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 532; Taylor *et al.*, 2018b: 62); Benin (Capo-Chichi *et al.*, 2004: 162); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 535); Cameroon; Central African Republic; Chad; Comoros (Louette, 2004; Goodman *et al.*, 2010c: 125; Hume and Middleton, 2011: 33); Congo (Bates *et al.*, 2013: 335); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 535); Côte d'Ivoire; Equatorial Guinea (Annobón, Bioko);

Ethiopia; Gabon; Gambia (Emms and Barnett, 2005: 50); Ghana; Kenya; Madagascar; Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988: 29; Monadjem *et al.*, 2010d: 535); Mauritius; Mayotte (Ramasindrazana *et al.*, 2015a: 109); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 535); Namibia (Monadjem *et al.*, 2010d: 535); Nigeria; Réunion; São Tomé and Principe (Juste and Ibáñez, 1993b: 906; Rainho *et al.*, 2010a: 35); Senegal; Seychelles [Aldabra]; Sierra Leone; Somalia; South Africa (Monadjem *et al.*, 2010d: 535); Sudan; Swaziland (Monadjem *et al.*, 2010d: 535); Tanzania; Togo; Uganda; Zambia (Ansell, 1967; Ansell, 1969; Ansell, 1978;Ansell, 1986; Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 535); Zimbabwe (Monadjem *et al.*, 2010d: 535).
Presence uncertain: Burundi; Guinea; Guinea-Bissau; Liberia; Mali; Mauritania; Rwanda.

GEOGRAPHIC VARIATION:
Krutzsch (2000: 114) [referring to Rosevear (1965), Smithers and Lobão Tello (1976) and Happold (1987)] indicates that geographic variation is evident in the gular sac in this species. In Nigeria and Mozambique, it is only present in males, while in West Africa the males have a functioning sac and females have a vestigial pouch.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Fenton (1992: 49) indicates that the grizzled dorsal pelage contributes to the bat's camouflage while resting on natural surfaces. In the resting position, the striking white venter is completely concealed.

From western Uganda, Monadjem *et al.* (2011: 30) reported the following data for 2 specimens: Fa: 60.25 mm, mass: 27.0 g, wing loading: 13.3 N/m^2, aspect ratio: 5.8.

ECHOLOCATION:
See Taylor (1999b), and Taylor (2000: 63). Rainho *et al.* (2010a: 21) report the calls of 5 individuals from São Tomé.

For 10 calls of specimens from Soutpansberg and Waterberg, South Africa, Taylor *et al.* (2013b: 18) recorded the following parameters: F_{max}: 29.0 ± 1.17 (27.8 - 31.1) kHz, F_{min}: 25.3 ± 1.49 (22.1 - 27.9) kHz, F_{knee}: 28.3 ± 1.29 (27.0 - 30.2) kHz, F_{char}: 26.2 ± 0.94 (24.9 - 27.9) kHz, duration: 2.9 ± 0.64 (2.0 - 3.6) msec.

From western Uganda, Monadjem *et al.* (2011: 32) report the following values: F_{min}: 13.13 kHz, F_{max}: 13.48 kHz, F_{char}: 13.43 kHz, F_{knee}: 13.18 kHz, duration: 9.1 msec. They also indicate (p. 33) that the F_{peak} of 25.6 [actually 25.9] kHz reported by Schoeman and Jacobs (2008: Table S1) is probably for an harmonic.

Barataud and Giosa (2013: 150) reported on 9 sequences from Réunion with QFC = 39 kHz and QCF/FM = 18.

For Swaziland, Monadjem *et al.* (2017c: 179) recorded the following parameters: F_{min}: 25.1 ± 0.72 (24.3 - 25.9) kHz, F_{knee}: 28.6 ± 0.60 (28.1 - 29.5) kHz, F_c: 25.9 ± 1.20 (24.3 - 27.2) kHz, and duration: 2.7 ± 0.27 (2.4 - 3.0) kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported for specimens from South Africa, 2*n* = 42, FN = 64, BA = 24, a metacentric X chromosome, and a submetacentric Y chromosome.
Protein / allozyme - Unknown.

HABITAT:
Open savanna and forst edges in the wetter northern and eastern parts of the subcontinent (Taylor, 2000: 62).

HABITS:
Fenton and Griffin (1997: 248) recorded one call above 24 kHz, which they attributed to *T. mauritianus* at an altitude of 500 - 550 m above a *Brachystegia* woodland in Zimbabwe.

ROOST:
In the Durban area, Taylor *et al.* (1999: 67) found most of the roosts (72 %) being associated with the outer walls of houses at a height between 2 and 12 metres. The colony size varied from 1 to 5.

In a rural area on Madagascar; Rakotondramanana *et al.* (2017: 133) found a colony roosting on the trunk of a palm tree (*Cocos nucifera*), under dried fronds. They left the roost about 30 minutes after sunset. Ravelomanantsoa *et al.* (2019: 110) report it also roosting in *Tamarindus indica*.

DIET:
They feed primarily on moths (Allen *et al.*, 1917); termite alates such as *Macrotermes falciger* (Happold and Happold, 1988), and other insects (Smithers, 1971). See also (Taylor, 2000: 62; 2005: 275).

PREDATORS:
Demeler (1981: 133) found remains of *T. mauritianus* in pellets of *Bubo africanus* in the Yankari Game Reserve (Nigeria).

Mikula *et al.* (2016: Supplemental data) mention Wahlberg's eagle (*Hieraaetus wahlbergi* (Sundevall, 1851)) as a diurnal avian predator.

Goodman *et al.* (2015c: 78) found the remains of one individual in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

POPULATION:
Structure and Density - *Taphozous mauritianus* is not rare and is easy to find. It usually roosts under covering vegetation on the outer bark of trees (Hutson *et al.*, 2008f; IUCN, 2009).
Trend - 2008 - Unknown (Hutson *et al.*, 2008f; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Kaudern (1914: 12) reported that he received a female with a very small fetus from villagers in Fenerive (Madagascar) on 6 January 1912.

Krutzsch (2000: 113) mentioned that *T. mauritianus* is monoestrous in parts of its range and polyoestrous in others.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births from October to December and f'rom February to March.

PARASITES:
HEMIPTERA
Polyctenidae: *Eoctenes intermedius* (Speiser, 1904) from the Congo (Haeselbarth *et al.*, 1966: 16).

DIPTERA
Nycteribiidae: *Tripselia blainvillii* (Leach, 1817) distributed over the Madagascan region and tropical Africa from west to east between lat. 10° north and south (Haeselbarth *et al.*, 1966: 113). Hutson (2004a: 129) mentions that *Basilia (Tripselia) blainvilli* (Nycteribiidae) is a widespread parasite of *Taphozous mauritianus*. (synonyms: *Nycteribia (Acrocholidia) fryeri*, *Tripselia fryeri*).

SIPHONAPTERA
Ischnopsyllidae: *Chiropteropsylla brockmani* Rothschild, 1915 widespread (Haeselbarth *et al.*, 1966: 192).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Taphozous mauritianus*: Astroviruses, Paramyxoviruses and Rotaviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in one individual from Limpopo Province, South Africa, none were tested positive (0/1).

In their overview table, Maganga *et al.* (2014a: 8) reported that no viruses were ever found in this bat species.

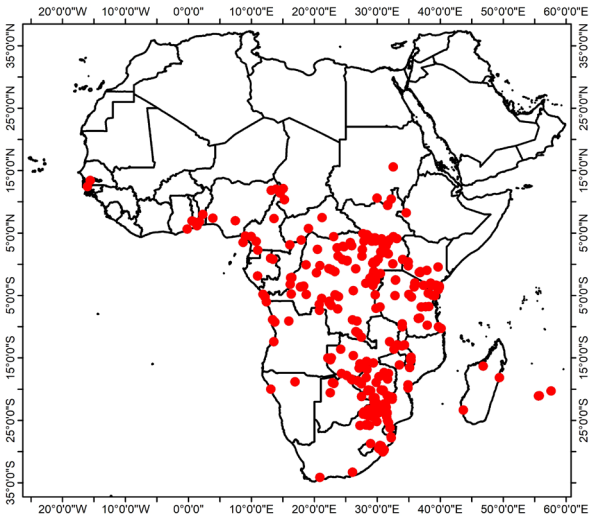


Figure 136. Distribution of *Taphozous mauritianus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burundi, Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea-Bissau, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Nigeria, Réunion, Rwanda, Senegal, Sierra Leone, South Africa, South Sudan, Sudan, Swaziland, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Taphozous nudiventris Cretzschmar, 1830

*1830-1831. *Taphozous nudiventris* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 70, pl. 27b. Publication date: 1830-1831. Type locality: Egypt: Giza province: Giza [30 01 N 31 13 E] [Goto Description]. Lectotype: SMF 4310: ad ♂, skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1824. Old catalog II.J.1.a; see Mertens (1925: 20), Qumsiyeh (1985: 26). - Comments: Kock (1969a: 83) mentioned the type locality as "Egypt, Nubia" and indicates that Giza is the type locality of the lectotype. Corbet and Hill (1992: 87) only mention "Egypt". Allen (1939a: 67) mentioned 1826 as year of description, whereas Kock (1969a: 83) mentioned

1830. Grubb *et al.* (1998: 73) mentions "1830, vel 1831". - Etymology: From the masculine Latin adjective *nùdus*, meaning "naked" and the masculine Latin substantive *vènter*, meaning"belly", as the fur stops short of the end of the body both dorsally and ventrally (see Lanza *et al.*, 2015: 221). (Current Combination)

1838. *Taphozous nudiventer:* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe. Tome Seconde, 2: 280, pl. 60, figs 10 - 12. Publication date: 1838. - Comments: Lapsus (Allen, 1939a: 67). (Lapsus)

1877. *Nycticejus serratus* Heuglin, Reise in Nordost Afrika, 2: 35. Publication date: 1877. Type locality: Sudan: ?Abyssinia: on the Araschkol and nearby mountains: "Sherq el Aqabah" [14 15 N 32 10 E] [Goto Description]. - Comments: According to Simmons (2005) this is an enigmatic taxon, which is variously referred to either *Taphozous nudiventris* (e.g. Allen, 1939a: 67; Koopman, 1993a) or *Scotophilus nigrita leucogaster* (Allen, 1939a) [implying that it might either be *S. dinganii* or *S. leucogaster*], but which may not represent either of those species. Kock (1969a: 83) includes it with a question mark in the synonymy of *Taphozous nudiventris*, and Happold (2013bm: 434) mentions it as a possible synonym of that species.

1885. *Taphozous perforatus var. assabensis* Monticelli, Ann. Accad. O. Costa de Aspir. Nat. Napoli, ser. 1, 1: 78, pl. 7. Type locality: Eritrea: Assab [13 01 N 42 43 E]. - Comments: Allen (1939a: 67) indicates that Monticelli considered it a synonym of *perforatus*, but Senna (1905), who examined the type, says it is *T. nudiventris*. The type specimen was collected by prof. G.B. Licata.

1964. *T(aphozous) mudiuemtris:* Walker, Mammals of the World, I: 241. (Lapsus)

2013. *Taphozous nudiuentris:* Liu, Wang, Zhang, Li, He, Huang, Jiang, Murphy and Shi, Proc. R. Soc. Lond., B 281 (1776): 20132950 3 (for 2014). Publication date: 18 December 2013. (Lapsus)

? *Liponycteris nudiventris:* (Name Combination)

? *Taphozous (Liponycteris) nudiventris:* (Name Combination)

? *Taphozous nudiventris nudiventris:* (Name Combination)

TAXONOMY:

Simmons (2005) assigns four subspecies to *Taphozous nudiventris*: *T. n. kachhensis* Dobson, 1872; *T. n. magnus* Wettstein 1913; *T. n. nudaster* Thomas, 1915; and *T. n. zayidi* Harrison, 1955. The enigmatic taxon *T. n. serratus* Heuglin, 1877 has been variously referred to either *Taphozous nudiventris* (e.g., Allen, 1939a, Koopman, 1993a) or *Scotophilus leucogaster* (e.g., Allen, 1939a; Koopman, 1993a), although it might not represent either of these species. See Felten (1962), Hayman and Hill (1971), Harrison and Bates (1991), Bates and Harrison (1997) and Barkley (1984) for further information on this taxon.

COMMON NAMES:

Albanian: Pipistreli i varrezave barkzhveshur. Arabian: Khafash Abu Bouz, Khaffash. Armenian: Մերկփոր պարկաթև. Azerbaijani: Ilpaqqarı n mə zar yarasası. Basque: Hilobi-saguzar gibelsoil. Belarusian: Маrільнік галабрухі. Bosnian: Golotrbuš ni grobni šišmiš. Breton: Logodenn-dall kof noazh ar bezioù. Bulgarian: Голокоремен прилеп. Castilian: Murciélago de cola libre y vientre desnudo. Catalan: Ratpenat de tomba de carpó nu. Croatian: Golotrbi grobni šišmiš. Chinese: 裸腹墓蝠. "Congolese": Kubukubo, Papo. Czech: Netopýr lysobřichý, Hrobkovec lysobř chý. Danish: Nø genrumpet gravflagermus. Dutch: Kaalbuikgrafvleermuis. English: Naked-bellied Tomb Bat, Naked-rumped Tomb Bat, Egyptian sheath-tailed bat, Naked-rumped bat, Naked-bellied Taphozous. Estonian: Paljaskõ ht-kääpanahkhiir. Finnish: Arohautalepakko. French: Taphien à croupe nue, Taphien à ventre nu. Frisian: Kealbûktimpelflearmûs. Galician: Morcego de tumba de cú espido. Georgian: შიშველმუცელა ქარქაშკუდა. German: Nacktbäuchige Tempelfledermaus, Nacktbauch-Grabfledermaus. Greek: Άτριχη ταφονυχτερίδα Hebrew: Ashman Gadol. Hungarian: Csupaszhasú sírlakó-denevér. Irish Gaelic: Ialtóg nochtphrompach thuama. Italian: Pipistrello delle tombe a ventre nudo, Tafozòo nudivèntre. Latvian: KailvĒ dera sikspā rnis. Lithuanian: Plikapilvis maiš iasparnis. Luxembourgish: Plakegbauchege Griewerflatterer. Macedonian: Торбокрилест лилјак. Maltese: Farfett il-Lejl Għ ieri. Montenegrin: Golotrbuš ni grobni slijepi miš. Norwegian: Nakengumpflaggermus. Polish: Grobownik goł obrzuchy. Portuguese: Morcego-de-ventre-nú. Rhaeto-Romance: Pipistrel da fossa a venter niv. Romanian: Liliacul cu burtă golaş a. Russian: Мешкокрыл голобрюхий. Serbian: Голотрби гробнички м[ј]ешкокрилаш [= Golotrbi grobnič ki m[j]eš kokrilaš]. Scottish Gaelic: Ialtag nochd-thònach thuaim. Slovak: Hladkonos holobruchý. Slovenian: Golotrebuš ni

mavzolejnik. Swedish: Nakengumpsfladdermus. Tamil: திறந்த ரம்ப்டு கல்லறை வௌவால், Iṟanta Rampṭu Kallaṟai Veḷavā. Turkish: Çı plakkarı nlı Mezar Yarasası. Ukrainian: Мішкокрил голобрюхий. Welsh: Ystlum beddrod tinfoel.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Bates *et al.*, 2008; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Bates *et al.*, 2008; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004bp; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is tolerant of a certain level of human disturbance. Loss of some roosts (e.g., in buildings) and use of pesticides probably impact some populations negatively, but overall it is not significantly threatened (Bates *et al.*, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Bates *et al.* (2008) [in IUCN (2009)] report that there are international legal obligations for protection through the Bonn Convention (Eurobats) in areas to which this applies. However, through most of its range, no specific conservation measures are place for this species. It occurs in many protected areas across its wide range. A study on the impacts of pesticides is required, especially ways in which the impact might be minimised.

GENERAL DISTRIBUTION:
Taphozous nudiventris has a much larger range than previously believed. It has been recorded throughout the southern desert and sub-desert belt of western and central Palaearctic, from Morocco, through the Saharan region across northern Africa to Egypt and north through the Middle East to southern Turkey, and the more arid areas of the Indian subcontinent. The most southerly record is from northern Tanzania. There are two isolated records from Myanmar (the southernmost locality being in the general vicinity of Bago (Pegu) Yoma (Bates *et al.*, 2000)).
In South Asia this species is presently known from Afghanistan (Kabul, Kandahar and Nangarhar provinces), Bangladesh, India (Andhra Pradesh, Bihar, Delhi, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal) and Pakistan (Punjab and Sind) (Molur *et al.*, 2002).
It has also been recorded from the Cape Verdian islands (Tranier and de Naurois, 1985: 304)

Native: Afghanistan; Algeria (Horácek *et al.*, 2000: 104); Burkina Faso (Kangoyé *et al.*, 2015a: 614); Chad; Congo (The Democratic Republic of the); Djibouti (Pearch *et al.*, 2001: 396); Egypt; Eritrea (Lavrenchenko *et al.*, 2004b: 138); Ghana; Guinea-Bissau (Castella *et al.*, 2000; Rainho and Ranco, 2001: 38); India; Iran, Islamic Republic of; Iraq; Israel; Jordan; Kenya; Macronesian Islands (Cape Verd islands (Tranier and de Naurois, 1985; de Naurois, 1994; Hazevoet, 1995; Masseti, 2010); Mauritania; Morocco; Myanmar; Niger; Nigeria; Pakistan; Palestinian Territory, Occupied; Saudi Arabia; Senegal; Somalia; Sudan; Syrian Arab Republic; Tanzania; Togo; Turkey; United Arab Emirates (Anonymus, 2008: 38); Yemen.
Presence uncertain: Ethiopia; Kuwait; Libyan Arab Jamahiriya; Oman; Qatar; Tunisia; Uganda; Western Sahara. The records from Lebanon were revoked by Benda and Engelberger (2016: 17).

ECHOLOCATION:
In Jordan, Benda *et al.* (2010b: 204) registered the following parameter for 17 calls: F_{start}: 26.1 ± 1.0 (24.4 - 27.6) kHz, F_{end}: 22.2 ± 0.6 (20.3 - 22.9) kHz, F_{peak}: 24.5 ± 0.5 (23.6 - 25.3) kHz, Pulse duration: 15.4 ± 2.6 (11.0 - 19.5) msec, and Inter-pulse interval: 363.9 ± 115.1 (188.0 - 571.0) msec.

From Israel, Hackett *et al.* (2016: 223) reported the following parameters for 74 calls: Pulse duration: 12.99 ± 3.50 msec, F_{start}: 24.39 ± 1.55 (22.3 - 25.3) kHz, F_{end}: 22.80 ± 1.29 (20.4 - 26.3) kHz, F_{peak}: 23.38 ± 1.31 (21.3 - 26.3) kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).

Karyotype - Đulic (1984), Yaseen *et al.* (1994), Hood and Baker (1986), Asan and Albayrak (2007) reported 2*n* = 42, FN = 64, BA = 24. However, Sreepada *et al.* (1995) reported 2*n* = 42, FN = 66, BA = 26 for specimens from India. In Turkey, Karatas and Sözen (2003: 359) and Arslan and Zima (2014: 7) reported 2*n* = 42, FNa = 64, FN = 68, a meta-/submetacentric X and an acrocentric Y chromosome. The autosomal chromosomes consist of 12 metacentric and submetacentric pairs and 8 acrocentric pairs.

Protein / allozyme - Unknown.

HABITS:
Lucan and Šálek (2012: 235) report on the mobbing behaviour of *T. nudiventris* on a barn owl (*Tyto alba*) in the Dakhla Oasis in Egypt. The bats

were able to detect the owl when it was on route to their roost, but it could not be determined how the bats were able to do this. There were no alarm or distress calls from other bats, so possibly visual cues or acoustic signals (e.g. sounds made by the feathers of the flying owl) might be involved.

ROOST:
Davis (2007: 10) found that in the United Arab Emirates, they may roost in groups of 200 to 1,000+ individuals. During late pregnancy and lactation, the females form separate groups.

DIET:
Benda *et al.* (2012a: 282) report that the most important food categories in Syria, Sudan, Oman and Turkey are Coleoptera (Scarabaeidae) and Orthoptera. Desai *et al.* (2012) [in Benda *et al.*, 2012a: 282] found seasonal changes in the food composition of these bats in Gujarat (India): Coleoptera and Orthoptera prevailed in winter, while Isoptera, Lepidoptera, Orthoptera, Neuroptera and Hymenoptera (Vespoidea) were most consumed in summer.

PREDATORS:
In Algeria, Djilali *et al.* (2016: 161) found remains of 2 *T. nudiventris* specimens in 516 preys captured by the Short-eared Owl (*Asio flammeus*).

POPULATION:
Structure and Density - It is common in some places, and less so in others. It is an uncommon species in the western part of its range: colonies in Africa and the Mediterranean region are generally restricted to a few individuals, although large colonies (dozens to hundreds) have been found in eastern Africa (Bates *et al.*, 2008; IUCN, 2009). The species is common in its range in South Asia, however, a declining trend in its population has been observed in recent years (Bates and Harrison, 1997).
Trend - 2008 - Stable (Bates *et al.*, 2008; IUCN, 2009). *T. nudiventris* populations within the Asia Minor and Levant region are predicted to have a stable population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

REPRODUCTION AND ONTOGENY:
Kurta and Kunz (1987: 82) report that, at birth, the young has a forearm length of about 34.4 % of that of the mother (27.5 against 80.0 mm).

In the United Arab Emirates, Davis (2007: 10) indicates that they arrive in their summer roosts in March, and a single young is born in mid-April. Young are carried by their mothers until 8 weeks of age.

In Gujarat (India), Desai *et al.* (2012: 33) found that pregnancy lasted for 87 days and parturition occurred in August/September. The young reached their full adult size in nine months, when females become sexually mature. The males only become mature at the age of 20 months.

MATING:
In Gujarat (India), Desai *et al.* (2012: 33) report that copulation and fertilization takes place during the last week of March and the first week of April.

PARASITES:
Duszynski (2002: 20) indicates that *T. nudiventris* might be a host for *Eimeria dukei* Lavier, 1927, but as Cerná and Ryšavý (1976) did not provide any proof about the parasite, the identification might be wrong, given the fact that eimerians are reasonably host specific.

HEMIPTERA
Cimicidae: *Leptocimex vespertilionis* Ferris and Usinger, 1957 known only from the Sudan (Zeidab, Khartoum, Wad Medani) (Haeselbarth *et al.*, 1966: 13).

ACARINA
Dermanyssidae: Zumpt and Till (1954: 49) mentions that Hirst (1926) described *Steatonyssus sudanensis* from a "*Liponycteris nudiventris*" from near Khartoum, Sudan, but that this mite hasn't been found since.

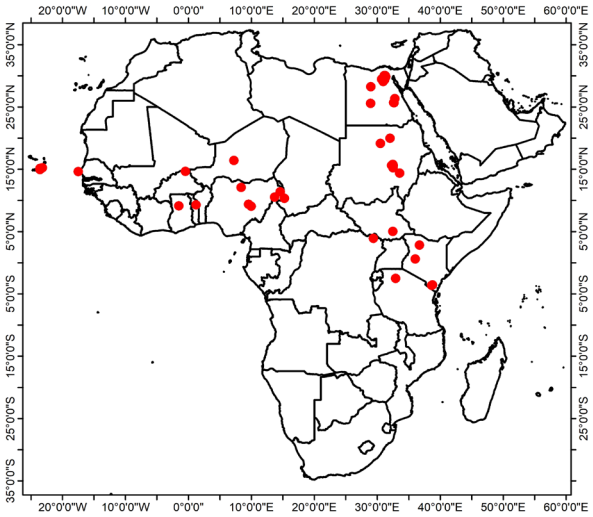


Figure 137. Distribution of *Taphozous nudiventris*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Burkina Faso, Cameroon, Cape Verde, Congo (Democratic Republic of the), Djibouti, Egypt, Ethiopia, Ghana, Kenya, Niger, Nigeria, Senegal, Somalia, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda.

Taphozous perforatus E. Geoffroy St.-Hilaire, 1818

*1818. *Taphozous perforatus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 126. Publication date: 1818. Type locality: Egypt: Kom Ombo [24 26 N 32 57 E]. Holotype: MNHN A.372: ad, alcoholic (skull not removed). Number 198 in Rode (1941: 243), who indicates the type might be a male. - Comments: Allen (1939a: 66) mentioned "Egypt" only as type locality. Restricted to Ombos (=Kom Ombo), between Edfu and Aswan by Kock (1969a: 74): see Meester *et al.* (1986: 32). Mahoney and Walton (1988a: 116) in Grubb *et al.* (1998: 72) considered the date of Geoffroy's publication to be 1813. Gardner and Hayssen (2004: 12) mention that the correct date should be 1818, not 1813 as mentioned on the publication itself. - Etymology: From the masculine scientific Latin adjective *perforàtus*, meaning "perforated", since the tail, as in all Emballonuridae, seems to perforate the uroparagium (see Lanza *et al.*, 2015: 227). (Current Combination)

1877. *Taphozous maritimus* Heuglin, Reise in Nordost Afrika, 2: 25. Publication date: 1877. Type locality: Sudan: Suakin [19 06 N 37 22 E].

1915. *Taphozous perforatus hædinus* Thomas, J. Bomb. nat. Hist. Soc., 24: 62. Publication date: 30 September 1915. Type locality: Kenya: Northern Guaso Nyiro: Chanler Falls [=Chandler's Falls] [00 47 N 38 04 E, 2 000 ft]. Holotype: BMNH 1912.7.1.46: ad ♂, skin only. Collection date: 3 September 1911; original number: 756.

2014. *Taphozous perforates:* Kohl and Kurth, Viruses, 6 (8): 3115. Publication date: 13 August 2014. (Lapsus)

? *Taphozous (Taphozous) perforatus:* (Name Combination)

? *Taphozous perforatus haedinus:* (Name Combination)

TAXONOMY:
Harrison (1958b, 1962) regards *sudani* as a separate species, but is not followed in this by subsequent authors (Rosevear, 1965; Kock, 1969a; Hayman and Hill, 1971; Koopman, 1975). Hayman and Hill (1971) make no attempt to recognize subspecies within *perforatus*, but Kock (1969a) recognizes three, *perforatus*, *sudani* and *haedinus*. Koopman (1975) does not agree entirely with the geographic limits suggested by Kock, but appears to accept the validity of the names proposed. Simmons (2005) recognized three subspecies: *haedinus* Thomas, 1916; *sudani* Thomas, 1915; and *senegalensis* Desmarest, 1820.

COMMON NAMES:
Afrikaans: Egiptiese witlyfvlermuis. Arabian: Khafash abu bouz saghir, Khaffash. Chinese: 埃及墓蝠. Czech: hrobkovec egyptský, wečerník senegalský, wečerník prowrtaný, netopýr slujový. Dutch: Egyptische grafvleermuis. English: Geoffroy's Tomb Bat, Egyptian Tomb Bat, Tomb Bat, Perforated Taphozous bat, African Taphozous. French: Taphien perforé, Taphien des tombeaux, Chauve-souris des tombes egyptiennes. German: Ägyptische Grabfledermaus. Hebrew: Ashman Katan. Italian: Tafozòo perforàto. Portuguese: Morcego das sepulturas do egipto.

ETYMOLOGY OF COMMON NAME:
The specimen from which this species was described was taken by Geoffroy Saint-Hilaire from a royal tomb in Egypt (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Kock *et al.*, 2008d; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Kock *et al.*, 2008d; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004aa; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT D2 ver 3.1 (2001) (Richards *et al.*, 2016b). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
Kock *et al.* (2008d) [in IUCN (2009)] report that human disturbance has been highlighted as a threat to *T. perforatus*, but overall it is unlikely that this species is significantly threatened across its very wide range. In South Asia it is threatened by clearing of thorn forests for agricultural purposes, from mining and stone quarrying. Roost disturbance due to human interference and development of old buildings for tourism purposes is also considered serious threats (C. Srinivasulu *pers. comm.*, Molur *et al.*, 2002).

In Egypt, Mansour *et al.* (2017: 109) found that liver and kidney tissues of these bats contained

0.39 µg/g wet weights of DDTs (its usage was prohibited in Egypt in 1980) and 0.11 µg/g wet weights of PCBs (banned worldwide in 1990s). These values showed variations between sexes and seasons.

CONSERVATION ACTIONS:
Kock *et al.* (2008d) [in IUCN (2009)] report that this species is present in many protected areas, and no direct conservation measures are currently needed for the species as a whole. The species has not been recorded from any protected areas in Pakistan or India. Being a poorly understood species in the region, more studies on distribution, abundance, reproduction and ecology are recommended (Molur *et al.*, 2002).

GENERAL DISTRIBUTION:
Taphozous perforatus occurs widely throughout northern and sub-Saharan Africa, the Arabian Peninsula, and Asia, east to the Indian Subcontinent. In sub-Saharan Africa, records extend along the Nile and east to Ethiopia and northern Somalia, and west to Mauritania, Senegal, Gambia, Guinea-Bissau, Ghana, Burkina Faso, Benin, Niger, and northern Nigeria, and south to Kenya (including Lamu island), Tanzania, Democratic Republic of Congo, Zimbabwe, and Botswana. In southwest Asia, it has been recorded from Israel, Saudi Arabia, Yemen and Oman. In South Asia, this species is presently known to be widely distributed from southern Pakistan (Roberts, 1977) and western India (Gujarat, Madhya Pradesh and Rajasthan) (Bates and Harrison, 1997, Molur *et al.*, 2002) and recently reported from central Eastern Ghats in Andhra Pradesh (Chakraborty *et al.*, 2004). It has been recorded up to 200 m.

Native: Benin; Botswana (Monadjem *et al.*, 2010d: 535); Burkina Faso (Kangoyé *et al.*, 2015a: 614); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 535) ; Djibouti (Pearch *et al.*, 2001: 394); Egypt (Benda *et al.*, 2008f: 1); Ethiopia (Lavrenchenko *et al.*, 2004b: 147); Gambia; Ghana; Guinea-Bissau (Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 37); India; Iran, Islamic Republic of; Israel; Kenya; Mali; Mauritania; Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 535); Niger; Nigeria; Oman; Pakistan; Saudi Arabia; Senegal; Somalia; Sudan; Tanzania; Togo; Uganda; Yemen (Benda *et al.*, 2011b: 30); Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 535); Zimbabwe (Monadjem *et al.*, 2010d: 535).
Presence uncertain: Angola; Côte d'Ivoire; Eritrea; Guinea; Namibia (Cotterill, 2004a: 260); Palestinian Territory, Occupied; United Arab Emirates; Zambia.

ECHOLOCATION:
In Jordan, Benda *et al.* (2010b: 204) registered the following parameters: F_{start}: 31.4 ± 1.5 (29.6 - 34.4) kHz, F_{end}: 27.6 ± 0.6 (26.6 - 28.8) kHz, F_{peak}: 29.2 ± 0.6 (28.5 - 30.0) kHz, duration: 12.4 ± 4.2 (5.8 - 19.7) msec, and interpulse interval: 225.1 ± 110.4 (58.0 - 426.0) msec.
Two sets of data from Iran were presented by Benda *et al.* (2012a: 182): **1**: F_{start}: 31.4 ± 1.6 (30.0 - 34.2) kHz, F_{end}: 29.1 ± 1.7 (28.1 - 31.8) kHz, and F_{peak}: 30.4 ± 2.1 (28.9 - 33.4) kHz; **2** (hand released): F_{start}: 35.9 ± 0.5 (35.3 - 36.6) kHz, F_{end}: 29.9 ± 0.5 (29.4 - 30.8) kHz, F_{peak}: 32.5 ± 0.3 (32.1 - 33.0) kHz, duration: 4.8 ± 0.3 (4.5 - 5.2) msec, and interpulse interval: 47.3 ± 26.8 (12.5 - 81.3) msec.

Götze *et al.* (2016: 2) mentioned that *T. perforatus* doesn't shift the frequency of their echolocation signals (jamming avoidance response - JAR) in the presence of conspecifics.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Đulic (1984) and Yaseen *et al.* (1994) reported 2*n* = 42, FN = 64, BA = 24, a metacentric X chromosome and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

Mansour *et al.* (2016: 66) investigated the presence of heavy metals in bats from two caves in the Saqqara region of Egypt and found that cobalt was not detected in winter and spring, and at very low concentration in the other seasons (ca. 0.01 µg/g tissue). High concentrations were found for Fe, Ca, Mg, and to some extent also Al and Zn, whereas Ba, Cu and Mn were found at relatively lower concentrations, and Cr, Cd, Mo, Ni and Pb were detected at very low concentrations. Ba, Cd, Co, Cr, Mo, Ni and Pb were not detected in kidney tissue. Kidneys of males showed higher concentrations of Mg than those of females.

DIET:
Rydell and Yalden (1997: 72) report that *T. perforatus* mainly feeds on Lepidoptera (moths - 56 % by volume), but also that Isoptera (14 %), Coleoptera (10 %) and Orthoptera (8 %) are major food categories. Furthermore, Hemiptera, Neuroptera, Hymenoptera and Diptera are eaten.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Fox kestrel (*Falco alopex* (Heuglin, 1861)) and the Lanner falcon (*Falco biarmicus* Temminck, 1825) as avian predators.

POPULATION:
Structure and Density - It is common in parts of its African range, but is less common elsewhere. It is found in small colonies (between six to eight individuals) in the southern African subregion (Skinner and Chimimba, 2005). In South Asia the abundance, population size and trends for this species are not known, and the species has only been recorded from a few localities (Bates and Harrison, 1997).
Trend - 2008 - Stable (Kock *et al.*, 2008d; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 113) indicates that *T. perforatus* is a polyoestrous species, although he also mentions (lower on the same page) that it is monoestrous in parts of its range and polyoestrous in others.

PARASITES:
HAEMOSPORIDA
Nycteria medusiformis Garnham and Heisch, 1953 was reported from various countries by Perkins and Schaer (2016: Suppl.).

DIPTERA
From Iran, Benda *et al.* (2012a: 275) report on the presence of *Raymondia huberi* Frauenfeld, 1855 (Streblidae). They also indicate that this bat fly occurs in a broad area from East Africa to the Middle East. Other parasites reported by Benda *et al.* (2012a: 276) from the north African part of the bat's range are: *Argas boueti* Roubaud et Colas-Belcour, 1933, *Chiropteropsylla aegyptia* (Rothschild, 1903), and *C. brockmani* Rothschild, 1915.

VIRUSES:
In bats from Saudi Arabia, Mishra *et al.* (2019: 5) found evidence for the presence of the following viruses: Bat astrovirus, Bat Coronavirus, Bat mastadenovirus, Bat papillomavirus, Chuvirus, Rotavirus.

Bunyaviridae
Willoughby *et al.* (2017: Suppl.) report the presence of Kaeng Khoi orthobunyavirus.

Coronaviridae - Coronaviruses
Gortazar and Segalés (2013: 954) indicate that recently a virus was identified from a Saudi-Arabian *T. perforatus* specimen that showed 100 % nucleotide identity with MERS-CoV (Middle East Respiratory Syndrome) in a conserved portion of its CoV genome, suggesting that this species might be the host for the MERS-CoV virus.

Flaviviridae
Flavivirus
Dakar bat virus was isolated from the pooled bat organs and salivary glands of this species in 1974 (Williams *et al.*, 1964; Kemp *et al.*, 1974). Reported in this species by de Jong *et al.* (2011: 10), Luis *et al.* (2013: Suppl.), Blitvich and Firth (2017: 3), Willoughby *et al.* (2017: Suppl.).

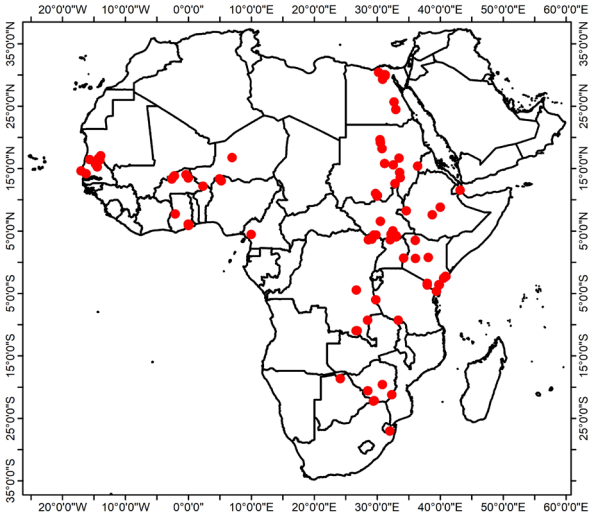


Figure 138. Distribution of *Taphozous perforatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Botswana, Burkina Faso, Cameroon, Congo (Democratic Republic of the), Djibouti, Egypt, Ethiopia, Ghana, Kenya, Mauritania, Niger, Nigeria, Senegal, South Africa, South Sudan, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Taphozous perforatus perforatus E. Geoffroy St.-Hilaire, 1818

*1818. *Taphozous perforatus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 126. Publication date: 1818. Type locality: Egypt: Kom Ombo [24 26 N 32 57 E]. Holotype: MNHN A.372: ad. Presented/Donated by: ?: Collector Unknown. - Comments: Allen (1939a: 66) mentioned "Egypt" only as type locality. Restricted to Ombos (=Kom Ombo), between Edfu and Aswan by Kock (1969a: 74): see Meester *et al.* (1986: 32). Mahoney and Walton (1988a: 116) in Grubb *et al.* (1998: 72) considered the date of Geoffroy's publication to be 1813. Gardner and Hayssen (2004: 12) mention that the correct date should be 1818, not 1813 as mentioned on the publication itself. - Etymology: From the masculine scientific Latin adjective *perforàtus*, meaning "perforated",

since the tail, as in all Emballonuridae, seems to perforate the uroparagium (see Lanza *et al.*, 2015: 227). (Current Combination)

1820. *Taphozous senegalensis* Desmarest, Encyclopédie Méthodique, (Zoologie, Mammalogie), 1: 130. Publication date: 1820. Type locality: Senegal: "Senegal". - Comments: Based on "le lérot-volant" of Daubenton, Mém. Acad. Paris, p. 366, 1759 (see Allen, 1939a: 66).

1958. *Taphozous perforatus swirae* Harrison, Durban Mus. Novit., 5 (11): 144. Publication date: 15 December 1958. Type locality: Nigeria: N Nigeria: Sokoto [13 02 N 05 16 E]. Holotype: BMNH 1967.1226: ad, skin and skull. Collected by: Mrs. Pamela Swire; collection date: 26 August 1958. Skin made up by D.L. Harrison, formerly in HZM collection 12.2690. - Comments: Grubb *et al.* (1998: 72) mention the locality as Sokoyo. Considered a valid subspecies by Grubb *et al.* (1998: 73), but see Kock (1969a: 80 - 81).

? *Taphozous perforatus perforatus:* (Name Combination, Current Combination)

Taphozous perforatus sudani Thomas, 1915

*1915. *Taphozous Sudani* Thomas, Ann. Mag. nat. Hist., 8, 15 (90): 561. Publication date: 1 June 1915. Type locality: Sudan: Equatoria Province: Upper Nile, N of Lado: Mongalla [05 10 N 31 50 E, 500 m] [Goto Description]. Holotype: BMNH 1902.7.4.2: ad ♂. Collected by: W.L.S. Loat Esq. Presented/Donated by: W.L.S. Loat Esq. - Etymology: Referring to the country where the type specimen was collected.

1962. *Taphozous sudani australis* Harrison, Occ. Pap. Nat. Mus. S. Rhod., 26B: 763. Type locality: Zimbabwe: Junction between Limpopo and Shashi rivers [22 12 S 29 23 E] [Goto Description]. Holotype: [Unknown] ad ♂. Collected by: M.P. Stuart Irwin *et al.*; collection date: 5 May 1960; original number: 9932. Rhodesian School Exploration Society Sentinel Ranch Expedition. - Comments: Homonym of *T. australis* Gould, 1854, from Australia (Harrison, 1964a; Kock, 1969a: 74; Meester *et al.*, 1986: 32; Simmons, 2005).

1964. *Taphozous sudani rhodesiae* Harrison, Arnoldia Rhod., 1 (3): 2. - Comments: Renaming of *australis* Harrison, 1962, preoccupied.

? *Taphozous perforatus sudani:* (Current Combination, Current Spelling)

PARASITES:
Polyctenidae: *Eoctenes intermedius* (Speiser 1904) from the Congo (Haeselbarth *et al.*, 1966: 16).

†Genus ***Vespertiliavus*** Schlosser, 1887

*1887. *Vespertiliavus* Schlosser, Beitr. Pal. Geol. Österr.-Ung., 6: 70; pl. I, figs 37, 40, 44, 45, 47, 48, 50-60,.

†***Vespertiliavus aenigma*** (Ravel, 2016)

*2016. *?Vespertiliavus aenigma* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 384, figs 14, 15. Publication date: 30 September 2016. Type locality: Tunisia: Kassérine governorate: Djebel Chambi National Park: Chambi [35 14 03 N 08 45 29 E, 630 m] [Goto Description]. - Etymology: From the latin *aenigma*, meaning enigma, puzzle or riddle, referring to the original morphology of the specimens, which makes it difficult to assign them systematically (see Ravel *et al.*, 2016: 384).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Late lower Eocene to early middle Eocene. Timeframe:

†***Vespertiliavus kasserinensis*** (Ravel, 2016)

*2016. *Vespertliavus kasserinensis* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 377, figs 11 - 13. Publication date: 30 September 2016. Type locality: Tunisia: Chambi [35 14 03 N 08 45 29 E, 630 m] [Goto Description]. - Etymology: The name refers to the city of Kasserine, at the foot of Djebel Chambi (see Ravel *et al.*, 2016: 377).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Timeframe: Late lower Eocene to early middle Eocene.

Family NYCTERIDAE Van der Hoeven, 1855

*1855. *Nycteridae* Van der Hoeven, Handboek Dierkunde, 2nd ed., 2: 1028. - Comments: Type genus: *Nycteris* Cuvier and Geoffroy, 1795. - Etymology: The family gets its name from the Greek name for a bat, *Nycteris* (see Taylor, 2005). (Current Combination)
1866. *Nyctericina* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 91. Publication date: 1 February 1866.
1910. *Petaliidæ* Miller, Proc. Biol. Soc. Wash., 22: 90 [Goto Description]. - Comments: Type genus: *Nycteris* Cuvier and Geoffroy, 1795. Replacement name for Nycteridae Dobson, 1875, due to the fact that Miller (1910) considered the name for the type genus (*Nycteris* Geoffroy 1803) to be antedated by *Nycteris* Borkhausen, 1797).
1984. *Nycteridídae:* Butler, Palaeovert., 14 (3): 117, 185. Publication date: 15 November 1984. (Emendation)
2015. *Nycteriidae:* Anti, Owusu, Agbenyega, Annan, Badu, Nkrumah, Tschapka, Oppong, Adu-Sarkodie, and Drosten, Emerg. Inf. Dis., 21 (8): 1419. Publication date: August 2015. (Lapsus)
2018. *Nicteridae:* Malekani, Musaba, Gembu, Bugentho, Toengaho, Badjedjea, Ngabu, Mutombo, Laudisoit, Ewango, Van Cakenberghe, Verheyen, Asimonyo, Masudi, Bongo and Ngbolua, Nat. Conserv. Res., 3 (1): 68.. Publication date: January 2018. (Lapsus)

TAXONOMY:
Koopman (1993a) mentions Van der Hoeven (1855) as author whereas Corbet and Hill (1992: 88) mention Dobson (1875e: 348).

Flower (1900: 344), Sclater (1901: 120), Medway (1978: 19), Sigé and Legendre (1982), Kock *et al.* (2002: 82), Hand and Archer (2005: 376), and Lanza *et al.* (2015: 232) use the name Nycteridídae, but we follow Gunnell and Simmons (2005: 212), who state (when referring to the Tanzanycteridae): "This family is a new taxon named by Gunnell *et al.* (2003) for *Tanzanycteris*. They spelled the family name Tanzanycteridídae, but we follow Simmons and Geisler (1998: 133, footnote 13), who argued that all bat family group names based on generic epithets ending with the Greek root -nycteris should be spelled the same way, i.e., -nycteridae rather than -nycteridídae."

Simmons and Geisler (1998: 133) state: "Despite Russell and Sigé (1970)'s argument about the nature of the greek root of -nycteris, we think that it is counterproductive to spell some family-group names in one fashion and others differently. Because Nycteridae is widely accepted as the spelling of the family-group name based on *Nycteris*, we argue that all family-group names based on genera ending in -nycteris should be spelled in the same fashion."

COMMON NAMES:
Afrikaans: Langoor-vlermuise. Czech: rýhonosovití, nykteridovití. Dutch: Spleetneusvleermuizen. English: Slit-faced bats, Hollow-faced bats, Hispid bats, Long-eared bats. Finnish: Valkopäälepakot. French: Nyctéridés. German: Schlitznasenfledermäuse, Schlitznasen-Fledermäuse, Schlitznasen. Norwegian: Hullneser, striflaggermus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Shi and Rabosky (2015: 1537) calculated the family-level stem age and crown age to be respectively 52.8 and 17.9 MYA.

The split off from the Emballonuridae occurred according to Amador *et al.* (2016: 22) some 51 MYA, and the diversification within the family started about 33 MYA.

Ravel *et al.* (2016: 415, 418) indicate that *Koufechia gunnelli* represents the basal taxon of the Nycteridae. They also suggest that the family originated in Africa in the Lower Eocene and migrated to Europe in the Oligocene, and even more recently to Asia.

†Genus ***Khoufechia*** Ravel, 2016

*2016. *Khoufechia* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 391. Publication date: 30 September 2016. - Etymology: From the Arabian "*Khoufèche*", a term to designate abat (see Ravel *et al.*, 2016: 391).

TAXONOMY:
Ravel *et al.* (2016: 358) indicate that this genus has a basal position within the Nycteridae.

†***Khoufechia gunnelli*** Ravel, 2016

*2016. *Khoufechia gunnelli* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 391, figs 18 - 20. Publication date: 30 September 2016. Type locality: Tunisia: Kassérine governorate: Djebel Chambi National Park: Chambi [35 14 03 N 08 45 29 E, 630 m] [Goto Description]. - Etymology: In honour of Gregg Gunnell for his numerous contributions to the study of African paleogene bats (see Ravel et al., 2016: 394).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Late lower Eocene to early middle Eocene.
Timeframe:

Genus ***Nycteris*** G. Cuvier and E. Geoffroy, 1795

*1795. *Nycteris* G. Cuvier and E. Geoffroy, Mag. Encyclop. , 1 année 2: 186. - Comments: Type: *Vespertilio hispidus* Schreber, 1774. Gray *et al.* (1999: 1) mention Geoffroy and Cuvier, 1795 as authors. - Etymology: From the Greek "*νυκτοριο*", meaning "nocturnal", or from the feminine Greek substantive "*νυκτερίς*" (nykterís), "bats" (see Lanza *et al.*, 2015: 234). (Current Combination)
1803. *Nicteris:* Desmarest, Nouveau Dictionnaire d'Histoire Naturelle, 15: 501. (Lapsus)
1813. *Nycterus:* G. Fischer, Zoognosia, ed. iii, I: 18. (Lapsus)
1838. *Petalia* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 494. Publication date: 1 February 1838. - Comments: Type species: *Nycteris Javanicus* E. Geoffroy Saint-Hilaire, 1813.
1845. *Nyctoris:* ?, London Encyclopedia, 22: 738. (Lapsus)
1866. *Nycterops* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 83. Publication date: May 1866 [Goto Description]. - Comments: Type species: *Nycterops pilosa* Gray, 1866 (=*Vespertilio hispidus* Schreber, 1774). - Etymology: Derived from Nycteris and the Greek "*οψ*", meaning aspect (see Palmer, 1904: 465).
1866. *Pelatia:* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 83. Publication date: May 1866. (Lapsus)
1977. *Petelia:* Lekagul and McNeeley, Mammals of Thailand, 107. (Lapsus)
1998. *Nyteris:* Van Cakenberghe and De Vree, Bonn. zool. Beitr., 48 (2): 123. (Lapsus)
? *Nycteris sp.:*

TAXONOMY:
Meester *et al.* (1986) state that Andersen (1912b) divided *Nycteris* into four groups, three of which, viz. *hispida*, *aethiopica* (= *macrotis* - Koopman, 1965, 1975) and *thebaica*, occur in Southern Africa. The fourth group (*arge*) is limited to the African forest block.
Ellerman and Morrison-Scott (1951 1: 106), Corbet and Hill (1992: 88) mention *Nycteris* to be a *nomen nudum*, which was validated by Opinion 111 (Anonymus, 1929) [See also Stiles (1914: 66)]. Revised by Van Cakenberghe and De Vree (1985, 1993a, 1993b, 1999a). A key is provided by Gray *et al.* (1999: 1, Mammalian Species, 612).

Known species of the genus *Nycteris*: ***arge*** Thomas, 1903; ***aurita*** (K.Andersen, 1912); ***gambiensis*** (K. Andersen, 1912); ***grandis*** Peters, 1865; ***hispida*** (Schreber, 1775); ***intermedia*** Aellen, 1959; *javanica* E. Geoffroy, 1813 – Java, Nusa Penida (near Bali) and Kangean Isl (Indonesia) (Simmons, 2005: 392); ***macrotis*** Dobson, 1876; ***madagascariensis*** Grandidier, 1937; ***major*** (K. Andersen, 1912); ***nana*** (K. Andersen, 1912); ***parisii*** De Beaux, 1924;

thebaica E. Geoffroy, 1818; *tragata* (K. Andersen, 1912) – Burma, Thailand, western Malaysia, Sumatra, Borneo (Simmons, 2005: 394). ***vinsoni*** Dalquest, 1965; ***woodi*** K. Andersen, 1914.

COMMON NAMES:
Czech: rýhonosi, šerowecové, dutonosecové, nykteridy. English: Hollow-faced bats, Slit-faced bats. French: Nyctères. German: Schlitznasen-Fledermäuse, Schlitznasen. Italian: Nitterìdi, Nicterìdi. Kiluba (DRC): Kasusu. Kiande (DRC): Kakorokombe.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery (2007: 619) reported on the presence of *Nycteris* sp. in Pleistocene deposits at Wonderwerk Cave, South Africa. The approximate fossil date for the genus was reported by Shi and Rabosky (2015: 1532) to be about 5.332 million years ago.

MOLECULAR BIOLOGY:
In their study of the *FoxP2* gene, Li *et al.* (2007: 6) found that *Nycteris* shows the highest rate of non-synonymous change at exon 17, which they link with the evolution of nasal emission, multi-harmonic call structure and prey location by passive listening.

PARASITES:
HAEMOSPORIDA
Perkins and Schaer (2016: Suppl.) reported *Nycteria medusiformis* Garnham and Heisch, 1953 from various countries in Africa.

ACARI
Demodecidae: Fain (1960: 84) described *Stomatodex cornett* from a *Nycteris* sp. from Astrida (=Butare), Rwanda.
Myobiidae: Fain (1994: 1280) indicates that one species of *Ewingana* has been reported from a *Nycteris*, but this is possibly due to a museum contamination. Various species of the genus *Nycteris* do harbour one species of the monotypic genus *Nycterimyobia* (also see Fain, 1994: 1280).

DIPTERA
Nycteribiidae: *Penicillida pachymela* Speiser, 1901, from Somalia, Sudan, Kenya, Tanzania, the Congo, Guinea and the Cameroon Mts (Haeselbarth *et al.*, 1966: 114).

VIRUSES:
Coronaviridae
None of the 18 Kenyan bats tested positive for CoV (Tao *et al.*, 2017: Suppl.).

Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that one of two examined *Nycteris* specimens from Kenya tested positive for *Paramyxovirus* sequences.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Horton *et al.* (2014: Table S1) tested 1 Tanzanian and 1 Kenyan *Nycteris* sp. specimen, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

Nycteris arge Thomas, 1903

*1903. *Nycteris arge* Thomas, Ann. Mag. nat. Hist., ser. 7, 12 (72): 633. Publication date: 1 December 1903. Type locality: Cameroon: SW Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. Holotype: BMNH 1904.2.8.2: ad ♂, skull and alcoholic. Collected by: George Latimer Bates Esq. - Etymology: From the Greek "*argos*" meaning shiny, bright, nimble, swift, rapid. (Current Combination)
1910. *Petalia arge:* Thomas and Wroughton, Trans. Linn. Soc. Lond., 19 (5) (63): 488. (Name Combination)
2002. *Nycteris argae:* Fenton and Bogdanowicz, Can. J. Zool., 80: 1008. (Lapsus)

TAXONOMY:
Formerly included *intermedia* (Hayman and Hill, 1971: 19), but see Van Cakenberghe and De Vree (1985).

arge species group (Van Cakenberghe and De Vree, 1985; Simmons, 2005: 391).

COMMON NAMES:
Chinese: 淡色凹脸蝠. Czech: rýhonos guinejský. English: Bates's Slit-faced Bat, Nimble Slit-faced Bat. French: Nyctère de Bates. German: Bates' Schlitznasen-Fledermaus. Kiluba (DRC): Katutu. Spanish (Castillian): Murciélago de Cara Hueca.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bf; IUCN, 2009).

Assessment History -

2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bf; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004by; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
It parts of its range it is presumably threatened by conversion of forest to agricultural land, and the logging of roost trees (Mickleburgh *et al.*, 2008bf; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bf) [in IUCN (2009)] reported that in view of the species wide range, it is presumably present in some protected areas. Further studies are needed into the distribution and threats to this species.

GENERAL DISTRIBUTION:
Nycteris arge is widely distributed over much of West and Central Africa. It ranges from Sierra Leone in the west, through West Africa and the Congo Basin to western Uganda, southern Sudan, western Kenya, northern Tanzania and Burundi. It is distributed as far south as southern parts of the Democratic Republic of the Congo and northern Angola.

Amori *et al.* (2016: 217) [referring to Grubb *et al.* (1998: 74)] pointed out that the record from Togo (reported until ACR, 2015) is actually from Ghana.

Native: Angola (Hayman, 1963; Simmons, 2005: 391; Monadjem *et al.*, 2010d: 547); Burundi; Cameroon (Simmons, 2005: 391); Central African Republic (Lunde *et al.*, 2001: 537); Congo (Bates *et al.*, 2013: 335); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Simmons, 2005: 391; Monadjem *et al.*, 2010d: 547); Côte d'Ivoire; Equatorial Guinea [= Bioko] (Simmons, 2005: 391); Gabon; Ghana (Decher and Fahr, 2007: 12 - 13); Guinea (Fahr *et al.*, 2006a: 72); Kenya (Webala *et al.*, 2004: 171; Simmons, 2005: 391); Liberia (Monadjem and Fahr, 2007: 50); Nigeria; Rwanda; Sierra Leone (Simmons, 2005: 391); Sudan (Simmons, 2005: 391); Tanzania; Uganda (Kityo and Kerbis, 1996: 60).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data for 11 specimens: Fa: 45.23 ± 0.880 mm, mass: 10.9 ± 0.94 g, wing loading: 5.9 ± 0.50 N/m^2, aspect ratio: 4.8 ± 0.49.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
Eisenberg and Wilson (1978: 743) indicate that *N. arge* has a relatively larger cranial volume than its congeners, which they link to differences in feeding strategy and habitat selection.

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 3.15 - 4.28 mm in length; the shaft is long, slender, parallel-sided and essentially straight; the base is expanded and round; in lateral profile it is sometimes angled ventrally while the tip is simple, with only a small expansion (Thomas *et al.*, 1994: 19).

ECHOLOCATION:
From western Uganda, Monadjem *et al.* (2011: 32) reported two different sets of data for two calls each: F_{min}: 21.55 kHz, F_{max}: 22.11 kHz, F_{char}: 21.88 kHz, F_{knee}: 21.77 kHz, duration: 4.1 msec; F_{min}: 46.43 kHz, F_{max}: 47.83 kHz, F_{char}: 47.23 kHz, F_{knee}: 47.23 kHz, duration: 5.9 msec. The authors indicate that these different data might represent harmonics.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
R.B. Woosnam [in Thomas, 1910b: 488] reported it to be flying low over the water of the Aruwimi River.

Monadjem *et al.* (2016y: 367) recorded this species widely from forested habitats between 400 and 1,000 m in the Mount Nimba area.

POPULATION:
Structure and Density - This is a common species (Mickleburgh *et al.*, 2008bf; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008bf; IUCN, 2009).

PARASITES:
HAEMOSPORIDA
Schaer *et al.* (2015: 381) found *Nycteria* cf. *eradi* parasites in *N. arge* from Sierra Leone. Landau *et al.* (2012: 142) and Perkins and Schaer (2016: Suppl.) mention this parasite as *Nycteria eradi* Rosin, Landau *et al.*, 1978.

HEMIPTERA
Polyctenidae: *Eoctenes nycteridis* (Horváth 1910) from Liberia, Congo, Ruanda-Urundi, Tanzania, Uganda and Eritrea (Haeselbarth *et al.*, 1966: 17).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested [as *N. argae*] between 1986 and 1999, for antibody to

SARS-CoV in sera in one individual from Oriental Province, DRC, none tested positive (0/1).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Kenya, Liberia, Nigeria, Sierra Leone, South Sudan, Tanzania, Uganda.

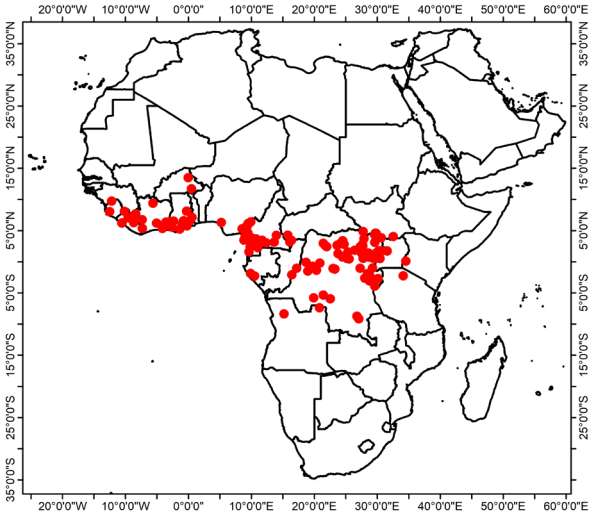


Figure 139. Distribution of *Nycteris arge*

Nycteris aurita (K. Andersen, 1912)

*1912. *Petalia aurita* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): 547. Publication date: 1 November 1912. Type locality: Kenya: Kilifi [03 38 N 39 51 E] [Goto Description]. Holotype: BMNH 1889.1.11.1: ad ♀, skull and alcoholic. Collected by: G.D. Trevor-Roper. Presented/Donated by: G.D. Trevor-Roper. - Etymology: From the feminine Latin adjective *aurìta*, meaning "long-eared" (see Lanza *et al.*, 2015: 236).

1924. *Nycteris aurita:* de Beaux, Atti Sic. Lig. Sci. Lett., n.s., 3 (1): ???. (Name Combination, Current Combination)

1957. *Nycteris hispida aurita:* Ansell, Ann. Mag. nat. Hist., ser. 12, 10: ???. (Name Combination)

GENERAL COMMENTS:
Lanza *et al.* (2015: 236) pointed out that we erroneously mentioned Kitui as type locality for this taxon, whereas this should be Kilifi.

TAXONOMY:
Nycteris aurita is often considered as a synonym or subspecies of *N. hispida* (Blyth, 1863: 391), but see Van Cakenberghe and De Vree, 1993b).

hispida species group Van Cakenberghe and De Vree, 1993b; Simmons, 2005: 391).

COMMON NAMES:
Chinese: 安氏凹脸蝠. Czech: rýhonos východoafrický. English: Andersen's Slit-faced Bat. French: Nyctère d'Andersen, Nyctère à longues oreilles. German: Andersens Schlitznasen-Fledermaus. Italian: Nitterìde orecchiùta, Nicterìde orecchiùta.

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population (it is common where it has been recorded), and because its savanna habitat is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008r; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008r; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004n; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are poorly known, however, it is likely that there are no major threats to the species, as it has been recorded from an extensive habitat that is not severely declining (Mickleburgh *et al.*, 2008r; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008r) [in IUCN (2009)] report that it is not known if there are any direct conservation measures in place, or if the species is present within any protected areas. Further studies are needed into the distribution, natural history and possible threats to this little known species.

GENERAL DISTRIBUTION:
Nycteris aurita is known from scattered records in East Africa. It has been recorded from northern Somalia in the north of its range, through southern

Ethiopia and Sudan, into Kenya and Tanzania in the south.

Native: Ethiopia (Lavrenchenko *et al.*, 2004b: 147; Simmons, 2005: 391); Kenya (Simmons, 2005: 391); Somalia (Simmons, 2005: 391); Sudan; Tanzania (Simmons, 2005: 391), United Republic of; Uganda; Zambia.

POPULATION:
Structure and Density - There is little information available on the abundance of this species, but it seems to be common where it has been recorded (Mickleburgh *et al.*, 2008r; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008r; IUCN, 2009).

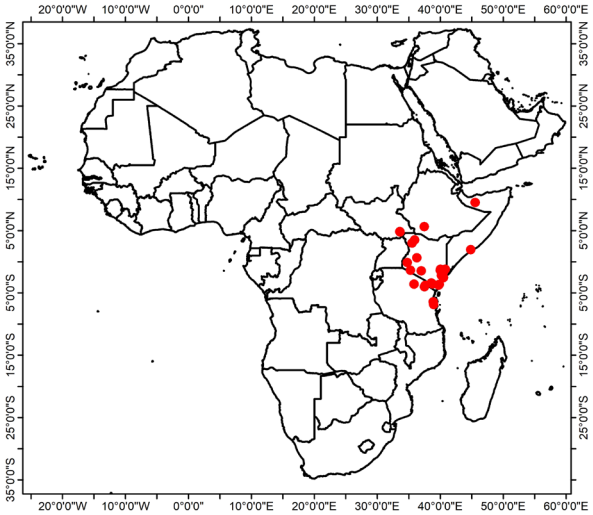


Figure 140. Distribution of *Nycteris aurita*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia, Kenya, Somalia, South Sudan, Tanzania.

Nycteris cf. parisii De Beaux, 1924

2016. *Nycteris cf. parisii* Kruskop, Benda, Vasenkov and Lavrenchenko, Lynx, 47: 60.

TAXONOMY:
Due to the lack of molecular genetic analyses, Kruskop *et al.* (2016: 60) indicate that taxonomic composition and species delimitations in the *N. woodi* complex are rather uncertain. Van Cakenberghe and De Vree (1985) suggested that *parisii* and *benuensis* are synonyms of *N. woodi*, but based on bacular morphology, Thomas *et al.* (1994) suggested that *parisii* is specifically different from *woodi*. Kruskop *et al.* (2016: 60) state that the shape of the baculum of the specimens they report on, is more like that of *woodi*, and not like that of *parisii* which would be the species involved if the complex contains more than one species.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia.

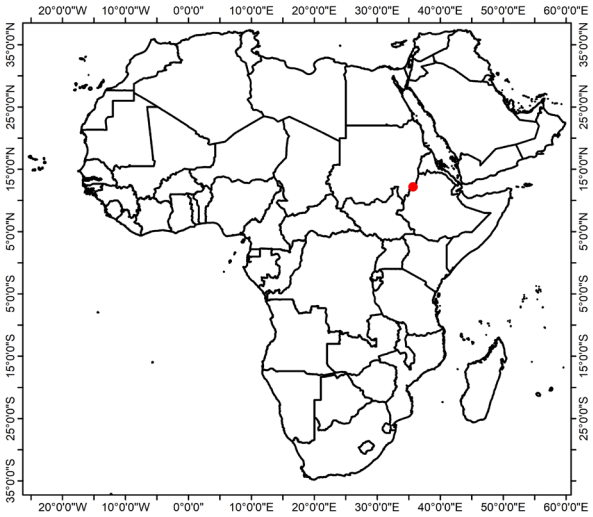


Figure 141. Distribution of *Nycteris* cf. *parisii*

Nycteris gambiensis (K. Andersen, 1912)

*1912. *Petalia gambiensis* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): 548. Publication date: 1 November 1912. Type locality: Senegal: Dialocote [13 25 N 13 20 W] [Goto Description]. Holotype: BMNH 1911.6.10.10: ad, skin and skull. Collected by: G.F. Owen; collection date: 7 May 1910; original number: A5.

1923. *P[etalia (Nycteris)] th[ebaica] gambiensis:* de Beaux, Atti Soc. ital. Sci. nat., 62: 96. (Name Combination)

1929. *Nycteris thebaica gambiensis:* Ingoldby, Ann. Mag. nat. Hist., ser. 10, 3: ???. (Name Combination)

1939. *Nycteris gambiensis:* G.M. Allen, Bull. Mus. comp. Zool., 83: 69. (Name Combination, Current Combination)

1975. *[Nycteris] gambianus:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 381. (Lapsus)
2007. *Nycteris cambiensis:* Nel and Markotter, Crit. Rev. Microbiol., 33 (4): 308. (Lapsus)

TAXONOMY:
Reviewed by Van Cakenberghe and De Vree (1999a).

thebaica species group (Van Cakenberghe and De Vree, 1999a; Simmons, 2005: 392).

COMMON NAMES:
Czech: rýhonos západoafrický. English: Gambian Slit-faced Bat. French: Nyctère de Gambie. German: Gambia Schlitznasen-Fledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Bergmans and Fahr, 2008; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Bergmans and Fahr, 2008; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Bergmans and Fahr, 2004; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species overall. It is threatened in parts of its range by habitat loss, often resulting from conversion of savanna to agricultural use (Bergmans and Fahr, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Bergmans and Fahr (2008) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species, and it is not known if it occurs in any protected areas. There is a need to protect roosts of this species, and to better determine the eastern limits of the species range.

GENERAL DISTRIBUTION:
Nycteris gambiensis is a West African species which ranges from Senegal and the Gambia, through most of West Africa, as far east as central Nigeria. There is a single uncertain record from Cameroon which requires verification.

A record from Sierra Leone is in error (J Fahr *pers. comm.* in Simmons, 2005: 392)

Native: Benin (Simmons, 2005: 392); Burkina Faso (Simmons, 2005: 392; Kangoyé *et al.*, 2015a: 615); Côte d'Ivoire (Simmons, 2005: 392); Gambia (Simmons, 2005: 392); Ghana (Simmons, 2005: 392); Guinea (Simmons, 2005: 392; Decher *et al.*, 2016: 264); Guinea-Bissau (Monard, 1939; Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 43; Simmons, 2005: 392); Mali; Mauritania; Niger; Nigeria (Simmons, 2005: 392); Senegal (Simmons, 2005: 392); Togo (Simmons, 2005: 392).
Uncertain: Cameroon; Sierra Leone (Simmons, 2005: 392).

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 2.88-3.42 mm in length; the shaft is slender and parallel-sided; the base is expanded and in lateral view is angled ventrally, while the tip is simple with a slight expansion (Thomas *et al.*, 1994:22).

POPULATION:
Structure and Density - It can be a locally common species (Bergmans and Fahr, 2008; IUCN, 2009).
Trend - 2008 - Unknown (Bergmans and Fahr, 2008; IUCN, 2009).

VIRUSES:
Willoughby *et al.* (2017: Suppl.) report the following viruses: Chobar Gorge virus, Lagos bat lyssavirus, Saboya virus.

Coronaviridae - Coronaviruses
Betacoronavirus
Annan *et al.* (2013: 457) reported that 46 out of 185 (24.9 %) *N.* cf. *gambiensis* specimens tested in Ghana were found to be positive for 2c *Betacoronavirus*. They also found that juvenile bats and lactating females were more likely to be infected than adult males and non-lactating females.

Flaviviridae
Flavivirus
de Jong *et al.* (2011: 10) and Luis *et al.* (2013: suppl.) reported Saboya virus occurring on this species. Calderon *et al.* (2016: 8) also mention Sokuluk virus.

Reoviridae
Orbivirus
Fomede virus - reported in the CDC's Arbovirus Catalogue, to have been isolated in 1978 from the Republic of Guinea, from the brain and internal organs of *N.* cf. *gambiensis*. Reported by de Jong *et al.* (2011: 11) and Luis *et al.* (2013: suppl.).

Rhabdoviridae
Lyssavirus - Rabies related viruses

Lagos bat virus - Isolated in Guinea (Institute Pasteur, 1985).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Guinea-Bissau, Nigeria, Senegal, The Gambia, Togo.

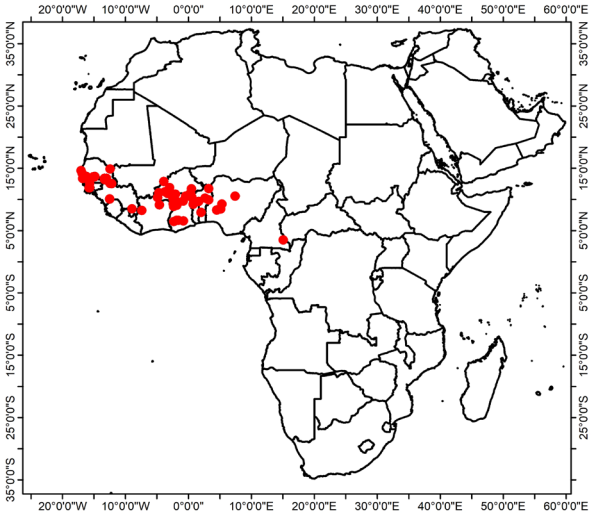


Figure 142. Distribution of *Nycteris gambiensis*

Nycteris grandis Peters, 1865

*1865. *Nycteris grandis* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 351, 358. Type locality: Ghana: vicinity of Elmina [05 05 N 01 21 W] [Goto Description]. Paralectotype: RMNH MAM.27348: ad, skin only. Collected by: Colonel C.J.M. Nagtglas; collection date: 1863. - Comments: Grubb *et al.* (1998: 76) mention the type locality as 'Usually given as "Guinea" but the type, in the Leiden Museum, was collected in 1863 by Nagtglas, and ascribed to Côte d'Or (Jentink, 1888b: 170). The type locality may be further restricted to the vicinity of Elimina [Ghana] which is the only definite locality Jentink cited for any of the Nagtglas material'. The publicatiion covers a meeting held on 13 July 1865. - Etymology: From the Greek "*grandis*" meaning magnificent (Brown, 1991; Jaeger, 1972, both in Hickey and Dunlop, 2000: 3). (Current Combination)

1866. *Nycteris Baikii* Gray, in: Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 672 (for 1866). Type locality: "Africa": West Africa: Baikie. - Comments: Meester *et al.* (1986: 34) mention "Gray in Peters" as author. Nomen nudum.

1912. *Petalia grandis:* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): ???. (Name Combination)

1923. *Nycteris marica* Kershaw, Ann. Mag. nat. Hist., ser. 9, 12 (70): 534. Publication date: 1 October 1923. Type locality: Tanzania: Kilosa: Tindiga [06 55 S 37 20 E] [Goto Description]. Holotype: BMNH 1923.8.2.1: ad, skin and skull. Collected by: Professor Arthur Loveridge; collection date: 24 January 1922.

1925. *Nycteris proxima* Lönnberg and Gyldenstolpe, Ark. Zool. Stockholm, 17B (9): 1. Publication date: 14 May 1925. Type locality: Congo (Democratic Republic of the): Semliki valley: Kartoushi [00 44 N 29 34 E] [Goto Description]. Holotype: [Unknown] ad ♂. Collection date: 11 March 1921; original number: 813. See Lönnberg and Gyldenstolpe (1925: 2).

1938. *[Nycteris] narica:* Frechkop, Exploration du Parc National Albert, 50. (Lapsus)

1938. *[Nycteris] praxima:* Frechkop, Exploration du Parc National Albert, 50. (Lapsus)

1981. *N[ycteris] g[randis] marica:* Kock, Senckenb. biol., 61 (5/6): 325. (Name Combination)

1991. *Nycteris graudis:* Baker, Honeycutt and Van den Bussche, Bull. Am. Mus. Nat. Hist., 206: 46. (Lapsus)

2016. *Nycteris grande:* Bhatnagar, Smith, Rai and Frahm, Anat. Rec., 299: 495. Publication date: 21 January 2016. (Lapsus)

TAXONOMY:
Reviewed by Van Cakenberghe and De Vree (1993b). *N. marica* is sometimes recognized as a distinct savanna subspecies, but this does not seem justified based on morphology (Van Cakenberghe and De Vree, 1993b; Hickey and Dunlop, 2000; Simmons, 2005: 392).

hispida species group (Van Cakenberghe and De Vree, 1993b; Simmons, 2005: 392).

COMMON NAMES:
Afrikaans: Groot spleetneusvlermuis. Chinese: 魁凹脸蝠. Czech: rýhonos velký, nycteris velká. English: Large Slit-faced Bat. French: Grande nyctère. German: Große Schlitznase, Große Schlitznasen-Fledermaus. Portuguese: Morcego grande orelhudo.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bg; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bg; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cd; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
In general, there appear to be no major threats to this species as a whole. It is threatened in parts of its range by habitat loss, particularly the logging of large trees used for roosting. Some populations may be threatened by overharvesting for subsistence food (Mickleburgh *et al.*, 2008bg; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bg) [in IUCN (2009)] report that in view of the species wide range, it is presumably present in a number of protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Nycteris grandis is broadly distributed in sub-Saharan Africa. It ranges from Senegal, through West and Central Africa, to southern Sudan, southeastern Kenya and eastern Tanzania, with scattered records as far south as Zambia, Zimbabwe and Mozambique. Also found on the islands of Zanzibar and Pemba (Simmons, 2005: 392). It is a lowland species.

Native: Benin; Burkina Faso (Kangoyé *et al.* (2012: 6025; 2015a: 615); Cameroon; Central African Republic (Lunde *et al.*, 2001: 537); Congo (Bates *et al.*, 2013: 335); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547); Côte d'Ivoire; Equatorial Guinea (Fahr and Ebigbo, 2003: 128); Gabon; Ghana; Guinea; Kenya (Simmons, 2005: 392); Liberia (Fahr, 2007a: 103); Malawi (Happold *et al.*, 1988; Happold and Happold, 1997b: 815; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547); Mozambique (Smithers and Lobão Tello, 1976; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547; Monadjem *et al.*, 2010c: 381); Nigeria; Senegal (Simmons, 2005: 392); Sierra Leone; Sudan; Tanzania (Stanley and Goodman, 2011: 43) (including the islands of Pemba and Unguja [O'Brien, 2011: 289]); Togo (Capo-Chichi *et al.*, 2004: 162); Uganda (Kityo *et al.*, 2009: 137); Zambia (Ansell, 1969; Ansell, 1986; Monadjem *et al.*, 2010d: 547); Zimbabwe (Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Hickey and Dunlop (2000).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Hickey and Dunlop (2000).

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 3.45-3.54 mm in length and is small in relation to body size; the shaft is stout and deep, unlike that of any other *Nycteris* examined, the base is narrow and in lateral profile is usually angled ventrally, while the tip is squared, with a pronounced ventral projection (Thomas *et al.*, 1994: 21).
For a description of the skull, ears and tragus, and wingshape and aspect ratio see Hickey and Dunlop (2000).

SEXUAL DIMORPHISM:
N. grandis is not sexually dimorphic in size (Hickey and Dunlop, 2000: 1).

ECHOLOCATION:
See Taylor (1999b) and Hickey and Dunlop (2000).

Keeley *et al.* (2018: 14) indicate that echolocation calls range between 17 and 114 kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Porter *et al.* (2010) reported for a single male Gabonese specimen as $2n = 42$, with 34 biarmed and 6 acrocentric autosomes, with an X as a large subtelocentric and the Y is a small acrocentric.
Protein / allozyme - Unknown.

HABITAT:
This species has been recorded from a variety of lowland habitats, ranging from lowland tropical moist forest (often found near to swampy sites) to drier savanna areas and Miombo woodland (Rosevear, 1965; Fenton *et al.*, 1990; Hickey and Dunlop, 2000; Skinner and Chimimba, 2005). Kangoyé *et al.* (2015a: 615) report it from a gallery forest in Lera, Burkina Faso.

In the Mount Nimba area, Monadjem *et al.* (2016y: 367) recorded this species from forested and forest edge habitats between 400 and 700 m.

HABITS:
See Hickey and Dunlop (2000).

ROOST:
Nycteris grandis generally roosts in hollow trees, but is also found in man made structures such as houses (Fenton *et al.*, 1990; 1993), disused water towers (Fenton *et al.*, 1990; 1993) and culverts (Rosevear, 1965). They may also roost in hollow fallen logs, and holes or small caverns in rocks (Rosevear, 1965; Hickey and Dunlop, 2000).

DIET:
Fenton *et al.* (1981: 463; 1990: 2, 4) found that in the Mana Pools National Park, in Zimbabwe, *N. grandis* primarily fed on frogs (e.g. *Ptychadena anchietae, P. mossambica, P.* spp., *Xenopus laevis*), bats (e.g. *Nycteris thebaica, Rhinolophus* cf *darlingi*, "*Pipistrellus* cf. *nanus*", *Hipposideros* cf. *caffer*), arthropods, but sometimes also captured birds (*Cisticola fulvicapilla, Apalis flavida*) and fish (*Tilapia rendalli*, *Barbus* sp., *Alestes* sp.).

POPULATION:
Structure and Density - It appears to be a rare, or rarely recorded, species. The species occurs in small colonies, but is usually found only as single animals or in pairs (Mickleburgh *et al.*, 2008bg; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bg; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
See Hickey and Dunlop (2000).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 115), referring to Verschuren (1957), indicates that *N. grandis* is polyoestrous with two or more (continuous) cycles per year, a postpartum oestrus and often no anoestrus.

Stanley and Goodman (2011: 43), referring to Verschuren (1957), report on a pregnant female collected on 31 July 1993 in the East Usambara Mountains (Tanzania).

PARASITES:
Little information is available regarding parasites of *N. grandis* (Hickey and Dunlop, 2000).

HAEMOSPORIDA
Schaer *et al.* (2015: 381) found two different forms of *Nycteria* sp. parasites in *N. grandis* from Sierra Leone. Karadjian *et al.* (2016: 9834) mentioned *Nycteria medusiformis* and *Nycteria* sp. from the DRC.

HEMIPTERA
Polyctenidae: *Eoctenes nycteridis* (Horváth, 1910) from Liberia, Congo, Ruanda-Urundi, Tanzania, Uganda and Eritrea (Haeselbarth *et al.*, 1966: 17).

SIPHONAPTERA
Pulicidae: *Echidnophaga aethiops* Jordon and Rothschild, 1906 locality not mentioned (Haeselbarth *et al.*, 1966: 135).

VIRUSES:
Keymer (1971) reported "broad trypanosomes" from four of six specimens collected from Zambia.

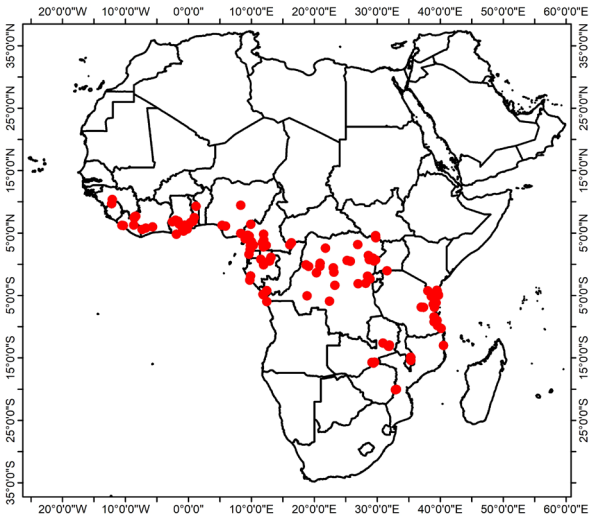


Figure 143. Distribution of *Nycteris grandis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Mozambique, Nigeria, Sierra Leone, Tanzania, Togo, Zambia, Zimbabwe.

Nycteris hispida (Schreber, 1774)

*1774. *Vespertilio hispidus* Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, 1 (8): pl. 56 + 1 (9): 169, 188. Publication date: 1774. Type locality: Senegal: "Senegal" [Goto Description]. - Etymology: From the masculine Latin adjective *hìspidus*, meaning "shaggy", referring to the bristly hair around the facial slit (see Lanza *et al.*, 2015: 242).

1813. *Nycteris Daubentonii* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 20: 19. Publication date: August 1813. Type locality: Senegal: "Senegal" [Goto Description].
1840. *Nycteris hispida:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 3: ???. (Name Combination, Current Combination)
1843. *Nycteris poensis* Gray, Catalogue of the species of mammals of the British Museum, 24. Publication date: 13 May 1843. Type locality: Equatorial Guinea: Bioko [formerly Fernando Po] [ca. 03 21 N 08 40 E] [Goto Description]. Holotype: BMNH 1855.12.26.252: ad ♀, skin and skull. Presented/Donated by: Captain E. Downes R.N. Intended specimen = *Rhinolophus martini* Fraser: see Meester *et al.* (1986: 33). - Comments: Considered a nomen nudum by Dobson (1878: 162) and Allen (1939a: 69).
1843. *Rhinolophus Martini* Fraser, Proc. zool. Soc. Lond., 1843, V (cxxi): 25. Publication date: July 1843. Type locality: Equatorial Guinea: Bioko [formerly Fernando Po] [ca. 03 21 N 08 40 E] [Goto Description].
1852. *Nycteris villosa* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 48, pl. 11. Publication date: 1852. Type locality: Mozambique: Inhambane [24 00 S 35 28 E] [Goto Description]. Holotype: ZMB 394/85665: ♂, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008) [skull: ZMB 394 + skeleton: ZMB 85665]. - Comments: Considered a valid subspecies by Taylor (1998: 33).
1866. *Nycterops pilosa* Gray, Proc. zool. Soc. Lond., 1866, I (vi): 83. Publication date: May 1866. Type locality: "Africa": "Africa".
1878. *Nycteris hispida villosa:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 163. (Name Combination)
1883. *Nycteris hispidus:* Rochebrune, Act. Soc. Linn. Bordeaux, 37: ???. (Name Combination)
1910. *Petalia hispida:* Thomas and Wroughton, Trans. Linn. Soc. Lond., 19 (5) (63): 488. (Name Combination)
1917. *Nycteris pallida* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 425. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Faradje [03 44 N 29 43 E] [Goto Description]. Holotype: AMNH 49144: ad ♂. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 1 March 1912; original number: 1858. Paratype: RMCA 12390: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 22 Novermber 1911; original number: formerly AMNH 49119. Presented/Donated by: ?: Collector Unknown. Topotype: MCZ 17226: ♂, alcoholic (skull not removed). Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 9 March 1912. Presented/Donated by: ?: Collector Unknown.
1935. *[Nycteris hispida] martini:* Braestrup, Vidensk. Meddr dansk naturh. Foren., 99: 88. (Name Combination)
1935. *N[ycteris] h[ispida] pallida:* Braestrup, Vidensk. Meddr dansk naturh. Foren., 99: 88. (Name Combination)
1935. *Nycteris hispida hispida:* Braestrup, Vidensk. Meddr dansk naturh. Foren., 99: 88. (Name Combination)

TAXONOMY:
Koopman (1975: 377, 378) includes *aurita* and *pallida*. Van Cakenberghe and De Vree (1993b) consider *aurita* as a separate species.

hispida species group (Van Cakenberghe and De Vree, 1993b; Simmons, 2005: 392).

COMMON NAMES:
Afrikaans: Harige spleetneusvlermuis, Harige Langoorvlermuis. Chinese: 粗毛凹脸蝠. Czech: rýhonos štětinatý, šerowec senegalský. English: Hairy Slit-faced Bat, Hairy Long-eared Bat. French: Nyctère hérissée, Nyctère hirsute. German: Rauhaarschlitznase, Gemeine Schlitznasen-Fledermaus, Haarige Schlitznasenfledermaus. Italian: Nitterìde irsùta, Nicterìde irsùta, Nitterìde ìspida, Nicterìde ìspida. Kiluba (DRC): Katutu. Portuguese: Morcego orelhudo piloso.

ETYMOLOGY OF COMMON NAME:
Although this species is not hairier than any of the other slit-faced bats, the name is applied to it as a translation of the specific name *hispida*, which is from the Latin *hispidus*, meaning hairy or bristly, refering to the bristly hair around the facial slit (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008s; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008s; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004m; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016c). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species. It is locally threatened in parts of its range by habitat loss, largely through the conversion of forest to agricultural use (Mickleburgh *et al.*, 2008s; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008s) [in IUCN (2009)] report that in view of the species wide range it is presumably present in a number of protected areas (including the Udzungwa Mountains National Park of Tanzania (Stanley *et al.*, 2005b)). No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
This species has a wide range, encompassing much of sub-Saharan Africa, with the exception of the Horn of Africa and parts of southern Africa. There is an apparently disjunct population in western Mauritania close to the border with Senegal, and an isolated record from central Mali. Also recorded from the island of Unguja [=Zanzibar] (Simmons, 2005: 392; O'Brien, 2011: 289).

The records from Cape of Good Hope are probably invalid (Cotterill, 1996a).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 710,458 km^2.

Native: Angola (Crawford-Cabral, 1989; Hayman, 1963; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547); Benin (Capo-Chichi *et al.*, 2004: 162); Botswana (Archer, 1977; Cotterill, 2004a: 261; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547); Burkina Faso (Kangoyé *et al.*, 2015a: 615); Burundi; Cameroon; Central African Republic (Lunde *et al.*, 2001: 537); Chad; Congo (Bates *et al.*, 2013: 336); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 547); Côte d'Ivoire; Equatorial Guinea [= Bioko] (Simmons, 2005: 392); Ethiopia (Lavrenchenko *et al.*, 2004b: 132); Gabon; Gambia (Simmons, 2005: 392; Emms and Barnett, 2005: 50); Ghana; Guinea (Fahr *et al.*, 2006a: 72); Guinea-Bissau (Bocage, 1892a; Monard, 1939; Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 41); Kenya; Liberia (Fahr, 2007a: 103); Malawi (Happold *et al.*, 1988; Happold and Happold, 1997b: 815; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547); Mali; Mauritania (Simmons, 2005: 392); Mozambique (Smithers and Lobão Tello, 1976; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547; Monadjem *et al.*, 2010c: 381); Namibia (Monadjem *et al.*, 2010d: 547); Niger; Nigeria; Rwanda; Senegal (Adam and Hubert, 1976; Simmons, 2005: 392); Sierra Leone; Somalia (Simmons, 2005: 392); South Africa (Monadjem *et al.*, 2010d: 547); Sudan; Tanzania (Stanley *et al.*, 2005b); Togo; Uganda (Kityo and Kerbis, 1996: 60); Zambia (Ansell, 1973; Ansell, 1974; Ansell, 1986; Monadjem *et al.*, 2010d: 547); Zimbabwe (Monadjem *et al.*, 2010d: 547).

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 3.33 - 4.16 mm in length, the shaft is long, slender and variably ventrally curved, the base is expanded and in lateral profile is angled ventrally, while the tip is sometimes angled ventrally, it has a projection on the ventral aspect varying between individuals from a slight swelling to a pronounced hook (Thomas *et al.*, 1994: 20).

ECHOLOCATION:
See Taylor *et al.* (2005).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Lee *et al.* (1989) reported 2*n* = 42, FN = 78, BA = 38, and a metacentric X and Y.
Protein / allozyme - Unknown.

HABITAT:
Nycteris hispida has been recorded from a wide variety of habitats, ranging from lowland tropical moist forest, into moist savanna, dry savanna, papyrus swamps and marsh.

R.B. Woosnam [in Thomas, 1910b: 488] reported it to be most numerous among the acacia trees on the plains around the south end of the Ruwenzori range.

Monadjem *et al.* (2016y: 367) recorded *N. hispida* sparsely in open savanna on the Liberian side of Mount Nimba.

ROOST:
Colonies roost in hollow trees, dense bushes, caves, holes in termite colonies and similar habitats.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention *N. hispida* to be taken by the Western marsh harrier (*Circus aeruginosus* (Linnaeus, 1758)).

POPULATION:
Structure and Density - Colonies range in size from individual and pairs of animals to up to 20 bats. This is a very common bat (Mickleburgh *et al.*, 2008s; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008s; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 94) reports that the testes are probably permanently scrotal in *N. hispida*, according to Matthews (1941). The specieis's reproductive cycle is polyoestrous with two or more (continuous) cycles per year, a postpartum oestrus and often no anoestrus. Matthews (1941) also noticed that copulation followed shortly after parturition.

In Burkina Faso, Kangoyé *et al.* (2015a: 615) captured females carrying young during the month of September.

From Sierra Leone, Weber *et al.* (2019: 25) reported a lactating female with a young attached on 25 May.

PARASITES:
Protozoa
Kassahun *et al.* (2015: 168) examined one *N. hispida* specimen from Awash-Methara (Ethiopia) and found it infected by *Leishmania major* Friedlin.

ACARI
Trombiulidae: Vercammen-Grandjean and Fain (1958: 30) described *Trombigastia (Trombigastia) nycteris* from *N. hispida hispida* from the Astrida region (=Butare), Rwanda (Stekolnikov, 2018a: 120).

HEMIPTERA
Polyctenidae: *Eoctenes nycteridis* (Horváth, 1910) from Liberia, Congo, Ruanda-Urundi, Tanzania, Uganda and Eritrea (Haeselbarth *et al.*, 1966: 17).

SIPHONAPTERA
Ischnopsyllidae: *Lagaropsylla idea* Smit, 1957, primary host being molossids but recorded from this taxon (Haeselbarth *et al.*, 1966: 190).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - One fecal sample was tested by Pfefferle *et al.* (2009) in Ghana in February 2008, and this was found to be negative for coronavirus (CoV) RNA.

Hantaviridae (formerly included in Bunyaviridae)
Hantavirus
Weiss *et al.* (2012b: 160) report the presence of a new hantavirus, named Magboi virus [MGBV], in one *N. hispda* specimen collected at the Magboi River, Gola National Park, Sierra Leone. Arai *et al.* (2019: 2) tentatively included this virus in the genus *Loanvirus*.

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that the single specimen they examined from Ghana did not test positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

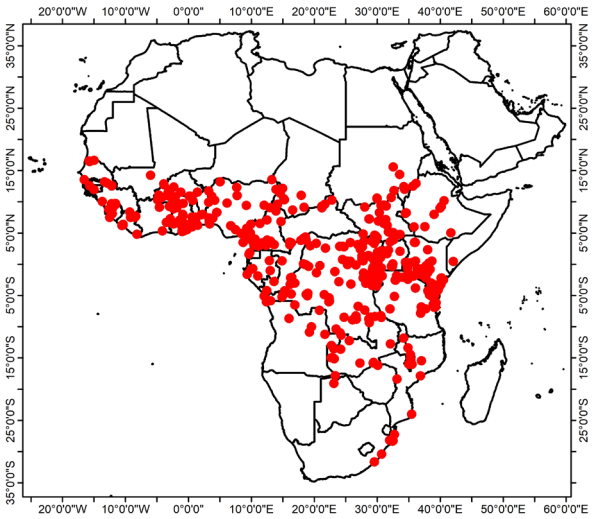


Figure 144. Distribution of *Nycteris hispida*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mauritania, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Nycteris intermedia Aellen, 1959

*1959. *Nycteris intermedia* Aellen, Archs Sci. Genève, 12 (2): 218. Type locality: Côte d'Ivoire: NW of Abidjan: Adiopodoumé [05 19 N 04 08 W, 0 - 30 m] [Goto Description]. Holotype: MHNG 923.094: ad ♀, skull and alcoholic. Collected by: Dr. Villy Aellen; collection date: 20 July 1953; original number: A1437. Paratype: MHNG 923.095: ad ♀, skull and alcoholic. Collected by: Dr. Villy Aellen; collection date: 24 July 1953; original number: A1438. Paratype: MHNG 923.096: ad ♀, skull and alcoholic. Collected by: Dr. Villy Aellen; collection date: 19 August 1953; original number: A1439. Presented/Donated by: ?: Collector Unknown. Paratype: ad ♀; alcoholic and skull; Collector: Villy Aellen; Original number: Collection date:. Paratype: MHNG 923.097: ad ♀, skull and alcoholic. Collected by: Dr. Villy Aellen; collection date: 24 July 1953; original number: A1440. Presented/Donated by: ?: Collector Unknown. - Etymology: Referring to its intermediary size between *Nycteris arge* and *Nycteris nana*. (Current Combination)

TAXONOMY:
Formerly included in *N. arge*, but Van Cakenberghe and De Vree (1985) regard this as a distinct species (Simmons, 2005: 392).

COMMON NAMES:
Czech: rýhonos prostřední. English: Intermediate Slit-faced Bat. French: Nyctère d'Aellen, Nyctère moyen. German: Intermediäre Schlitznasenfledermaus, Intermediäre Schlitznasen-Fledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in some protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bh; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bh; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004bm; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is threatened in parts of its range by deforestation including loss of roosting trees (Mickleburgh *et al.*, 2008bh; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bh) [in IUCN (2009)] report that there do not appear to be any direct conservation measures in place, however, the species has been recorded from some protected areas (e.g. Comoe National Park and Tai National Park both in Côte d'Ivoire). Further research is needed into the distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Nycteris intermedia is broadly distributed in sub-Saharan Africa, ranging from Liberia in the west, to western Tanzania in the east, with records as far south as northeastern Angola. The species appears to be known from around 27 localities. It is typically a lowland species.

Native: Angola (Van Cakenberghe *et al.*, 1999; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 547); Cameroon; Central African Republic (Lunde *et al.*, 2001: 537); Congo (The Democratic Republic of the); Côte d'Ivoire (Simmons, 2005: 392); Equatorial Guinea; Gabon; Ghana; Guinea (Denys *et al.*, 2013: 282); Liberia (Simmons, 2005: 392); Tanzania (Simmons, 2005: 392).

MOLECULAR BIOLOGY:
Denys *et al.* (2013: 282) report the karyotype for one female from the Guinean Mount Nimba area as: $2n = 34$, NFa = 62, including 15 pairs of large to small metacentric and submetacentric chromosomes and one middle-sized acrocentric pair. The X chromosome is submetacentric.

POPULATION:
Structure and Density - This species appears to be relatively rare. It is usually found as small groups of animals (Mickleburgh *et al.*, 2008bh; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bh; IUCN, 2009).

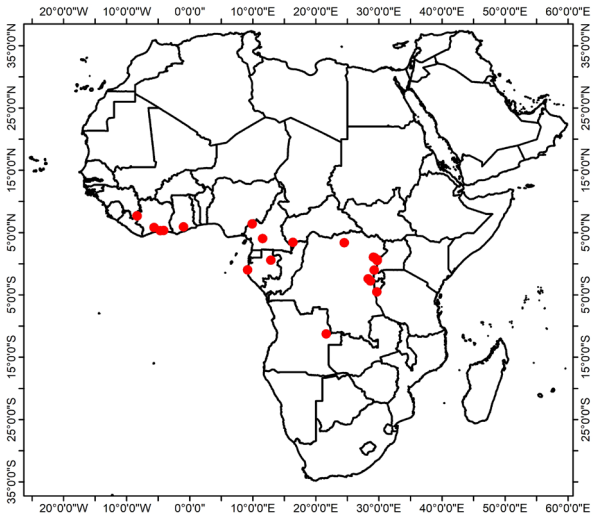


Figure 145. Distribution of *Nycteris intermedia*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Angola, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Gabon, Ghana, Guinea, Liberia, Tanzania.

Nycteris macrotis Dobson, 1876

*1876. *Nycteris macrotis* Dobson, Monograph of the Asiatic Chiroptera and catalogue of the species of bats in the collection of the Indian Museum Calcutta, 80. Type locality: Sierra Leone: "Sierra Leone" [Goto Description]. Holotype: BMNH 1866.2.2.2: sad ♂, skull and alcoholic. - Etymology: From the Greeek adjective "*μακρός*" (macròs), meaning "long, large" and the neuter Greek substantive "*οὖς*" (genitive *ώu0964\ός*"; "*ûs*", "*ōtós*"), meaning "ear", although the ear of the species is not of especially outstanding size (see Lanza *et al.*, 2015: 244). (Current Combination)

1878. *Nycteris æthiopica* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, xxxviii, 162, 165, pl. 11, fig. 3. Publication date: June 1878. Type locality: Sudan: Kordofan province: Sennaar [15 35 N 33 38 E, 425 m] [Goto Description]. Holotype: BMNH 1847.5.27.32: ad, skin and skull. Collected by: Theodor Kotschy.

1901. *Nycteris aethiopica aethiopica:* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 30.

1901. *Nycteris aethiopica luteola* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 30. Publication date: 1 July 1901. Type locality: Kenya: Kitui [01 22 S 38 01 E, 3 500 ft] [Goto Description]. Holotype: BMNH 1901.5.6.4: ad ♀, skin and skull. Collected by: Dr. Sidney Langford Hinde; collection date: 14 February 1901.

1912. *Petalia aethiopica aethiopica:* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): ???.

1912. *Petalia aethiopica luteola:* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): ???.

1912. *Petalia macrotis:* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): ???. (Name Combination)

1917. *Nycteris major* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 427. - Comments: Not of Andersen (1912b).

1922. *Nycteris oriana* Kershaw, Ann. Mag. nat. Hist., ser. 9, 10 (56): 179. Publication date: 1 August 1922. Type locality: Malawi: Shiré valley: Chiromo [16 32 S 35 09 E, 60 m] [Goto Description]. Holotype: BMNH 1922.4.25.3: ad ♀, skin and skull. Collected by: Rodney Carrington Wood Esq. Collection date: 7 June 1918; original number: 312.

1923. *Nycteris luteola:* Loveridge, Proc. zool. Soc. Lond., 1923, II: 396.

1939. *Nycteris æthiopica guineensis* Monard, Arq. Mus. Bocage, 10: 66, fig. 4. Publication date: March 1939. Type locality: Guinea-Bissau: Mansoa [12 04 N 15 19 W] [Goto Description]. Syntype: [Unknown] ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 1937; original number: 284. Syntype: [Unknown] ♀, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 1937; original number: 282. Syntype: MHNG 1326.005: ad ♂, skull and alcoholic. Collected by: Dr. Albert Monard; collection date: 14 December 1937; original number: 283. Syntype: NMBA 5271: ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 17 Decembre 1937; original number: 319. Syntype: RMCA 15310: ad ♀, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 1937; original number: 285. - Comments: Monard (1939: 66) mentions a larger series: 282 (♀), 283 (♂), 284 (♂), 285 (♀), 319 (♂).

1939. *Nycteris æthiopica guineensis f. aurantiaca* Monard, Arq. Mus. Bocage, 10: 68. Publication date: March 1939. Type locality: Guinea-Bissau: Pitche [12 20 N 13 57 W] [Goto Description].
1942. *Nycteris aethiopica oriana:* G.M. Allen and Loveridge, Bull. Mus. comp. Zool., 89 (4): 150, 161.
1953. *Nycteris macrotis macrotis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 54. (Name Combination)
1953. *Nycteris macrotis oriana:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 54. (Name Combination)
1960. *Nycteris macrotis luteola:* Harrison, J. East Afr. Nat. Hist. Soc., 23 (7) (104): 288. Publication date: December 1960. (Name Combination)
1969. *Nycteris macrotis aethiopica:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 97. (Name Combination)
? *Nycteris aethiopica:* (Alternate Spelling)
? *Nycteris marcrotis oriana:* (Name Combination)

TAXONOMY:
Meester *et al.* (1986) indicate that both Koopman (1965, 1975, 1982) and Kock (1969a) included the extralimital [to southern Africa] *aethiopica* Dobson, 1878, and *luteola* Thomas, 1901, as subspecies in this species. While Hayman and Hill (1971) treat *macrotis* and *aethiopica* as separate species, they confirm that the distinction is by no means certain. *N. macrotis macrotis* Dobson, 1876 may include also *Plecotus aethiopicus* Fitzinger, 1866, from the White Nile, a *nomen nudum* (Kock, 1969a).
Kock (1969a) regards *oriana* as a synonym of the extralimital *luteola*, but Ansell (1978) and Smithers (1983) treat it as a separate subspecies.

Does not include *madagascariensis* Grandidier, 1937 (see Peterson *et al.*, 1995), or *vinsoni* Dalquest, 1965 (see Van Cakenberghe and De Vree, 1999a).

Simmons (2005: 393) recognises three subspecies - *aethiopica* Dobson, 1878; *luteola* Thomas, 1901; and *oriana* Kershaw, 1922.

COMMON NAMES:
Afrikaans: Groter spleetneusvlermuis. Chinese: 大耳凹脸蝠. Czech: rýhonos velkouchý, nykteris velkouchá. English: Large-eared Slit-faced Bat, Greater Slit-faced Bat, Big-eared slit-faced bat. French: Nyctère de Dobson, Nyctère à grandes oreilles. German: Großohrige Schlitznasen-Fledermaus. Italian: Nitterìde di Dòbson; Nicterìde di Dobsòn.

ETYMOLOGY OF COMMON NAME:
Although the specific name *macrotis* is derived from the Greek "*makros*" and "*otis*" meaning large eared, the species' ears are in fact smaller than in species such as the Egyptian slit-faced bat (*N. thebaica*) (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008aa; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008aa; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004at; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
In general, there are no major threats to this species. In parts of its range it is threatened by general habitat loss, presumably mostly through the conversion of land to agricultural use (Mickleburgh *et al.*, 2008aa; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008aa) [in IUCN (2009)] report that in view of the species wide range it is presumably present in some protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Nycteris macrotis is a widespread African species which ranges from Senegal in the west, to Somalia in the east, being recorded as far south as northern Botswana. Found on the island of Zanzibar (Simmons, 2005: 392). It has been recorded between sea level and 2,200 m asl.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,466,326 km^2.

Native: Angola (Hayman, 1963; Van Cakenberghe and De Vree, 1985; Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 547); Benin (Capo-Chichi

et al., 2004: 162); Botswana (Monadjem *et al.*, 2010d: 547); Burkina Faso (Kangoyé *et al.*, 2015a: 616); Burundi; Cameroon; Central African Republic; Chad; Congo (Bates *et al.*, 2013: 336); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Gallagher and Harrison, 1977; Van Cakenberghe and De Vree, 1985; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 547); Côte d'Ivoire; Equatorial Guinea; Ethiopia (Simmons, 2005: 392); Gabon; Gambia (Emms and Barnett, 2005: 50; Simmons, 2005: 392); Ghana; Guinea; Guinea-Bissau (Seabra, 1900a; Monard, 1939; Rainho and Ranco, 2001: 44); Kenya; Liberia (Fahr, 2007a: 103); Malawi (Happold *et al.*, 1988; Van Cakenberghe and De Vree, 1985; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 548); Mali (Meinig, 2000: 105); Mauritania (1st record: Benda *et al.*, 2011a: 267); Mozambique (Lopes and Crawford-Cabral, 1992; Simmons, 2005: 392; Monadjem *et al.*, 2010d: 548; Monadjem *et al.*, 2010c: 381); Niger; Nigeria; Rwanda; Senegal (Simmons, 2005: 392); Sierra Leone; Somalia; Sudan; Tanzania (including the island of Unguja [O'Brien, 2011: 289]); Togo; Uganda (Kityo and Kerbis, 1996: 60); Zambia (Ansell, 1967; Ansell, 1973; Ansell, 1978; Cotterill, 2002b: 6; Monadjem *et al.*, 2010d: 548); Zimbabwe (Simmons, 2005: 392; Monadjem *et al.*, 2010d: 548).

Presence uncertain: Namibia (Cotterill, 2004a: 261).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Fain (1953b: 102) reported on the exceptional yellowish-orange colour of some specimens from a cave near the Nyumba Mission (Rwanda). Other specimens from the save cave were uniformly orange or somewhat darker, or yellowish-brown with a few grey hairs, brownish-grey with orange-yellowish hairs, and brownish-grey with a pale belly without any yellowish or orange hairs. These colour differences were not found to be linked with either the sexe or the age of the specimens

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 3.84 to 5.12 mm in length, the shaft is long, parallel-sided and usually straight, thickening towards the base, the base has two basal lobes of varying development, in lateral view it is sometimes angled ventrally, while the tip is expanded and trifid with three variably developed processes (Thomas *et al.*, 1994: 21).

Brain - Based on specimens from Bénin, Amrein *et al.* (2007) reported that proliferating cells, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus was found to be absent. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. Furthermore, Amrein *et al.* (2007) detected few DCX positive cells in the rostral migratory stream and the olfactory bulb. No NeuroD was detected in the hippocampal granule cells (Amrein *et al.*, 2007).

Femur - Louzada *et al.* (2019: 136) provided a detailed description of the femur, which has a well-developed medial ridge that begins on the shaft of the femur, a short and well-developed lateral ridge, and
well-developed trochanters. The latter nearly reach the same level proximally. The femur is greatly sinusoidal and the torsion of the proximal epiphysis is the most conspicuous of all the bat families they examined.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - There is no published male of this species (only a female), and so Lee *et al.* (1989) described the karyotype as having a diploid number of 2*n* = 40, aFN = 74, BA = 36, X = M, and suggested that the Y chromosome might be a small metacentric as in the other *Nycteris* species.
Protein / allozyme - Unknown.

HABITAT:
Monadjem *et al.* (2016y: 367) reported one specimen from the Mount Nimba area, which was recorded from a disturbed habitat close to a settlement at 500 m.

ROOST:
In the Parc National du 'W' in Niger Republic, 300 km west of Sokoto, they have been found roosting in thatched huts and others were found in abandoned mine shafts (Poché, 1975).
Stanley *et al.* (2007c: 60) refer to Koopman (1975), who mentions that *N. macrotis* is known to roost in burrows in the ground made by aardvarks (*Orycteropus afer*) or porcupines (*Hystrix cristata*).
Weber and Fahr (2006: 4) indicate that *N. macrotis* largely or exclusively depends on the availability of caves as day roosts in Guinea.

POPULATION:
Structure and Density - In the Parc National du 'W' in Niger Republic, 300 km west of Sokoto, they have been found roosting in groups of 10-20 individuals (Poché, 1975). Happold (1987) notes that they are solitary or live in small groups.
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008aa; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 115) indicates that most nycterid species (including *N. aethiopica* = *N. macrotis*) are polyoestrous with two or more (continuous) cycles

per year, a postpartum oestrus and often no anoestrus. In the DRC and Rwanda, Anciaux de Faveaux (1978c) reported copulations in August and October.

Matthews (1937) [in Krutzsch (2000: 115)] noted that male *N. luteola* [= *N. macrotis*] collected at the time of post partum oestrus were reproductively functional. For the same "species", Martin and Bernard (2000: 32) reported that the corpus luteum is only present for the first half of pregnancy. Krutzsch (2000: 94) furthermore reports that the testes are probably permanently scrotal.

PARASITES:

HAEMOSPORIDA

Schaer *et al.* (2015: 381) found *Nycteria* sp. parasites in *N. macrotis* from South Sudan.

HEMIPTERA

Polyctenidae: *Eoctenes nycteridis* (Horváth, 1910) from Liberia, Congo, Ruanda-Urundi, Tanzania, Uganda and Eritrea (Haeselbarth *et al.*, 1966: 17).

ACARI

Trombiculidae: Stekolnikov (2018b: 280) examined one larva of *Trombigastia nycteris* Vercammen-Grandjean and Fain, 1958, which was collected from an unknown locality in Rwanda (the slide label refers to "Ada", which might refer to "Astrida" [=Butare]). Stekolnikov (2018a: 162; 2018b: 284) also reported on three larvae of *Microtrombicula nycteris* (Jadin, Vercammen-Grandjean and Fain, 1955), collected in Butare.

DIPTERA

Streblidae: *Raymondi alulata* Speiser, 1908 from Angola, the Congo, Malawi and Somalia (Haeselbarth *et al.*, 1966: 102). *Raymondia scopigera* Jobling, 1954 in Cameroon (Haeselbarth *et al.*, 1966: 103, host referred to *N. aethiopica*), Senegal and Sierra Leone (Shapiro *et al.*, 2016: 255).

VIRUSES:

Flaviviridae

In Uganda, Kading *et al.* (2018: 3) found neutralizing antibodies against non-specific Flaviviruses.

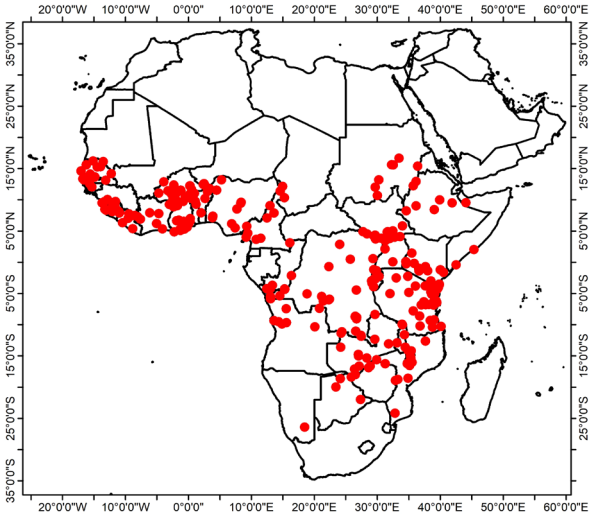


Figure 146. Distribution of *Nycteris macrotis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:

"Africa", Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Nycteris madagascariensis G. Grandidier, 1937

*1937. *Nycteris madagascariensis* G. Grandidier, Bull. Mus. natn. Hist. nat., Paris, sér. 2, 9: 353. Publication date: November 1937. Type locality: Madagascar: N of Diego-Suarez [=Antsiranana]: Rodo valley, N of Pirkana: Ankarana, near the [12 05 S 49 05 E] [Goto Description]. Holotype: MCZ 45433: ♀, skull and alcoholic. Collection date: June 1910. Formerly Grandidier collection; see Helgen and McFadden (2001: 142). Paratype: MCZ 45434: ad ♀, skull and alcoholic. Formerly Grandidier collection; see Helgen and McFadden (2001: 142). - Etymology: Referring to the island of Madagascar, where the species occurs. (Current Combination)

TAXONOMY:

Earlier included in *thebaica*, but considered a synonym of *macrotis* by Van Cakenberghe and De Vree (1985), Koopman (1993a: 162), but a valid species by Peterson *et al.* (1995: 63), Russ *et al.* (2001), Simmons (2005: 393).

macrotis species group (see Van Cakenberghe and De Vree, 1985).

COMMON NAMES:

Czech: rýhonos madagaskarský. English: Madagascar Slit-faced Bat. French: Nyctère de Madagascar, Chauve-souris malgache balafrée.

German: Madagassische Schlitznasen-Fledermaus.

CONSERVATION STATUS:
Global - This species is listed as Data Deficient (DD ver 3.1 (2001)), as it is only known from two specimens from 1910 in the Irodo River Valley and has not been recorded since. Further extensive surveys are needed for this species, as well as knowledge on its distribution, biology, ecology, and any threats affecting it (Hutson *et al.*, 2008q; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Hutson *et al.*, 2008q; IUCN, 2009). 2000 - DD ver 2.3 (1994).

MAJOR THREATS:
The threats to this species are not known (Hutson *et al.*, 2008q; IUCN, 2009).

CONSERVATION ACTIONS:
Hutson *et al.* (2008q) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Further studies are needed into the distribution, abundance, natural history and threats to this species.

GENERAL DISTRIBUTION:
Nycteris madagascariensis is endemic to Madagascar where it is known only from two specimens caught in northern Madagascar near Analamera in the Irodo River Valley in 1910 (Peterson *et al.*, 1995).

Native: Madagascar (Peterson *et al.*, 1995; Simmons, 2005: 393).

POPULATION:
Structure and Density - It is known only from two specimens and has not been recorded since 1910 (Hutson *et al.*, 2008q; IUCN, 2009).
Trend - 2008 - Unknown (Hutson *et al.*, 2008q; IUCN, 2009).

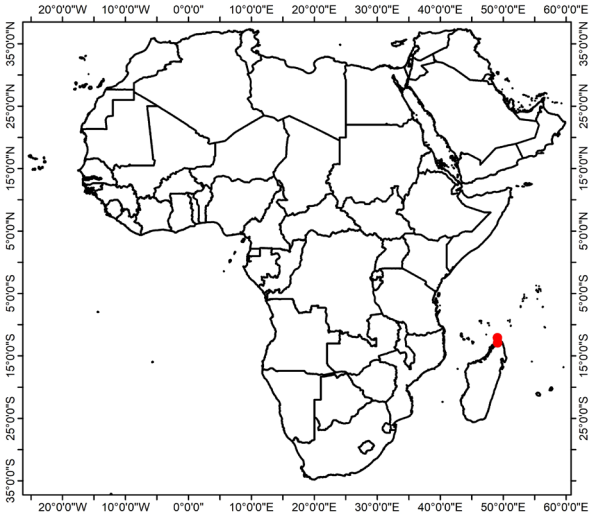


Figure 147. Distribution of *Nycteris madagascariensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Nycteris major (K. Andersen, 1912)

*1912. *Petalia major* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): 547. Publication date: 1 November 1912. Type locality: Cameroon: Ja River [ca. 03 00 N 13 00 E] [Goto Description]. Holotype: BMNH 1909.10.2.49: ad ♀, skull and alcoholic. Collected by: George Latimer Bates Esq. Collection date: 23 January 1906. - Etymology: From the Latin "*maior*" (see Kozhurina, 2002: 16).

1917. *Nycteris avakubia* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 426, fig. 3. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Avakubi [01 18 N 27 32 E] [Goto Description]. Holotype: AMNH 49403: ad ♂, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: September 1913; original number: 2623.

1917. *Nycteris major:* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 427. Publication date: 29 September 1917. - Comments: The specimens assigned to this species by Allen (1917), however, belong to *Nycteris macrotis* (see Koopman, 1965). (Name Combination, Current Combination)

TAXONOMY:
Includes *avakubia* J.A. Allen, 1917 (see Koopman, 1965; Van Cakenberghe and De Vree, 1985; Simmons, 2005: 393).

arge species group (Van Cakenberghe and De Vree, 1985; Simmons, 2005: 393).

COMMON NAMES:
Czech: rýhonos kamerunský. English: Ja Slit-faced Bat, Dja Slit-faced Bat; Large Slit-faced Bat. French: Nyctère de Ja. German: Dja-Schlitznasenfledermaus, Dja Schlitznasen-Fledermaus.

SIMILAR SPECIES:
Eisentraut (1956b: 517) indicated that the claws of *N. major* are more robust than those of *N. arge*.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence in Central Africa, natural history, and threats. If the species is found to range more widely in Central Africa it is likely to meet the criteria for Least Concern, as the extent and quality of its habitat are probably not declining at a rate sufficient to justify listing in a higher category (Mickleburgh *et al.*, 2008bi; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008bi; IUCN, 2009). 2004 - VU A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2004cg; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species appears to need rather large trees, and is presumably threatened by deforestation resulting from logging activities and the conversion of forest to agricultural use (Mickleburgh *et al.*, 2008bi; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bi) [in IUCN (2009)] report that although there appear to be no direct conservation measures in place, it has been recorded from the Tai National Park in Côte d'Ivoire. Further studies are needed into the distribution, natural history and threats to this somewhat enigmatic species. There is a need to monitor to presence of this species at its known localities.

GENERAL DISTRIBUTION:
Nycteris major is distributed in West and Central Africa, where it has been patchily recorded from Guinea, Liberia (at Voinjama) and Côte d'Ivoire in the west, and from Cameroon and the Democratic Republic of the Congo in Central Africa (at Avakubi), with the southern-most record from northern Zambia (close to the border with the Democratic Republic of the Congo).

Native: Benin (Capo-Chichi *et al.*, 2004: 162); Cameroon (Simmons, 2005: 393); Central African Republic; Congo (The Democratic Republic of the) (Simmons, 2005: 393); Côte d'Ivoire (Simmons, 2005: 393); Guinea; Liberia (Simmons, 2005: 393); Zambia (Van Cakenberghe and De Vree, 1985; Simmons, 2005: 393; Monadjem *et al.*, 2010d: 548).

PREDATORS:
Demeler (1981: 133) found remains of *N. major* in pellets of *Bubo africanus* in the Yankari Game Reserve (Nigeria). However, as *N. macrotis* was often mis-identified as *N. major* and the latter species was not yet reported from that area, the bat's identification still needs to be confirmed.

POPULATION:
Structure and Density - This appears to be an extremely rare species, which is only known from a dozen or so specimens. It is not difficult to catch and efforts have been made to locate more specimens (Mickleburgh *et al.*, 2008bi; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bi; IUCN, 2009).

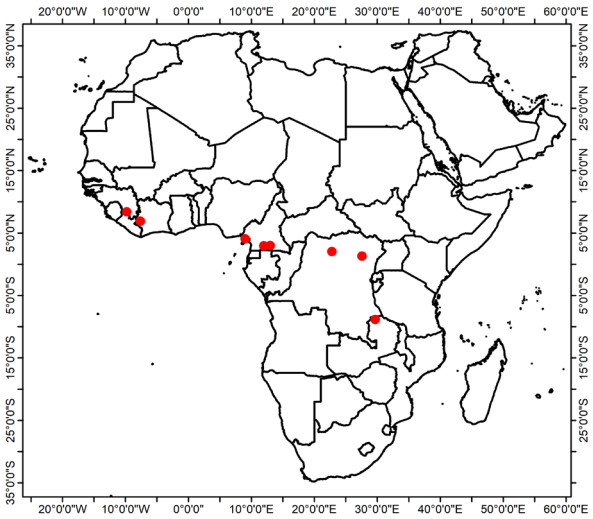


Figure 148. Distribution of *Nycteris major*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Côte d'Ivoire, Liberia, Zambia.

Nycteris nana (K. Andersen, 1912)

*1912. *Petalia nana* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): 547. Publication date: 1 November 1912. Type locality: Congo: [Rio Muni ?] Benito River [ca. 01 31 N 09 52 E] [Goto Description]. Holotype: BMNH 1900.2.5.46: ad ♂, skull and alcoholic. Collected by: George Latimer Bates Esq.

1926. *Nycteris nana:* Cabrera and Ruxton, Ann. Mag. nat. Hist., ser. 9, 17: xxx. (Name Combination, Current Combination)

1936. *Nycteris nana tristis* G.M. Allen and Lawrence, Bull. Mus. comp. Zool., 79 (3): 47. Publication date: 30 January 1936. Type locality: Kenya: W Nyanza: Kakamega district: Kaimosi [00 08 N 34 51 E, 2 130 m] [Goto Description]. Holotype: MCZ 31156: ad ♀, skin and skull. Collected by: Professor Arthur Loveridge; collection date: 13 February 1934. See Helgen and McFadden (2001: 142). (Name Combination)
1939. *Nycteris nana nana:* G.M. Allen, Bull. Mus. comp. Zool., 83: 70. (Name Combination)

TAXONOMY:
Includes *tristis* Allen and Lawrence, 1936 (Koopman, 1975; Van Cakenberghe and De Vree, 1985; Simmons, 2005: 393).

arge species group (Van Cakenberghe and De Vree, 1985; Simmons, 2005: 393).

COMMON NAMES:
Chinese: 侏凹脸蝠. Czech: rýhonos drobný. English: Dwarf Slit-faced Bat. French: Nyctère naine. German: Kleinste Schlitznasen-Fledermaus, Zwerg-Schlitznasenfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bj; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bj; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cc; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are poorly known, but it seems likely to be locally threatened by deforestation in parts of its range (Mickleburgh *et al.*, 2008bj; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bj) [in IUCN (2009)] report that it is not known if the species is present within any protected areas. Further studies are needed into the distribution, general ecology and threats to this species.

GENERAL DISTRIBUTION:
Nycteris nana has been widely recorded in West and Central Africa, with some records from East Africa. It ranges from Côte d'Ivoire and Ghana in the west, through south Cameroon and Equatorial Guinea (Rio Muni), to the Democratic Republic of the Congo, Rwanda and Burundi, to Uganda and western Kenya. It ranges as far south as northern Angola. Generally, a lowland species, but can be found up to 2,100 m asl.

A record from Tanzania, represents *intermedia* (J. Fahr *pers. comm.* in Simmons, 2005: 393).

Native: Angola (Crawford-Cabral, 1989; Simmons, 2005: 393; Monadjem *et al.*, 2010d: 548); Cameroon; Central African Republic; Congo (The Democratic Republic of the) (Van Cakenberghe and De Vree, 1985; Monadjem *et al.*, 2010d: 548); Côte d'Ivoire (Simmons, 2005: 393); Equatorial Guinea (Simmons, 2005: 393); Ghana; Kenya (Simmons, 2005: 393); Rwanda; Sudan (Simmons, 2005: 393); Togo; Uganda.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Verschuren (1955) reported on an albino specimen caught in a hollow tree in the DRC.

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 2.10 to 3.36 mm in length, smaller than that of *N. arge*, the shaft is slender, parallel-sided and essentially straight, the base is expanded and rounded and in lateral profile is often angled ventrally, while the tip is simple, with only a small expansion (Thomas *et al.*, 1994: 20).

POPULATION:
Structure and Density - It is considered to be a rather rare bat, colony sizes tend to be small (Mickleburgh *et al.*, 2008bj; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bj; IUCN, 2009).

PARASITES:
HAEMOSPORIDA
Schaer *et al.* (2015: 381) found *Nycteria* cf. *houini* in *N. nana* from South Sudan. Landau *et al.* (2012: 142) and Perkins and Schaer (2016: Suppl.) mentioned the parasite as *Nycterida houini* Rosin, Landau and Hugot, 1978, and also reported it from the Republic of Congo and Gabon.

VIRUSES:
Reoviridae
Orbivirus
Fomede virus - reported in the CDC's Arbovirus Catalogue, to have been isolated in 1978 from the Republic of Guinea, from the brain and internal organs of *N.* cf. *nana*. Reported by de Jong *et al.* (2011: 11).

Chobar Gorge virus was mentioned by Luis *et al.* (2013: Suppl.) and Willoughby *et al.* (2017: Suppl.).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Burundi, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Kenya, South Sudan, Uganda.

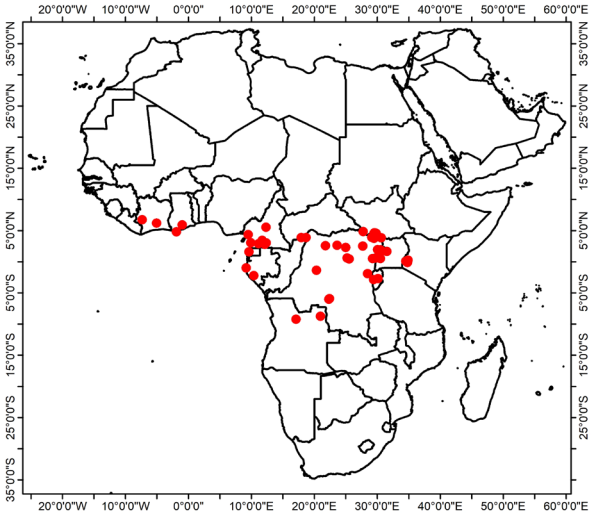


Figure 149. Distribution of *Nycteris nana*

Nycteris parisii (de Beaux, 1924)

*1924. *Petalia parisii* de Beaux, Atti Soc. ital. Sci. nat., 62: 254 (for 1923). Publication date: February 1924. Type locality: Somalia: Balli [=Ballei Uen] [00 42 N 43 04 E] [Goto Description]. Holotype: [Unknown] N 1449: ♀, skull and alcoholic. Collection date: 6 April 1922. See De Beaux (1924: 254), Allen (1939a: 70). - Etymology: In honour of Dr. Bruno Parisi, former head of the zoological section (1921 - 1927) and director (1928 - 1951) of the Museo Civico di Storia Naturale di Milano (see De Beaux, 1924: 255; Lanza *et al.*, 2015: 250).

1930. *Nycteris parisii:* Zammarano, Le colonie Italiane, ???. (Name Combination, Current Combination)

1952. *Nycteris benuensis* Aellen, Mém. Soc. neuchât. Sci. nat., 8: 53. Type locality: Cameroon: Rei Bouba [ca. 08 37 N 14 09 E] [Goto Description].

1971. *N[ycteris] p[arisii] benuensis:* Hayman and Hill, Mammals of Africa: Chiroptera, 18. (Name Combination)

1971. *N[ycteris] p[arisii] parisii:* Hayman and Hill, Mammals of Africa: Chiroptera, 18. (Name Combination)

2015. *[Nycteris] parissi:* Kaipf, Rudolphi and Meinig, NABU - Biodiversity Assessment in Kafa, Ethiopia, 13. (Lapsus)

TAXONOMY:
Included in *woodi* by Van Cakenberghe and De Vree (1985), Koopman (1993a: 162). Thomas *et al.* (1994: 22) elevated it to species rank (Simmons, 2005: 393).

Rosevear (1965: 173) included *N. parisii* in the *aethiopica* group. Included in the *macrotis* group (Simmons (2005: 393) based on Thomas *et al.* (1994: 22) being closely related to *N. macrotis*.

Simmons (2005: 393) recognises one subspecies *benuensis* Aellen, 1952.

COMMON NAMES:
Czech: rýhonos somálský. English: Parisi's Slit-faced Bat, Balli Slit-faced Bat, Parissi's Slit-faced Bat. French: Nyctère de Parisi. German: Parisis Schlitznasen-Fledermaus. Italian: Nitterìde di Parìsi, Nicterìde di Parìsi.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Mickleburgh *et al.*, 2008ap; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008ap; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004bf; IUCN, 2004).

MAJOR THREATS:
The threats to this species are not known (Mickleburgh *et al.*, 2008ap; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ap) [in IUCN (2009)] report that it is not known if the species is present within

any protected areas. Further studies are needed into the distribution, abundance, general ecology and threats to this species.

GENERAL DISTRIBUTION:
Nycteris parisii has been recorded from southern Somalia, south Ethiopia and from northern Cameroon, close the border with Nigeria. It is a low elevation species.

Nycteris parisii parisii may be distributed in East Africa and *N. p. benuensis* in West Africa.

Native: Cameroon (Aellen, 1952; Simmons, 2005: 393); Ethiopia (Hill, 1975; Simmons, 2005: 393); Somalia (Varty and Hill, 1988; Simmons, 2005: 393); Togo? (Amori *et al.*, 2016: 217).

DETAILED MORPHOLOGY:
Baculum - The shaft is long, parallel-sided and essentially straight, thickening towards the base, the base is expanded, in lateral profile it is angled ventrally, while the tip is expanded and trifid with three variably developed processes (Thomas *et al.*, 1994: 21).

POPULATION:
Structure and Density - The abundance of this species is not known, and only a few specimens have ever been collected. It was last recorded in the 1980s. Presumably this is a consequence of limited survey effort within the species known range (Mickleburgh *et al.*, 2008ap; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ap; IUCN, 2009).

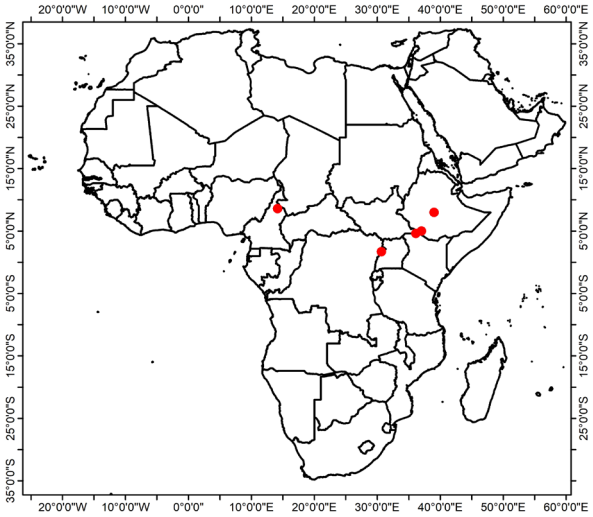


Figure 150. Distribution of *Nycteris parisii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Ethiopia, Somalia.

Nycteris thebaica E. Geoffroy St.-Hilaire, 1818

*1818. *Nycteris Thebaicus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 119, pl. 1, No 2. Publication date: 1818. Type locality: Egypt: Qena province: Thebes (near Luxor) [ca.25 41 N 32 39 E] [Goto Description]. Holotype: MNHN 889: ad ♀, skin only. Collected by: Etienne Geoffroy-Saint-Hilaire. Number 172 in Rode (1941: 235), who also mentioned number MNHN 142. - Etymology: From the masculine Latin adjective *thebàicus*, meaning "native or belonging to Thebes", the ancient capital of Upper Egypt, on the site of modern Luxor, the type locality of the species (see Lanza *et al.*, 2015: 254). (Current Combination)

1820. *Nycteris Geoffroyi* Desmarest, Encyclopédie Méthodique, (Zoologie, Mammalogie), 1: 127. Publication date: 1820. Type locality: Senegal: 40 mi (= 60 km) east of Podor [Goto Description]. - Comments: Included in *macrotis* by Kock (1969a: 93) [although with a question mark] and Meester *et al.* (1986: 35).

1829. *Nycteris affinis* A. Smith, Zool. Journ., 4 (16): 434. Publication date: May 1829. Type locality: South Africa: E Cape province: Grahamstown [33 17 S 26 31 E] [Goto Description]. - Comments: Type locality originally as "South Africa", restricted to "Grahamstown, eastern Cape Province, South Africa" by Roberts (1951: 69): see Kock (1969a: 98), Meester *et al.* (1986: 35), Gray *et al.* (1999: 2).

1829. *Nycteris Capensis* A. Smith, Zool. Journ., 4 (16): 434. Publication date: May 1829. Type locality: South Africa: SW Cape province: Swellidam [34 01 S 20 26 E] [Goto Description]. Lectotype: BMNH 1863.2.21.6: ad ♂, skin only. Collected by: A. Smith. Paralectotype: RMNH MAM.J1888-171b: ad, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters. - Comments: The type locality was originally mentioned as "Interior of South Africa, as well as upon the Eastern Coase", and restricted to "Swellidam, SW Cape Province, South Africa" by Roberts (1951: 69): see Kock (1969a: 98), Meester *et al.* (1986: 35), Gray *et al.* (1999: 2). Ansell and Dowsett (1988: 31) mention the locality as "Swellendam"). Considered a valid subspecies by Taylor (1998: 33).

1834. *Nycteris thebaica:* A. Smith, S. Afr. Quart. J., 2: 59. (Current Spelling)

1840. *N[ycteris] albiventer* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 1: 439. Type locality: Sudan: Northern province: Dongola [19 10 N 30 27 E] [Goto Description]. - Comments: Type locality originally given as "Nubia" (see Kock, 1969a: 98), restricted to Dongola, Northern Province, Sudan by Koopman (1975): see Gray *et al.* (1999: 2).

1840. *N[ycteris] discolor* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 1: 440. Type locality: South Africa: Ecklon [Goto Description]. - Comments: Allen (1939a: 68) mentioned the type locality as "Südspitze von Afrika". Kock (1969a: 98), Meester *et al.* (1986: 35) mention "Southern tip of Africa; Knysna, fide Roberts (1951: 69).").

1852. *Nycteris fuliginosa* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 46, pl. 10. Publication date: 1852. Type locality: Mozambique: 12 mi (19 km) NW Quellimane: Boror [17 53 S 36 51 E] [Goto Description]. Syntype: BMNH 1858.6.18.15: ad ♀. See Turni and Kock (2008: 27). Syntype: BMNH 1907.1.1.337: ad ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters. See Turni and Kock (2008: 27). Syntype: ZMB 392: ad ♂, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: March 1846. See Turni and Kock (2008: 27). Syntype: ZMB 3954: ad ♂, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: March 1846. See Turni and Kock (2008: 27). Syntype: ZMB 562: ad ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: March 1846. See Turni and Kock (2008: 27). - Comments: Turni and Kock (2008: 27) refer to Jentink (1888b: 171) in mentioning an additional syntype, which is possibly in the RMNH.

1861. *Nycteris labiata* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 4, 5. Publication date: 1861. Type locality: Eritrea: Bogos: Cheren [=Keren] [ca. 15 45 N 38 20 E] [Goto Description]. Syntype: SMNS 980a: ad ♂, alcoholic (skull not removed). Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See Dieterlen *et al.* (2013: 294). Syntype: SMNS 980b: sad ♂, alcoholic (skull not removed). Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See: Dieterlen *et al.* (2013: 294). Syntype: ZMB 2794a: ♂. Collected by: Martin Theodor von Heuglin; collection date: 1852. Formerly SMNS, see Turni and Kock (2008). Syntype: ZMB 2794b: ♂. Collected by: Martin Theodor von Heuglin; collection date: 1852. Syntype ex SMNS, see Turni and Kock (2008: 27). Paralectotype: RMNH MAM.27231: ad, skin and skull. Collected by: Martin Theodor von Heuglin; collection date: November 1861. See Turni and Kock (2008: 27). Turni (pers. comm., 12.04.2007) indicates that this specimen is possibly a syntype, but its collecting date (November 1861) is very close to the publication date. Turni and Kock (2008: 27) mention three additional syntypes: SMNS 980a-b, and one presumably in the RMNH (for the latter, they refer to Jentink, 1888b: 171).

1866. *Plecotus æthiopicus* Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 546. Type locality: Sudan: Bahr el Abiat (White Nile) [ca. 14 00 N 33 00 E] [Goto Description]. - Comments: Meester *et al.* (1986: 35) mention Fitzinger only as author. Nomen nudum (see Allen, 1939a: 68). Included in *macrotis* by Kock (1969a: 93), but rejected as nomen nudum.

1868. *Nycteris Geoffroyi Var. Senegalensis* Hartmann, Z. Gesel. f. Erdk., 3 (28/29): 44. Type locality: Sudan: Sennaar [15 35 N 33 38 E, 425 m] [Goto Description].

1871. *Nycteris angolensis* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 903 , fig. 5 (for 1870). Type locality: Angola: Biballe and Rio Coroca: Caconda [13 42 S 15 05 E, 1 900 m] [Goto Description]. Syntype: BMNH 1879.1.21.2:. Syntype: ZMB 3633: juv ♂, skull and alcoholic. From Rio Corvea, Angola; ex Lisbon Museum; see Turni and Kock (2008). Syntype: ZMB 3637: ♂, skull and alcoholic. Collected by: José Alberto de Oliveira Anchieta. Ex Lisbon Museum; this specimen was collected at Caconda, Biballe (see Turni and Kock (2008)). Peters (1871: 904) mentions Anchieta as collector for the type specimen. - Comments: Type locality restricted by Hill and Carter (1941): see Gray *et al.* (1999: 2). The publication covers a meeting held on 22 December 1870.

1871. *Nycteris damarensis* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 905, fig. 7 (for 1870). Type locality: Namibia: Damaraland: Otjimbingue [22 15 S 16 10 E] [Goto Description]. Syntype: BMNH 1838.2.8.4: ad, skin and skull. Collected by: Captain Alexander; original number: 1079. Presented/Donated by: ?: Collector Unknown. Syntype: NRM. See Turni and Kock (2008: 27). Syntype: ZMB 3298: ♂, skull and alcoholic. Collected by: Missionary Hahn. See Turni and Kock (2008: 27). Syntype: ZMB 3887: ad ♂, skull and alcoholic.

Collected by: Higgins. See Turni and Kock (2008: 27) [missing]. - Comments: Part of the original series is in the NRM (see Turni and Kock (2008: 27). The publication covers a meeting held on 22 December 1870. Peters (1871: 905) also mentions that the name *damarensis* was already used in the British Museum and in the Catalogue of Mammalia from 1843.

1881. *Nycteris Revoilii* Robin, Bull. Soc. Philom. Paris, (7) 5: 90. Type locality: Somalia: north of 10 ° N [Goto Description]. Holotype: MNHN ZM-MO-1881-4 (174): ad ♂, alcoholic (skull not removed). Collected by: Revoil. Presented/Donated by: ?: Collector Unknown. Paratype: MNHN ZM-MO-1881-1 (174a): ad ♂, alcoholic (skull not removed). Collected by: Revoil. Number 174a in Rode (1941: 236). Paratype: MNHN ZM-MO-1881-3 (174b): ad ♂, alcoholic (skull not removed). Collected by: Revoil. Number 174b in Rode (1941: 236). Cotype: MCZ 14929: ♀, alcoholic (skull not removed). Collected by: Revoil. Presented/Donated by: ?: Collector Unknown. - Comments: Type locality originally "Somalia", restricted to "Somalia, north of 10 °N" by Moreau *et al.* (1946: 399): see Gray *et al.* (1999: 2). Allen (1931: 235) mentions a "cotype" in MCZ (14929), collected by Revoil in Somaliland in 1880.
1900. *Nycteris thebaica var. angolensis:* Seabra, J. Sci. mat. phys. nat., ser 2, 6 (22): 18. (Name Combination)
1900. *Nycteris thebaica var. damarensis:* Seabra, J. Sci. mat. phys. nat., ser 2, 6 (22): 19. (Name Combination)
1900. *Nycteris thebaica var. Fuliginosa:* Seabra, J. Sci. mat. phys. nat., ser 2, 6 (22): 18. (Name Combination)
1904. *Nycteris thebaica capensis:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, supplement, ???. (Name Combination)
1908. *Petalia capensis:* Thomas and Wroughton, Proc. zool. Soc. Lond., ???.
1909. *Nycteris capensis var. fuluginosa:* Seabra, Ann. Scient. Acad. Politecn. Porto, 4: ???.
1910. *Petalia thebaica:* Thomas, Ann. Mag. nat. Hist., ser. 8, 6: ???. (Name Combination)
1911. *Petalia revoili:* G.M. Allen, Bull. Mus. comp. Zool., 54 (9): 322.
1912. *Petalia damarensis brockmani* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): 548. Publication date: 1 November 1912. Type locality: Somalia: Upper Sheikh [4 300 ft] [Goto Description]. Holotype: BMNH 1910.3.27.4: ad ♀, skin and skull. Collected by: Dr. Ralph Evelyn Drake-Brockman; collection date: 11 January 1910.
1912. *Petalia damarensis damarensis:* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): ???.
1912. *Petalia damarensis media* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): 548. Publication date: 1 November 1912. Type locality: Ethiopia: Harar province: Harer [09 18 N 42 08 E, 2 000 m] [Goto Description]. Holotype: BMNH 1912.2.28.1: ad, skin and skull. Collected by: G. Kristensen; collection date: 19 January 1912. Presented/Donated by: Nathanial Charles Rothschild.
1912. *Petalia thebaica thebaica:* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 10 (59): ???. (Name Combination)
1918. *Nycteris thebaica thebaica:* Wettstein, Denkschr. k. Akad. Wiss. Wien, Math.-Naturw. Kl., 94: ???. (Name Combination)
1923. *Petalia (Nycteris) thebaica aurantiaca* de Beaux, Atti Soc. ital. Sci. nat., 62: 91. Publication date: July 1923. Type locality: Kenya: Northern Guaso Nyiro: Archer's Post [00 39 N 37 41 E, 2 000 ft] [Goto Description]. Holotype: [Unknown] N 1432: ♀, skull and alcoholic. Collected by: L. Franchetti and L. Tonker; collection date: January 1920.
1933. *Nycteris damarensis damarensis:* G.M. Allen and Loveridge, Bull. Mus. comp. Zool., 75: ???.
1934. *Nycteris capensis capensis:* Shortridge, Mammals of South West Africa, 55. (Name Combination)
1934. *Nycteris capensis damarensis:* Shortridge, Mammals of South West Africa, 56.
1934. *P[etalia (Nycteris)] theb[aica] adana:* de Beaux, Atti Soc. ital. Sci. nat., 62: 93. (Name Combination)
1936. *Nycteris damarensis brockmani:* G.M. Allen and Lawrence, Bull. Mus. comp. Zool., 79 (3): 35, 49.
1936. *Nycteris thebaica revoili:* G.M. Allen and Lawrence, Bull. Mus. comp. Zool., 79 (3): 35, 49. (Name Combination)
1938. *Nycteris thebaica aurantiaca:* Frechkop, Exploration du Parc national Albert, Fasc. 10: ???. (Name Combination)
1939. *Nycteris damarensis media:* G.M. Allen, Bull. Mus. comp. Zool., 83: 69.

1944. *Nycteris thebaica albiventer:* Aharoni, Bull. Zool. Soc. Egypt, 6: 26. (Name Combination)
1956. *Nycteris thebaica brockmani:* Toschi, Atti Soc. ital. Sci. nat., 95: ???. (Name Combination)
1971. *Nycteris thebaica labiata:* Hill and Morris, Bull. Br. Mus. (nat. Hist.) Zool., 21 (2): 34. (Name Combination)
1975. *Nycteris thebiaca:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 379. - Comments: Lapsus (actually Koopman uses this name consequently in this publication). (Lapsus)
1998. *Nyteris angolensis:* Van Cakenberghe and De Vree, Bonn. zool. Beitr., 48 (2): 140. Publication date: October 1998. (Lapsus)
1998. *Nyteris thebaica:* Van Cakenberghe and De Vree, Bonn. zool. Beitr., 48 (2): 123. Publication date: October 1998. (Name Combination, Lapsus)
1999. *Nycteris thabaica labiata:* Van Cakenberghe and De Vree, Bonn. zool. Beitr., 48 (2): 147. (Lapsus)
? *Nycteris capensis:*
? *Nycteris thebaica angolensis:* (Name Combination)
? *Nycteris thebaica damarensis:* (Name Combination)
? *Nycteris thebaica revoilii:* (Alternate Spelling)

TAXONOMY:



Figure 151. *Nycteris thebaica* (SMG-15760) caught at Marloth Park, Mpumalanga, South Africa.

Meester *et al.* (1986) state that the subspecies classification of *thebaica* is uncertain. Hayman and Hill (1971), while acknowledging that the species may include valid subspecies, do not attempt to recognize any. Kock (1969a), however, lists seven subspecies, and Koopman (1975), while not providing a complete synonymy of the species, appears to come to broadly similar conclusions to Kock concerning those names that he does consider. Simmons (2005: 393) recognises seven subspecies - *adana* K. Andersen, 1912; *angolensis* Peters, 1870; *brockmani* K. Andersen, 1912; *capensis* A. Smith, 1829; *damarensis* Peters, 1870; *labiata* Heuglin, 1861; and *najdiya* Nader and Kock, 1982.

Van Cakenberghe and De Vree (1999a) suggest that the status of *brockmani* and *damarensis* remains unclear as these forms may represent distinct species (Harrison and Bates, 1991; Gray *et al.*, 1999).

thebaica species group (Van Cakenberghe and De Vree, 1999a; Simmons, 2005: 393).

COMMON NAMES:
Afrikaans: Gewone-spleetneusvlermuis, Egiptiese spleetneusvlermuis, Kaapse Langoorvlermuis. Arabian: Khafash Teiba, Khaffash. Chinese: 非洲凹脸蝠. Czech: rýhonos egyptský, šerowec tébský, dutonosec, netopýr koptový, nykteris egyptská. Dutch: Thebaanse spleetneusvleermuis. English: Egyptian Slit-faced Bat, Common Slit-faced Bat, Geoffroy's Nycteris, Cape Long-eared Bat. French: Nyctère de la Thébaïde, Nyctère égyptienne. German: Großohrhohlnase, Ägyptische Schlitznasen-Fledermaus, Stirngrubenfledermaus. Hebrew: leilan, Leylan. Italian: Nitterìde tebàna, Nicterìde tebàna, Nitterìde di Tèbe, Nicterìde di Tèbe. Portuguese: Morcego orelhudo do Egipto. Kiluba (DRC): Kasusu. Spanish (Castillian): Rinolofo egipcio. Yao: Liputiputi (applied to all small bats).

ETYMOLOGY OF COMMON NAME:
So named because they were first described from tombs in Thebes, Egypt (see Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
N. thebaica was found in upper Pleistocene samples at Border Cave, South Africa (Avery, 1991: 6).

Butler (1984: 185) reported on a distal end of a humerus found at Chamtwara (Kenya).

CONSERVATION STATUS:
Global - This species has a large range and faces no major threats, hence is listed as Least Concern LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bk; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bk; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004ce; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016d). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
Habitat destruction and degradation affect the species. Roost disturbance and degradation are the main threats in the Mediterranean region. These are not considered major threats at present (Mickleburgh *et al.*, 2008bk; IUCN, 2009).

In the Limpopo province, South Africa, Toussaint and McKechnie (2012: 1138) indicate that the cool baobab tree cavities appear to be critical for the presence of *N. thebaica* in that area and may buffer this species from future increases in extreme maximum ambient temperatures.

Aerial hawking and water stress are believed to be the major risk factors linked to climatic change (Sherwin *et al.*, 2012: 174).

Collinson *et al.* (2015: 311) report on two roadkills in the Greater Mapungubwe Transfrontier Conservation Area (GMTFCA), South Africa.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bk) [in IUCN (2009)] report that it may occur within some protected areas. No specific conservation measures are known. Protection of the roost sites is required and also legal protection of the species should be improved. Further research is required on the population size and trends.

GENERAL DISTRIBUTION:
Nycteris thebaica is broadly distributed across savanna and riparian zones. Mostly found in sub-Saharan Africa; also found in Morocco, Libya, Egypt (primarily down the Nile River valley, but also into Sinai) and the Middle East (Israel, Palestine and Jordan). Recorded form the islands of Unguja [=Zanzibar] and Pemba [see Simmons (2005: 393), although not from the latter by O'Brien (2011: 289)]. Elevation from sea level to 2,000 m.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,704,632 km^2 (covering 27 % of the total surface). In South Africa, its distribution is mainly affected by the mimimum temperature of the coldest month (Babiker Salata, 2012: 49).

Corbet (1984: 8) states that the inclusion of Corfu (Greece) in the range could be the result of a vagrant specimen from N Africa (for details see Van Cakenberghe and De Vree, 1999a).

Native: Angola (Crawford-Cabral, 1989; Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 548); Benin (Simmons, 2005: 393); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 548); Burkina Faso (Simmons, 2005: 393; Kangoyé *et al.*, 2015a: 617); Burundi; Cameroon; Central African Republic; Chad; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 548); Côte d'Ivoire; Djibouti (Pearch *et al.*, 2001: 397; Simmons, 2005: 393); Egypt (Simmons, 2005: 393); Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 133); Gambia; Ghana (Simmons, 2005: 393); Guinea (Konstantinov *et al.*, 2000: 144; Simmons, 2005: 393; Decher *et al.*, 2016: 264); Guinea-Bissau; Israel (Simmons, 2005: 393); Jordan (Al-Omari *et al.*, 2000: 5); Kenya (Simmons, 2005: 393); Libyan Arab Jamahiriya; Malawi (Ansell and Dowsett, 1988: 31; Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 548); Mali (Simmons, 2005: 393); Morocco (Simmons, 2005: 393; Benda *et al.*, 2010a: 157; El Ibrahimi and Rguibi Idrissi, 2015: 358); Mozambique (Smithers and Lobão Tello, 1976; Lopes and Crawford-Cabral, 1992; Monadjem *et al.*, 2010d: 548; Monadjem *et al.*, 2010c: 382); Namibia; Niger (Simmons, 2005: 393; Monadjem *et al.*, 2010d: 548); Nigeria (Simmons, 2005: 393); Palestinian Territory, Occupied; Rwanda; Saudi Arabia; Senegal (Simmons, 2005: 393); Sierra Leone; Somalia (Simmons, 2005: 393); South Africa (Simmons, 2005: 393; Monadjem *et al.*, 2010d: 549); Sudan; Swaziland (Monadjem, 2001, Monadjem, 2006b; Simmons, 2005: 393; Monadjem *et al.*, 2010d: 549); Tanzania (Stanley and Goodman, 2011: 43); Togo (Amori *et al.*, 2016: 218); Uganda (Kityo and Kerbis, 1996: 60); Yemen; Zambia (Ansell, 1969; Ansell, 1973; Ansell, 1978; Ansell, 1986; Monadjem *et al.*, 2010d: 549); Zimbabwe (Monadjem *et al.*, 2010d: 550).

Presence uncertain: Lebanon; Lesotho; Liberia; Mauritania.

Bates *et al.* (2013: 338) reject the presence of *N. thebaica* in the Republic of Congo as the locality (Kemo) mentioned by Pousargues (1896: 259) and Van Cakenberghe and De Vree (1999a: 143) is actually located in the Central African Republic.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Schoeman and Jacobs (2002: 157) mention the following wing parameters for 8 specimens from the Algeria Forestry Station (RSA): Fa: 48.2 ± 0.8

mm, Wing area: 155.4 ± 7.4 cm^2, Wing span: 28.7 ± 1.1 cm, Wing loading: 8.3 ± 0.9 N/m^2, and aspect ratio: 5.3 ± 0.3.

Four piebald (all-white fur/skin patches, eyes always normally coloured) specimens were reported from a mine in Tanzania (Howell, 1980; Lucati and López-Baucells, 2016: Suppl.).

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 2.49 to 2.97 mm in length, the shaft is slender and parallel-sided, the base is expanded, in lateral profile it is usually angled ventrally, while the tip is simple with a small expansion (Thomas *et al.*, 1994: 22).

Brain - From specimens collected in Bénin, Amrein *et al.* (2007) reported that proliferating cells, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus was found to be absent. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. Amrein *et al.* (2007) could not detect any antigen in the antibody against DCX, and no NeuroD was detected in the hippocampal granule cells.

Reproduction system - Carter and Enders (2016: 284) found that *N. thebaica* has an extensive smooth chorioallantois, and its luminal epithelium is incomplete.

FUNCTIONAL MORPHOLOGY:
Zhuang *et al.* (2012: 1) showed that the pit in the noseleaf of *Nycteris thebaica* has an effect on focusing the acoustic near field as well as shaping the radiation patterns and therefore enhancing the directionality.

Toussaint *et al.* (2012) investigated the patterns of heterothermy exhibited by *N. thebaica* during the austral winter in a tropical semi-arid environment. They expected that it would use pronounced heterothermy during the warm, dry winter months, but found this not to be the case. As possible reasons for this, they suggest the relatively high risk of predation, the communal roosting, the species' reproduction cycle (although they find this highly unlikely as the results for both sexes were similar), and the relatively long nightly foraging period.

SEXUAL DIMORPHISM:
In Swaziland, Monadjem (2001: 49) found that females were heavier and had longer forearms than males.

ECHOLOCATION:
Schoeman and Waddington (2011: 291) mention a peak frequency of 90.3 ± 0.7 kHz and a duration of 1.7 ± 0.1 msec for specimens from Durban, South Africa. Davies *et al.* (2013b: Table S8) report a peak frequency of 88.23 kHz and a range between 55.97 and 75.5 kHz. However, also in the Durban area, Naidoo *et al.* (2011: 23) mention a peak frequency of 65.8 ± 20.1 kHz, and a duration of 1.7 ± 1.0 msec. From the Algeria Forestry Station (RSA), Schoeman and Jacobs (2002: 157) report the type of call to be "Low duty echolocation dominated by frequency modulated calls", with F_{peak}: 77.4 ± 2.7 kHz, and a low intensity. Parker and Bernard (2018: 57) recorded one call at the Mapungubwe National Park (RSA): F_{char}: 62.50 kHz, F_{max}: 83.40 kHz, F_{min}: 62.40 kHz, F_{knee}: 63.10 kHz, duration: 1.68 msec and 11.63 calls/sec.

Although very common in their study area in Swaziland, Monadjem *et al.* (2017c: 181) were unable to detect this species using an Anabat Express Detector due to its whispering (low db) calls. Even at distances of 0.1 m, they could not detect a call.

For Morocco, Disca *et al.* (2014: 226) recorded the following information: call type: FM multi H, F_{start}: 137.0 ± 1.2 kHz, F_{end}: 19.6 ± 0.5 kHz, F_{peak}: 84.5 ± 3.9 kHz, $F_{max\ all\ harmonics}$: 27.9 ± 0.2 kHz, $F_{max\ first\ harmonic}$: 56.1 ± 0.7 kHz, $F_{max\ third\ harmonic}$: 105.4 ± 3.2 kHz, bandwidth: 117.4 ± 1.5 kHz, duration: 2.4 ± 0.3 msec. This information is based on one single sequence they were not able to identify in hand.

Hackett *et al.* (2016: 223) reported the following values for 13 calls from Israel: Pulse duration: 1.35 ± 0.13 msec, F_{start}: 78.45 ± 3.08 kHz, F_{end}: 63.20 ± 1.99 kHz, F_{peak}: 70.18 ± 2.00 kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Both Peterson and Nagorsen (1975) and Rautenbach *et al.* (1993) reported $2n$ = 42, FN = 78, BA = 38, with a submetacentric X chromosome, and a metacentric Y chromosome.
Protein / allozyme - Unknown.

HABITAT:
This species has a wide distribution and is found in most habitats throughout its range.

Cooper-Bohannon *et al.* (2016: Table S2) indicate that - in southern Africa - it occurs primarily in Savanna (63 %) areas, followed by SW arid (18 %) and Afromontane (10 %) habitats.

Based on the study of stable isotope ratios of carbon, nitrogen and hydrogen, Voigt *et al.* (2013: 755) suggest that *N. thebaica* might potentially be

a migratory bat species, as far as elevational migration along the slopes of Mount Kilimandjaro is concerned. However, they also point out that the very low wing loading and aspect ratio is atypical for a migratory species, and therefore still categorize it as a sedentary species. Foord *et al.* (2018: 5), furthermore, indicate that *N. thebaica* moves less than one km per night between its roost and foraging sides.

HABITS:
In Swaziland male *N. thebaica* exhibit less roost site fidelity than females: there is greater roost movement in males than females (Monadjem, 2006b).
Stanley *et al.* (2007b: 209) report on a specimen in a Victor Rat trap, because it probably chased insects attracted to the bait used in the trap.

Thomas and Jacobs (2013: 125) found that, at De Hoop Nature Reserve (South Africa), *N. thebaica* emerged significantly earlier during mid-summer than during early and late summer. They also reported that bats feeding on Lepidoptera (*N. thebaica* and *Rhinolophus capensis*) emerged earlier than bats feeding on Diptera (*Tadarida aegyptiaca*).

ROOST:
Roosting in caves, mine audits and various other hollow sites (Churchill *et al.*, 1997), road culverts (Monadjem, 1998a; 2001; 2006b), under houses (LaVal and LaVal, 1980; Seamark and Bogdanowicz, 2002). Avery *et al.* (1990: 7) indicate that cool and moist caves or cave-like structures are used as daytime roosts.

In Swaziland, Monadjem *et al.* (2015: 15) found that roost switching occurs frequently, with more transitions to roosts where large numbers of bats were staying. They also found that moving to another roost was related to the distance of the new roost from the original one.

MIGRATION:
The species is not known to undergo migration (Monadjem, 2006a), and Laycock (1973) and Wingate (1983) suggest that *N. thebaica* does not have any homing ability. Monadjem (2006b) states that bat numbers vary greatly with season, suggesting that some movement is taking place. Monadjem (2006b) also reported that a banded female in Swaziland was discovered 107 km from where it was originally banded.

DIET:
Casual observations in Israel (Makin, 1979), Sudan (McLellan, 1986) and Namibia (Felten, 1956) reported that scorpions formed a stable part of *N. thebaica* diet. Yerbury and Thomas, 1895) examined cull-parts in Arabia, identifying various species of Orthoptera. Whereas Chapman (1958, in Tanzania), Roer (1975, in Namibia), and LaVal and LaVal (1980, in South Africa) found that Orthoptera, Lepidoptera, and Coleoptera were the primary prey orders consumed by *N. thebaica*. LaVal and LaVal (1980) presented results for early autumn (April), mid-winter (July), spring (November), and summer (January to March), listing a monthly breakdown of all prey orders consumed and finding that Orthoptera predominated in the study. In Zimbabwe, Fenton (1975) combined the results of his wet season collection (November 1969 to March 1970), finding only Orthoptera and Lepidoptera wings. Fenton *et al.* (1977a) and Fenton and Thomas (1980) examined the faeces of *N. thebaica* in Zimbabwe, and found that in the wet season (January and February 1976) Lepidoptera, Diptera and Coleoptera formed the bats' diet, while in the dry season (June 1977) he found only Lepidoptera (100 percent volume). In Zambia, Whitaker and Black (1976) examined the stomach contents of 33 *N. thebaica* which they separated into summer (November to March) and winter (May to September) categories. They found similar prey orders in *N. thebaica* diet, but also found many wingless insects.
At Farm Laatstgevonden, South Africa, Taylor *et al.* (2012b: 62) found the following prey groups: Lepidoptera (31.5 %), Coleoptera (24.75 %), Hemiptera (19.5 %), Orthoptera (12.75 %), and other (11.5 %).
Bowie *et al.* (1999) at Mkuzi Game Reserve, KwaZulu Natal, South Africa, found that the diet consisted mainly of non-volant prey, primarily orthopterans and arachnids.
Feldman *et al.* (2000), in Israel, found they fed on Lepidoptera and Diptera.
Seamark and Bogdanowicz (2002) showed that prey eaten by *N. thebaica* varies significantly by order but not by season, and there was a significant interaction between the prey category and season, suggesting that these two factors are not independent from each other. Coleoptera (49.6 %) in the culled parts, (calculated as percent composition) dominated in spring (September-November), Orthoptera (38.8 %) in summer (December-February), Hemiptera (42.8 %) in autumn (March-May) and Lepidoptera (36.3 %) in winter (June-August). The diet also included a frog and small fish.

From the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following prey groups based on 51 faecal pellets from 8 bats (in volume percent): Lepidoptera (34.9 ± 27.3), Orthoptera (23.5 ± 19.6), Coleoptera (21.3 ± 17.6), Arachnida (13.5 ± 27.4), Diptera (3.8 ±

10.6), Hymenoptera (1.6 ± 4.6), and Hemiptera (1.5 ± 4.5).

Weier *et al.* (2019b: 6) examined droppings from this species in the Levubu region (Limpopo, RSA) and found DNA sequences of *Cryptophlebia peltastica* (Meyrick, 1921) (Lepidoptera) and *Nezara viridula* (Linnaeus, 1758) (Hemiptera).

Using Next Generation Sequencing (NGS), (Taylor *et al.* (2017b: 243, 252 - 254) reported on the 28 food items found in faecal pellets in the Limpopo province (RSA): Lepidoptera (occurred in 100 % of analysed pellets - *Toxocampinae tathorhynchus* + *Eutelia polychorda* + *Acanthovalva inconspicuaria* + *Isturgia roraria* + *Scopula rufisalsa* + *Hyblaea puera* + *Sena* sp. + *Sena prompta* + *Enmonodia capensis* + *Leucania BioLep10* + *Pandesma robusta* + *Pericyma atrifusa* + *Argyrogrammatini* sp. + *Thysanoplusia indicator* + *Tycomarptes* sp. + *Garella nilotica* + *Maurilia arcuata* + *Phycitinae* sp. + *Arotrura JFL201* + unmatched), Blattodea (50 % - *Pycnoscelus* + unmatched), Orthoptera (33 %), Coleoptera (17 % - *Cybister tripunctatus* + unmatched); Hemiptera (17 % - *Macrorhaphis acuta* + *Nezara viridula*); Orthoptera (Tettigoninae sp.).

PREDATORS:
Perrin (1982: 16) and Avery *et al.* (2005: 1054) found this species in pellets from *Tyto alba* in South Africa.

Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure - Monadjem (2001: 50) mentions that sex ratio was highly skewed with adult females outnumbering adult males by 2.8:1, even though the sex ratio of juveniles was 1:1. Sex ratios of adults varied seasonally, being highly skewed in July/August, October and December. Monadjem (2001: 50) suggests that this might be due to the females being resident and males joining them in late summer to mate.

Density - Fairly common through most of its range. However, an uncommon species in the Mediterranean region. In Morocco only three small colonies (usually 10 to 30 and occasionally up to 100 individuals) are known (Stéphane Aulagnier *pers. comm.* 2007 in Mickleburgh *et al.*, 2008bk; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bk; IUCN, 2009).

LIFESPAN:
In Swaziland, Monadjem (2006b) found that for both males and females, survivorship was low in the first year, but increased thereafter. While 15 % of females and 10 % of males banded as juveniles in 1998 and 1999 survived to three years of age. Monadjem (2006a) reported the age of *N. thebaica* in Swaziland to reach at least 7 to 8 years. Monadjem *et al.* (2015) studied the effect of time, age and sex class and climatic variables on survival from 1450 marked individuals from 16 roosts over a 10-year period. They found that the annual survival rate was highest in adult males and lowest in juvenile females. Climatological factors did not seem to have an influence.

ACTIVITY AND BEHAVIOUR:
Female *N. thebaica* in Swaziland appear to be resident year-round in the culverts, which suggests that males join females in late summer for the purpose of mating (Monadjem, 2001).
Lindeque (1987) describes the inflight behaviour of mating, where the active pursuit of the female by the male bat can be equated to courtship phase, with the butting phase inducing the female bat to hover and allowing the male to copulate, the brief frontal approach and head-neck biting by the male could be relict of some incomplete behaviour sequence.

Korine *et al.* (2015: 5) mention that the activity of *N. thebaica* could be underestimated because of the whispering nature of its echolocation calls.

REPRODUCTION AND ONTOGENY:
Martin and Bernard (2000: 32) mention that the corpus luteum is only present for the first half of pregnancy, and is subsequently completely regressed (Badwaik and Rasweiler, 2000: 276).

Bernard (1982a) [in Krutzsch (2000: 114)] indicated that this species is monoestrous in the subtropical, temperate regions of South Africa with a longer than usual gestation of five months and a three-month anoestrus. Male and female cycles are synchronized; spermatogenesis commences in late summer and the
epididymides contain mature sperm from autumn to summer (see Bernard, 1976).

A pregnant female was collected on 22 July 1992 in the West Usambara Mountains (Tanzania) (Stanley and Goodman, 2011: 43).

MATING:
Mating system is not known (Monadjem, 2001).

PARASITES:
BACTERIA

Four out of 49 specimens tested at Mlawula (Swaziland) by Dietrich *et al.* (2016b: 3) tested positive for *Bartonella* and one was positive for *Rickettsia*.
Dietrich *et al.* (2016a: 4) found *Leptospira* in the urine of a bat from South Africa, and *Coxiella* in its faeces. For the RSA, these bacteria were further identified as *Leptospira borgpetersenii*, whereas in bats from Swaziland sequences belonging to *L. interrogans* were found.

FUNGI
Brennan *et al.* (2015: 145) found no antibodies against *Pseudogymnoascus destructans* (White-nose syndrome) in blood samples from bats from Botswana.

HAEMOSPORIDA
Schaer *et al.* (2015: 381) found *Nycteria* sp. parasites in *N. thebaica* from South Sudan. Garnham and Heisch (1953: 357) described *Nycteria medusiformis* from a "*Nycteris capensis*".

NEMATODA
Spiruridae: An infection by *Spirura nycterisi* Khalil, 1975 in Tanzania was reported by Peralta-Rodríguez *et al.* (2012: 1006).

DIPTERA
Streblidae: *Raymondia alulata* Speiser, 1908, for which *N. thebaica* is the typical host, occurs in many parts of southern Africa from the Cape northwards to the Kaokoveld in Namibia and eastwards to Bukawayo in Zimbabwe (Haeselbarth *et al.*, 1966: 102). Shapiro *et al.* (2016: 249) reported it for the first time from Swaziland. *Raymondia hardyi* Fiedler, 1954 from South Africa (Shapiro *et al.*, 2016: 254). *Raymondia planiceps* Jobling, 1930 (Haeselbarth *et al.*, 1966: 102). *Raymondia seminuda* Jobling, 1954 from southern Botswana (Haeselbarth *et al.*, 1966: 103; Shapiro *et al.*, 2016: 255).
Nycteribiidae: *Nycteribia scissa rhodesiensis* Theodor, 1957 from Zimbabwe and Malawi (Haeselbarth *et al.*, 1966: 108). *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114).

SIPHONAPTERA
Pulicidae: *Echidnophaga aethiops* Jordan and Rothschild, 1906 described from Klipfontein, Namaqualand, South Africa and also found in Namibia, Botswana, Tanzania, Kenya and Somalia (Haeselbarth *et al.*, 1966: 135).
Ischnopsyllidae: *Oxparius isomalus* (Waterston, 1915) locality not stated (Haeselbarth *et al.*, 1966: 188).

ACARI
Laelapidae: *Metaspinolaelaps aelleni* Till ([May] 1958) was described from *Nycteris thebaica capensis* from Zululand. Till (1960: 223) suggests that this possibly might be a synonym of *Bewsiella fledermaus* Domrow, [March] 1958, but this view doesn't seem to be followed (e.g. https://en.wiki2.org/wiki/Metaspinolaelaps).
Macronyssidae: *Steatonyssus longipes* Radovsky and Yuker, 1953 was described from an Egyptian slit-faced bat (Negm *et al.*, 2018: 728).
Trombiculidae: Vercammen-Grandjean and Fain (1958: 24) mention the presence of *Trombigasta (Trombigastia) mounti* (Radford, 1954) on "*N. capensis damarensis*" in Asmara, Eritrea. Stekolnikov (2018a: 50, 119, 160, 173) reported *Whartonia oweni* Vercammen-Grandjean and Brennan, 1957, *Trombigastia mounti* (Radford, 1954) (from "*N. thebaica damarensis*"), *Microtrombicula minutissima* (Oudemans, 1910) (from "*N. thebaica capensis*"), *Microtrombicula tanzaniae* Goff, 1982.

VIRUSES:
Astroviridae
Four out of 14 Mozambican bats tested by Hoarau *et al.* (2018: 2) were positive for this group of viruses.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in six individuals from Limpopo Province, South Africa, none were tested positive (0/6).

Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that one out of twelve examined South African *N. thebaica* specimens tested positive for *Paramyxovirus* sequences.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Duvenhage Virus: In, 1986 Foggin (1988) recovered the Duvenhage (DUVV) virus from a *Nycteris thebaica* in Zimbabwe (see Paweska *et al.*, 2006; Hayman *et al.*, 2011a: 88; van Eeden *et al.*, 2011: 67). Markotter *et al.* (2013: 1000) report on antibodies for DUVV that were recovered from bats from Swaziland.
Rabies: Oelofsen and Smith (1993) tested 12 individual brains, from three localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burkina Faso, Cameroon, Central African Republic, Congo (Democratic Republic of the), Djibouti, Egypt, Eritrea, Ethiopia, Ghana, Guinea, Kenya, Malawi, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia,

South Africa, South Sudan, Sudan, Swaziland, Tanzania, The Gambia, Uganda, Zambia, Zimbabwe.

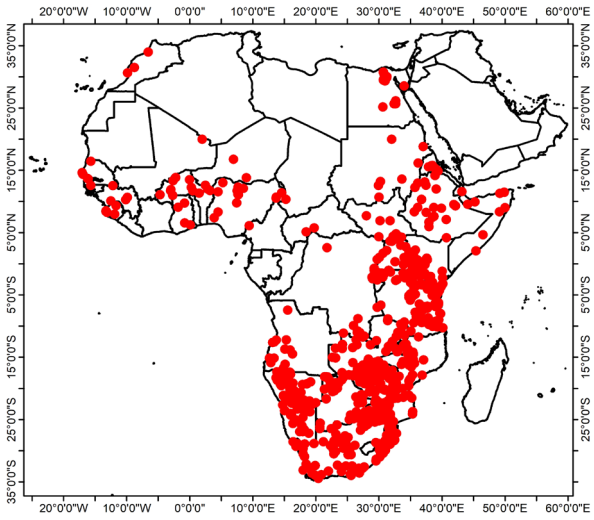


Figure 152. Distribution of *Nycteris thebaica*

Nycteris vinsoni Dalquest, 1965

*1965. *Nycteris vinsoni* Dalquest, J. Mamm., 46 (2): 254, 256. Publication date: May 1965. Type locality: Mozambique: 212 km SSW Beira, S bank Save river: Zinave [21 26 S 33 52 E] [Goto Description]. Holotype: KU 105221: ad ♀, skin and skull. Collected by: Prof. Dr. Walter Woelberg Dalquest; collection date: 8 October 1963; original number: MWUC 18739. Presented/Donated by: ?: Collector Unknown. See Jones and Genoways (1969: 130). - Etymology: In honour of J. Vinson, who sponsored an expedition to Mozambique during which the first specimens were collected (see Dalquest, 1965; Taylor, 2005). (Current Combination)

TAXONOMY:
Bronner *et al.* (2003) state that is was originally described from Mozambique (Dalquest, 1965). Kock (1969a) considered *Nycteris vinsoni* a synonym of *N. macrotis luteola*, based on the size and position of the second lower premolar. Hayman and Hill (1971) suggest that *N. vinsoni* is a variant of *N. aethiopica*, itself considered a member of the *N. macrotis* group (Koopman, 1965; Kock, 1969a). Koopman (1975) argued that the size and position of the second lower premolar is extremely variable, and instead recognised *vinsoni* as a distinct species closely related to *N. thebaica*, based on the presence of a pyriform tragus (and see Koopman, 1982). He later concluded that the tragus of the holotype is actually semilunate and therefore synonymised *vinsoni* under *N. macrotis oriana* (Koopman, 1992, 1993a). Swanepoel *et al.* (1980),Meester *et al.* (1986), Corbet and Hill (1992) and Simmons (2005: 394) retained *vinsoni* as a distinct species, a treatment endorsed by limited morphometric comparisons (Van Cakenberghe and De Vree, 1999a).

thebaica species group (Van Cakenberghe and De Vree, 1999a; Simmons, 2005: 394).

COMMON NAMES:
Afrikaans: Vinson se spleetneusvlermuis. Czech: rýhonos mosambický. English: Vinson's Slit-faced Bat, Mozambian Slit-faced Bat. French: Nyctère de Vinson, Nyctère du Mozambique. German: Vinsons Schlitznasen-Fledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Mickleburgh *et al.*, 2008aq; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008aq; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004be; IUCN, 2004). 2000 - LR/lc (Hilton-Taylor, 2000); CR (IUCN, 2000). 1996 - CR [assessed as *Nycteris macrotis*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not known (Mickleburgh *et al.*, 2008aq; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008aq) [in IUCN (2009)] report that the collection locality appears to be within Zinave National Park, Mozambique. Further studies are needed to better determine the geographic range, natural history and possible threats to this poorly known bat.

GENERAL DISTRIBUTION:
Nycteris vinsoni is known only from the type locality of "the south bank of the Save River, 212 km SSW Beira, Mozambique" (Dalquest, 1965).

Native: Mozambique (Dalquest, 1965; Simmons, 2005: 394).

POPULATION:
Structure and Density - It is known only from the type series of two animals (Mickleburgh *et al.*, 2008aq; IUCN, 2009).
Trend - Unknown (Mickleburgh *et al.*, 2008aq; IUCN, 2009).

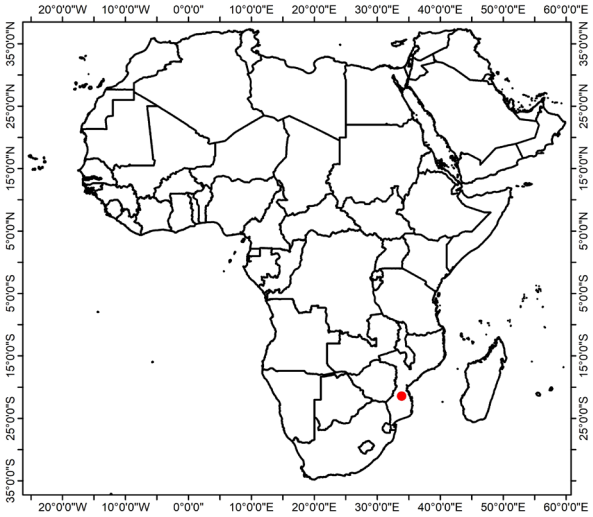


Figure 153. Distribution of *Nycteris vinsoni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Mozambique.

Nycteris woodi K. Andersen, 1914

*1914. *Nycteris woodi* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 13 (78): 563. Publication date: 1 June 1914. Type locality: Zambia: Chilanga [15 33 S 28 11 E, 4 100 ft] [Goto Description]. Holotype: BMNH 1914.4.22.2: ad, skin and skull. Collected by: Rodney Carrington Wood Esq. Collection date: November 1913. - Etymology: In honour of Rodney C. Wood, a well-known naturalist, who collected the original specimens at Chilanga, near Lusaka, Zambia (see Smithers, 1983: 118; Taylor, 2005). (Current Combination)
1946. *Nycteris woodi sabiensis* Roberts, Ann. Transv. Mus., 20 (4): 304. Type locality: Zimbabwe: Melsetter district: Sabi River: Birchenough Bridge [19 54 S 32 14 E] [Goto Description]. Holotype: TM 8578: ad ♀, skin and skull. Collected by: A.G. White; collection date: 11 January 1938. (Name Combination)
1946. *Nycteris woodi woodi:* Roberts, Ann. Transv. Mus., 20 (4): 304. (Name Combination)
2018. *Nycteris woodii:* Parker and Bernard, Mammalia, 83 (1): 53. Publication date: 14 April 2018. (Lapsus)

TAXONOMY:
Van Cakenberghe and De Vree (1985) included *parisii* and *benuensis*. Thomas *et al.* (1994) elevated *parisii* to full species rank, followed by Simmons (2005: 393), who included *benuensis* as a subspecies of *parisii*.

Simmons (2005: 394) recognised one subspecies *sabiensis* Roberts, 1946.

COMMON NAMES:
Afrikaans: Wood se spleetneusvlermuis, Wood-spleetneusvlermuis, Woodse Langoorvlermuis. Czech: rýhonos jihoafrický. English: Wood's Slit-faced Bat, Wood's Long-eared Bat. French: Nyctère de Wood. German: Woods Schlitznasen-Fledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in some protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ab; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008ab; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004ap; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT B1ab(ii,iii,iv, v) ver 3.1 (2001) (Schoeman *et al.*, 2016b). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
It is possibly locally threatened in parts of its range by habitat loss (particularly through conversion of land to cotton farming), pesticide use, and disturbance of roosting sites (Mickleburgh *et al.*, 2008ab; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ab) [in IUCN (2009)] report that it has been recorded from some protected areas (e.g. Kruger National Park, South Africa). Additional studies are needed into the distribution, natural history and possible threats to this poorly known species.

GENERAL DISTRIBUTION:
Nycteris woodi has been recorded from Zimbabwe, South Africa, to Zambia, north-west Mozambique and Malawi. It may range into southwestern Tanzania, however, it has yet to be recorded in this country. It is generally a lowland species. South of 8° S, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 308,190 km^2.

Native: Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988: 30; Monadjem *et al.*, 2010d: 550); Mozambique (Simmons, 2005: 394; Monadjem *et al.*, 2010d: 550); South Africa (Simmons, 2005: 394; Monadjem *et al.*, 2010d: 550); Zambia (Ansell, 1967; Ansell, 1986; Simmons, 2005: 394; Monadjem *et al.*, 2010d: 550); Zimbabwe (Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 550).
Presence uncertain: Tanzania (Simmons, 2005: 394).

DETAILED MORPHOLOGY:
Baculum - The baculum ranges from 2.49 to 2.73 mm in length, the shaft is straight and parallel-sided, the base is expanded, in lateral profile it is angled ventrally, while the tip is simple and unexpanded, unlike *N. macrotis* and *N. parisii* (Thomas *et al.*, 1994:21).

ECHOLOCATION:
See Taylor (1999b).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 42, FN = 78, BA = 38, a metacentric X chromosome, and an acrocentric Y chromosome, for a specimen from South Africa.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - The abundance of this species is not well known. It has been recorded in colonies of a few dozen individuals, otherwise animals have been recorded individually (Mickleburgh *et al.*, 2008ab; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008ab; IUCN, 2009).

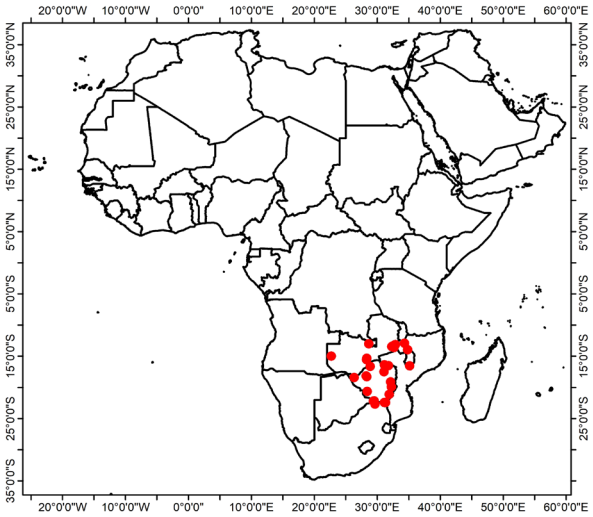


Figure 154. Distribution of *Nycteris woodi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Malawi, Mozambique, South Africa, Tanzania, Zambia, Zimbabwe.

INFRAORDER VESPERTILIONIFORMACEI Van Cakenberghe, Kearney and Seamark, 2007

*2007. *VESPERTILIONIFORMACEI* Van Cakenberghe, Kearney and Seamark, African Chiroptera Report. Publication date: July 2007. - Comments: The name of the Infraorder is based on *Vespertilio* Linnaeus, 1758 (type of VESPERTILIONIDAE Gray, 1821). (Current Combination)
? *Yangochiroptera*

TAXONOMY:
Currently two superfamily is known from within the Infraorder VESPERTILIONIFORMACEI for Africa: **MOLOSSOIDEA** Gervais, 1856; **VESPERTILIONOIDEA** Gray, 1821.

COMMON NAMES:
Czech: netop ýrotva ří, netopýři.

Superfamily MOLOSSOIDEA Gervais, 1856

*1856. *Molossoidae* Gervais. (Current Combination)
1998. *Molossoidea:* Simmons, Interfamilian relationships in bats, ???. - Comments: Originally included the families Molossidae Gervais, 1855 and Antrozoidae Simmons, 1998 [= Antrozoinae Miller, 1897]. Considered a synonym of Molossidae by Jackson and Groves (2015: 257).

Family MOLOSSIDAE Gervais, 1856

*1856. *Molossidae* Gervais, in: F. Comte de Castelnau, Exped. Partes Cen. Am. Sud., Zool, (Sec. 7), Vol. 1, pt. 2 (Mammifères): 53 footnote. Publication date: 23 July 1856. - Comments: Type genus: *Molossus* E. Geoffroy St. Hillaire, 1805. - Etymology: The name of the family is derived from the Greek "*molossus*", a kind of dog used by Greek shepherds, in ancient times (see Taylor, 2005). (Current Combination)
1865. *Molossi* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, p. 258. - Comments: Type genus: *Molossus* E. Geoffroy, 1805. Originally included the genera *Dysopes* Illiger, 1811 [= *Molossus* É. Geoffroy, 1805]; *Molossus* É. Geoffroy, 1805; *Promops* Gervais, 1855; *Mormopterus* Peters, 1865; *Nyctinomus* É. Geoffroy, 1818 [= *Tadarida*
Rafinesque, 1814]; and *Chiromeles* [= *Cheiromeles*] Horsfield, 1824 (see Jackson and Groves, 2015: 257).
1866. *Molossina* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 93. Publication date: 1 February 1866. - Comments: Type genus: Molossus E. Geoffroy, 1805. Proposed as tribe and originally included the genera *Molossus* É. Geoffroy, 1805; *Promops* Gervais, 1855 and *Nyctinomus* É. Geoffroy, 1818 [= *Tadarida* Rafinesque, 1814] (see Jackson and Groves, 2015: 257).
1872. *Molossidae* Gill, Smiths. Misc. Coll., 11 (1): 17. - Comments: Type genus: *Molossus* E. Geoffroy, 1805. Originally included the genus *Molossus* É. Geoffroy, 1805 (see Jackson and Groves, 2015: 257). (Current Combination)
1889. *Gymnuridae* Ameghino, Actas Acad. Nac. Ciencias, Argentine e Cordoba, p. 351. - Comments: See Taylor (1934).
1893. *Molossini* Winge, Samling af Afhandlinger. E Museo Lundii, 2 (1): 24. - Comments: Type genus: *Molossus* E. Geoffroy, 1805. Proposed as tribe(?) and originally included the genera *Mystacina* J. Gray, 1843; *Nyctinomus* É. Geoffroy, 1818 [= *Tadarida* Rafinesque, 1814]; *Chiromeles* [= *Cheiromeles*] Horsfield, 1824; and *Molossus* É. Geoffroy, 1805 (see Jackson and Groves, 2015: 257).

TAXONOMY:
Koopman (1993a: 232) mentioned Gervais, 1856, whereas Corbet and Hill (1992: 156) and Peterson *et al.* (1995: 142) mentioned Gill 1872: 17 as author for this family.

Revised by Freeman (1981b). For a very different arrangement see Legendre (1984). See also Lamb *et al.* (2011).

Pavlinov *et al.* (1995: 90) recognise two subfamilies: Cheiromelinae and Tadaridinae.

Most recent authors (Hoofer and Van Den Bussche, 2003: 2; Simmons, 2005; Lamb *et al.*, 2011: 1) accept that the Molossidae consists of two subfamilies: Molossinae and Tomopeatinae. The latter subfamily used to be assigned to the Vespertilionidae, but Hoofer and Van Den Bussche (2003: 2) clearly indicate that this subfamily belongs to the Molossidae. Representatives of this subfamily only occur in South America and are therefore not included here.

Based on 102 morphological characters from the skull, dentition, postcrania, external morphology, tongue, and penis, Gregorin and Cirranello (2015: 2) distinguish two clades within the Molossidae, both of which include taxa from the Old and the

New World: One clade is comprised of *Mormopterus, Platymops, Sauromys, Neoplatymops, Molossops, Cynomops, Cheiromeles, Molossus*, and *Promops*, whereas the second includes *Tadarida, Otomops, Nyctinomops, Eumops, Chaerephon*, and *Mops*. The relation of *Myopterus* to these two clades remains unclear. They also found that genera such as *Tadarida, Chaerephon* and *Molossops sensu lato* do not appear to be monophyletic.

Ammerman *et al.* (2012: 12) distinguish 16 - 17 genera, including 110 species worldwide.

Known genera within the family MOLOSSIDAE: *Tomopeas* Miller, 1900; ***Chaerephon*** Dobson, 1874; *Cheiromeles* Horsefield, 1824; *Cynomops* Thomas,1920; *Eumops* Miller, 1906; *Molossops* Peters, 1866; *Molossus* E. Geoffroy, 1805; ***Mops*** Lesson, 1842; ***Mormopterus*** Peters, 1865; ***Myopterus*** E. Geoffroy, 1818; *Nyctinomops* Miller, 1902; ***Otomops*** Thomas, 1913; ***Platymops*** Thomas, 1906; *Promops* Gervais, 1856; ***Sauromys*** Roberts, 1917; ***Tadarida*** Rafinesque, 1814.

COMMON NAMES:
Czech: morousovití, netopýři buldočí, tadaridovití. Dutch: Buldogvleermuizen. English: Free-tailed Bats, Wrinkled-lipped Bats, Bulldog Bats, Mastiff Bats, Bonneted Bats, Wolf-dog Bats. Finnish: Doggilepakot. French: Molossidés. German: Bulldoggfledermäuse, Bulldogg-Fledermäuse. Italian: Molòssidi. Norwegian: Buldoggflaggermus, foldeleppede flaggermus. Russian: Свободнохвостые, Бульдоговые. Spanish (Castillian): Murcielagos cola de raton o de cola libre. Tanoboase (Ghana): afrifraa, frede frede. Vietnamese: Họ dơi thò đuôi.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Lavocat (1961) found an indetermined Molossid species from the Mio-Pliocene at Beni Mellal. While Butler (1978: 66) found four indetermined species from the early Pleistocene at Olduvai, Avery (1991: 6) found the remains of two different sized molossids in the upper Pleistocene at Border Cave, South Africa.

Shi and Rabosky (2015: 1532) report that the approximate fossil date for the Molossidae is 37.2 million years ago. The family-level stem ages/crown ages are respectively 53.8 and 45.2 mya. Ammerman *et al.* (2012: 12) indicate that the split between the Old and New World Molossid bats took place about 29 Mya.

ROOST:
López-Baucells *et al.* (2018: 30) investigated roost selection by molossid bats in rural Madagascar and found that they predominantly roosted in modern public buildings (e.g. schools, offices and libraries), built with cement and bricks. Small, traditional housed made from mud and wood were much less used by molossids, but housed small colonies of vespertilionids.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention unidentified Molossidae to be taken by Grey kestrels (*Falco ardosiaceus* Vieillot, 1823) and Dickinson's kestrel (*Falco dickinsoni* Sclater, 1864), Red-necked falcon (*Falco ruficollis* Daudin, 1800), Eastern chanting goshawk (*Melierax poliopterus* (Cabanis, 1868)) [the latter three preying on "*Tadarida*" sp, where they also include *Mops* and *Chaerephon*].

PARASITES:
HEMIPTERA
Cimicidae: *Crassicimex sexualis* Ferris and Usinger, 1957 described from a single female taken 50 miles SE of Torit, Uganda (Haeselbarth *et al.*, 1966: 12, host referenced as a *Tadarida* sp.).

SIPHONAPTERA
Ischnopsyllidae: *Araeopsylla scitula* (Rothschild, 1909) found in southern Africa Cape Province, Lesotho, Natal, Transvaal and Botswana, where it has been collected from Free-tailed bats which are its true host (Haeselbarth *et al.*, 1966: 189). *Lagaropsylla* Jordan and Rothschild, 1921 almost all records of hosts are from Free-tailed Bats (Haeselbarth *et al.*, 1966: 190). *Lagaropsylla hoogstraali* Smit, 1957 from Sudan host recorded as a molossid (Haeselbarth *et al.*, 1966: 190). *Lagaropsylla idea* Smit, 1957 recorded mainly from free-tailed bats, with distributions in tropical Africa (Haeselbarth *et al.*, 1966: 190). *Lagaropsylla oblique* Smit 1957 known to infest molossid species from Sierra Leone, Cameroon and the Congo (Haeselbarth *et al.*, 1966: 191). *Lagaropsylla tauffliebi* Smit 1962 a series was taken from a free-tailed bat (*Tadarida* sp.) near Bangui, Central African Republic (Haeselbarth *et al.*, 1966: 191; host referenced as a *Tadarida* sp.).

Subfamily Molossinae Gervais, 1856

*1856. *Molossinae* Gervais, in: F. Comte de Castelnau, Exped. Partes Cen. Am. Sud., Zool, (Sec. 7), Vol. 1, pt. 2 (Mammifères): 53 footnote. Publication date: 23 July 1856. - Comments: Type genus: *Molossus* E. Geoffroy St. Hilaire, 1805. (Current Combination)

1866. *Molossina* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 93. Publication date: 1 February 1866. - Comments: Type genus: Molossus E. Geoffroy, 1805. Proposed as tribe and originally included the genera *Molossus* É. Geoffroy, 1805; *Promops* Gervais, 1855 and *Nyctinomus* É. Geoffroy, 1818 [= *Tadarida* Rafinesque, 1814] (see Jackson and Groves, 2015: 257).

1984. *Cheiromelinae* Legendre, Rev. suisse Zool., 91 (2): 425. Publication date: June 1984. - Comments: Type genus: *Cheiromeles* Horsfield, 1824. Pavlinov *et al.* (1995: 90) recognise this as a subfamily, but see R(3345: 432) and Jackson and Groves (2015: 257).

1984. *Molossinae:* Legendre, Rev. suisse Zool., 91 (2): 399, 425. Publication date: June 1984. - Comments: Type genus: *Molossus* E. Geoffroy, 1805. Originally included the genera *Molossus* É. Geoffroy, 1805; *Eumops* Miller, 1906; *Molossops* Peters, 1865 [including the subgenera *Cynomops* Thomas, 1920 and *Neoplatymops* Peterson 1965]; *Myopterus* É. Geoffroy, 1818 and *Promops* Gervais, 1855 (see Jackson and Groves, 2015: 258).

1984. *Tadaridinae:* Legendre, Arch. Zool. Mus., Moscow State Univ., 91 (2): 399, 426. - Comments: Type genus: *Tadarida* Rafinesque, 1814. Originally included the genera *Tadarida* Rafinesque, 1814; *Mormopterus* Peters, 1865a; *Nyctinomops* Miller, 1902; *Otomops* Thomas, 1913; and *Rhizomops* Legendre, 1984 [= *Tadarida* Rafinesque, 1814 (see Jackson and Groves, 2015: 257). (Lapsus)

1995. *Tadarinae:* Peterson, Eger and Mitchell, Faune de Madagascar, 84: 143. (Lapsus)

TAXONOMY:
Bronner *et al.* (2003) state that the genera *Mops* and *Chaerephon* have often been included as subgenera of *Tadarida* (Ellerman *et al.*, 1953; Hayman and Hill, 1971; Swanepoel *et al.*, 1980; Meester *et al.*, 1986; Corbet and Hill, 1992). Roberts (1951) elevated these taxa to generic rank, an approach followed by Freeman (1981b), Koopman (1982, 1993a) and Simmons (2005). In southern Africa, *Mops* is therefore represented by two species (*M. midas* and *M. condylurus*); *Chaerephon* by five (*C. bivittata, C. ansorgei, C. nigeriae, C. chapini* and *C. pumilus*); and *Tadarida* by four (*T. aegyptiaca, T. lobata, T. ventralis* and *T. fulminans*). Other African genera are *Mormopterus, Myopterus, Otomops, Platymops* and *Sauromys* (Lamb *et al.*, 2011: 2), with *Myopterus, Platymops* and *Sauromys* being endemic to mainland Africa.

Ammerman *et al.* (2012: 23) suggest that this subfamily should be subdivided into four tribes: Molossini containing the New World taxa (*Molossus, Eumops, Molossops, Cynomops, Neoplatymops, Nyctinomops*, and *Promops*), tribe Tadarini containing Old World taxa (*Tadarida, Chaerephon, Mops, Platymops, Sauromys, Myopterus*, and *Otomops*), tribe Cheiromelini, and tribe Mormopterini.

Based on five nuclear sequence markers, Napier (2013) found strong support for the monophyly of the combined genera *Chaerephon* and *Mops* (with the exception of *C. jobimena*). There was no support for monophyly of either of these genera, suggesting that both should be combined in a single genus. Her study also suggests that a new species of *Otomops* should be names from northeast Africa and Arabia.

COMMON NAMES:
Czech: praví morousi. English: Free-tailed Bats, Wrinkled-lipped Bats, Bulldog Bats, Mastiff Bats, Bonneted Bats, Wolf-dog Bats. French: Molosses.

Genus ***Chaerephon*** Dobson, 1874

*1874. *Nyctinomus (Chaerephon)* Dobson, J. Asiatic Soc. Bengal, 43 (2): 144. Publication date: 17 October 1874. - Comments: Type species: *Molossus (Nyctinomus) johorensis* Dobson, 1873. Not *Chaerephon* Godman in Godman and Salvin, 1900 (Insecta, Lepidoptera, Hesperiidae) (see Jackson and Groves, 2015: 258). - Etymology: From the Greek "*chaerephon*" meaning joyful-sounding. Flannery (1990: 370; 1995a: 404) refers to it as "a proper name, significance unknown". Dobson (1874) in Bouchard (1998: 4) and Lanza *et al.* (2015: 268) indicate that it refers to the friend of Socrates who is depicted as "*Χαιρεφῶν*" ("Chaerephon the bat") in Aristophanes' comedy, *Aves*, maybe alluding to his

nocturnal habits or bony appearance or as suggested by Plato in Apology, to his sudden, excitable nature.

1907. *Chaerephon:* Andersen. (Name Combination, Current Combination)
1917. *Chærephon (Lophomops)* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 460, text-fig. 9 - 11. Publication date: 29 September 1917 [Goto Description]. - Comments: Type species: *Chærephon (Lophomops) chapini* J.A. Allen, 1917, by original designation (see Jackson and Groves, 2015: 259).
1938. *Lephomops:* Frechkop, Exploration du Parc National Albert, 48. - Comments: Reported as subgenus of *Chaerephon* by Frechkop (1938: 48), but clearly a lapsus, as furtheron (p. 53) the correct *Lophomops* is used. (Lapsus)
1951. *Tadarida (Chaerephon):* Ellerman and Morrison-Scott. (Name Combination)
1962. *Tadarida (Chaerophoron):* Taufflieb, Bull. Inst. Rech. Sci. Congo, 1: 112. (Lapsus)
1965. *Nyctinimus:* Koopman, Am. Mus. Novit., 2219: 21. Publication date: 22 June1965. (Lapsus)
2004. *Chaeraphon:* Okafor, Igbinosa and Ezenwaji, Anim. Res. Int., 1 (1): 64. Publication date: April 2004. (Lapsus)
2017. *Chaereophon:* Weiss, Dabrowski, Kurth, Leendertz and Leendertz, Virology J., 14 (181): 1. Publication date: 18 September 2017. (Lapsus)
? *Chaerephon sp.:*
? *Chaerophon:* (Lapsus)

TAXONOMY:
Formerly included in *Tadarida*; see Freeman (1981b: 60, 133, 150); see also Legendre (1984). Harrison and Bates (1991: 62) and Ansell and Dowsett (1988: 45), Corbet and Hill (1992: 157), Grubb *et al.* (1998: 93) and Horácek *et al.* (2000: 137) include *Chaerephon* in *Tadarida*. A key is provided by Bouchard (1998: 1, Mammalian Species, 574).

Nyctinomus is considered a valid genus by McFarland (1998: 34), but included in *Tadarida* by Koopman (1993a: 240), Grubb *et al.* (1998: 93), or included in *Chaerephon* by Simmons (2005), or in *Mormopterus* by Jacobs and Fenton (2002, Mammalian Species, 703: 1). Grubb *et al.* (1998: 93) also indicate that Mahoney and Walton (1988a: 148 - 149) considered that *Nyctinomus* was dated from 1813 and was therefore the prior name for the genus *Tadarida* Rafinesque, 1814. Their case is unconvincing, and Grubb *et al.* (1998) do not think it desirable to change the long established usage of *Tadarida*. However, since *Chaerephon* Dobson, 1874 is clearly more recent it might be that *Nyctinomus* should be used instead of *Chaerephon*.

Known species within the genus *Chaerephon*: ***aloysiisabaudiae*** (Festa, 1907); ***ansorgei*** Thomas, 1913; ***atsinanana*** Goodman, Buccas, Naidoo, Ratrimomanarivo, Taylor and Lamb, 2010; ***bemmeleni*** (Jentink, 1879); ***bivittatus*** (Heuglin, 1861); *bregullae* (Felten, 1964) – Vanuatu, Fiji Isls (Simmons, 2005: 433); ***chapini*** J. A. Allen, 1917; ***gallagheri*** (Harrison,1975); *jobensis* (Miller, 1902) – Seram (Moluccas), Yapen Isl (Indonesia), New Guinea, northern and central Australia (Simmons, 2005: 434); *johorensis* (Dobson, 1873) – western Malaysia, Sumatra (Indonesia) (Simmons, 2005: 433); ***leucogaster*** A. Grandidier, 1870; ***major*** (Trouessart, 1897); ***nigeriae*** Thomas, 1913; *plicatus* (Buchannan, 1800) – Indiaand Sri Lanka to southern China, Hong Kong, Cambodiaand Vietnam, southeast through Malyasia to the Philippines, Borneo and Lesser Sunda Isls, Hainan (China), Cocos Keeling Isl (Indian Ocean) (Simmons, 2005: 434); ***pumilus*** (Cretzschmar, 1830-1831); ***russatus*** J. A. Allen, 1917; ***shortridge*** Thomas, 1926; *solomonis* (Troughton, 1931) – Solomon Isls (Simmons, 2005: 435); ***tomensis*** (Juste and Ibañez, 1993).

In their molecular phylogeny study, Lamb *et al.* (2010: 204; 2011: 9) found strong support for the monophyly of the *Chaerephon* + *Mops* taxa (about 17.2 Mya old), but not for either of the genera separated. They also found some indications that certain *Mops* species are ancestral and *Chaerephon* species more derived. Their results suggest that *Chaerephon* should not be considered a subgenus of *Tadarida*, nor a genus on itself. They suggest to combine *Chaerephon* (except *Chaerephon jobimena*) together with *Mops* into a single genus pending a more complete study.

Ammerman *et al.* (2012: 20) also found support for a *Mops* - *Chaerephon* clade, which resulted in paraphyly of *Chaerephon*, and confirm again that *Chaerephon* is distinct from *Tadarida*. A further morphological study by Gregorin and Cirranello (2015: 10) confirmed the paraphyly of *Chaerephon*, but was unable to resolve the relationships within the genus.

COMMON NAMES:
Czech: malí morousi, příšerecové. English: Wrinkle-lipped Bats, Lesser Free-tailed Bats, Lesser Mastiff Bats. French: Tadarides. Italian: Cherefónti.

CONSERVATION STATUS:
IUCN (2004) - assessed *C. shortridgei* as NT ver 3.1 (2001).

BIOGEOGRAPHY:
Taylor *et al.* (2009) investigated patterns in mitochondrial DNA (cytochrome *b* and D-loop) variation in *Chaerephon* spp. specimens from southern Africa and Madagascar, including individuals from Madagascar with distinct phenotypic characters and identified as *C. leucogaster* and *C. pumilus*. Taylor *et al.* (2009) found southern African populations of *C. pumilus* to be paraphyletic, Malagasy *C. leucogaster* to be nested within *C. pumilus* sensu lato, and Malagasy *C. pumilus* forming a sister group to a complex of African *C. pumilus* and Malagasy *C. leucogaster* clades. Goodman *et al.* (2010a) including *C. pusillus* samples from the Comoros (all four islands) and Aladabra, found that on Mayotte and Madagascar individuals that can phenotypically be assigned to *C. leucogaster* and *C. pumilus* sensu lato, are known to occupy the same day roost sites. Morphological and molecular genetics data indicate they act as a good biological species. The individuals from the Comoros and Aldabra formed a monophyletic group, which shows morphological similarity. Comorian individuals, classically assigned to *C. pumilus*, are best considered distinct from African and Madagascan populations, and represent the same taxon occuring in the western Seychelles under the name *C. pusillus*.

PARASITES:
NEMATODA:
Durette-Desset and Chabaud (1975: 317) described *Molinostrongylus bauchoti* from a Madagascan bat belonging to this genus.

ACARI
Trombiculidae: Stekolnikov (2018a: 154) mentioned *Microtrombicula intranasalis* Vercammen-Grandjean, 1965 from *Chaerephon* sp.

VIRUSES:
Of the 13 *Chaerephon* sp. specimens from Kisumu, Kenya, one tested positive for *Adenovirus*, one for *Rhabdovirus* and five for *Polyoma virus* (Conrardy *et al.*, 2014: 259). Of the 16 specimens from Moi University, one tested positive for *Adenovirus*, one for *Paramyxovirus* and two for *Polyomavirus*.

Adenoviridae
Conrardy *et al.* (2014) detected an adenovirus in two individuals out of 35 sampled in Kenya. This virus groups within the *Mastadenovirus* genus.

Coronaviridae - Coronaviruses
SARS-CoV - During February 2008 in Ghana, six fecal samples were tested negative for coronavirus (CoV) RNA by Pfefferle *et al.* (2009) [as *Chaerephon spp.*]. Tong *et al.* (2009) tested several bats collected in Kenya in 2006 positive for the presence of coronavirus RNA in fecal samples. Hu *et al.* (2015: 5) indicate that in Ghana, Kenya and Nigeria novel betacoronaviruses related to SARS-CoV have been detected.
12 of the 113 Kenyan specimens tested by Tao *et al.* (2017: Suppl.) were positive for CoV (10.6 %).

Flaviviridae
Pegivirus (BPgV) - 1 out of 3 Kenyan *Chaerephon* sp specimens was infected by clade K type *Pegivirus* (Quan *et al.*, 2013: Table S5).

Paramyxoviridae
Conrardy *et al.* (2014) detected a paramyxovirus in one out of 35 individuals sampled in Kenya. This virus groups with Morbillivirus-related viruses.

Rhabdoviridae
Conrardy *et al.* (2014) detected a rhabdovirus in one out of 35 individuals sampled in Kenya. This virus groups with the *Tupavirus* genus, with a near identical sequence detected in *Miniopterus africanus*.

Polyomaviruses
Orthopolyomavirus (BPyV) – DNA of two novel polyomaviruses were detected from fecal/oral swabs from *Chaerephon* sp specimens from Kenya (Tao *et al.*, 2012)

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Ghana, Kenya, Madagascar, Malawi, Namibia, Sierra Leone, South Sudan, Tanzania, Uganda.

Chaerephon aloysiisabaudiae (Festa, 1907)

*1907. *Nyctinomus aloysii-sabaudiae* Festa, Boll. Mus. Zool. Anat. Comp. Univ. Torino, 22 (546): 1. Publication date: 21 January 1907. Type locality: Uganda: Western province: Toro distrirct: East of Ruwenzori: "Toro distrirct" [ca. 00 30 N 30 00 E] [Goto Description]. - Comments: Coordinates mentioned as 01 00 N 30 22 E by Thorn *et al.* (2009: 71). Allen (1939a: 107) mentioned the type locality as "Ruwenzoni". Grubb *et al.* (1998: 84) mention "East of Ruwenzori, Toro district".
1917. *Nyctinomus aloysii-sabaudiæ:* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 460. (Name Combination)
1922. *Chaerephon angolensis sabaudiae:* de Beaux, Ann. Mus. civ. Stor. nat. Genova, ser. 3, (O.S. 49) 9: 371. Publication date: 28 August 1922. (Lapsus)
1966. *Tadarida (Chaerephon) cyclotis* Brosset, Biol. gabon., 2 (1): 80. Type locality: Gabon: Bélinga [01 13 N 13 10 E] [Goto Description].
? *Chaerephon aloysiisabaudiae:* (Current Combination, Current Spelling)
? *Tadarida aloysiisabaudiae:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: morous vévodský. English: Duke of Abruzzi's Wrinkle-lipped Bat, Abruzzi's Wrinkle-lipped Bat, Duke of Abruzzi's Free-tailed Bat. French: Tadaride du Duc des Abruzzes, Molosse du Duc des Abruzzes. German: Fürst von Abruzzen Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bn; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) assessed as *Tadarida aloysiisabaudiae* (Mickleburgh *et al.*, 2008bn; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004bi; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is threatened by deforestation of its habitat by logging activities (Mickleburgh *et al.*, 2008bn; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bn) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further studies are needed into the distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Chaerephon aloysiisabaudiae has been patchily recorded in West and Central Africa. It ranges from Côte d'Ivoire and Ghana in the west, through Cameroon and northern Central Africa, to southern Sudan and western Uganda. It is known from around 50 localities (mostly single specimens).

Native: Cameroon; Central African Republic; Congo (The Democratic Republic of the); Côte d'Ivoire (Beaucournu and Fahr, 2003: 175); Gabon; Ghana; Sudan; Uganda.
Presence uncertain: Ethiopia (Simmons, 2005).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) reported 2*n* = 48, FN = 66, BA = 20, a submetacentric X chromosome and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - This high-flying species is rarely captured. It is found in relatively small groups (Mickleburgh *et al.*, 2008bn; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bn; IUCN, 2009).

VIRUSES:
Reoviridae
Weiss *et al.* (2017: 1) isolated a new virus belonging to the subfamily Spinareovirinae: Taï Forest reovirus (TFRV) (tentatively assigned to the genus *Coltivirus*) from a bat in Côte d'Ivoire. This was the first bat-borne reovirus in Africa (Weiß, 2013: 65).

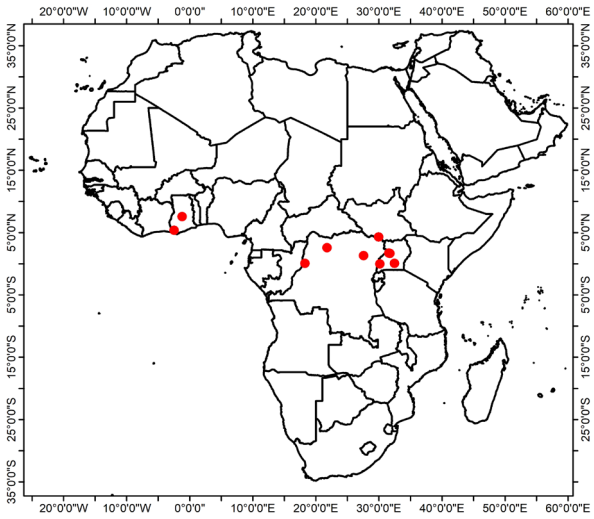


Figure 155. Distribution of *Chaerephon aloysiisabaudiae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Uganda.

Chaerephon ansorgei (Thomas, 1913)

*1913. *Nyctinomus ansorgei* Thomas, Ann. Mag. nat. Hist., ser. 8, 11 (63): 318. Publication date: 1 March 1913. Type locality: Angola: Malange [=Malanje] [09 32 S 16 20 E, 1 150 m] [Goto Description]. Holotype: BMNH 1910.4.8.4: ad ♂. Collected by: Dr. William John Ansorge; collection date: 17 February 1909; original number: 5. - Etymology: In honour of Dr. William John Ansorge (1850 - 1913), a collector of zoological specimens, who collected the type specimen of this species in Malange, northern Angola (see Taylor, 2005; Lanza *et al.*, 2015: 271).

1946. *Nyctinomus rhodesiae* Roberts, Ann. Transv. Mus., 20 (4): 307. Type locality: Zimbabwe: Bindura district: Masembura Native Reserve: Chikupo caves [17 24 S 31 20 E] [Goto Description]. Holotype: TM 9977: ad ♂, skin and skull. Collected by: H.B. Masterson; collection date: 10 July 1945.

1967. *Tadarida bivittata:* Ansell, Arnoldia Rhod., 2 (38): 25. - Comments: Not of Heuglin, 1861.

? *Chaerephon ansorgei:* (Name Combination, Current Combination)

? *Tadarida (Chaerephon) ansorgei:* (Name Combination)

? *Tadarida ansorgei:* (Name Combination)

TAXONOMY:
Distinct from *bivittata*; see Eger and Peterson (1979: 1889), who revised it.

COMMON NAMES:
Afrikaans: Ansorge se losstertvlermuis, Ansorge-losstertvlermuis. Chinese: 安氏犬吻蝠. Czech: morous Ansorgeův. English: Ansorge's Wrinkle-lipped Bat, Ansorge's Free-tailed Bat. French: Tadaride d'Ansorge, Molosse d'Ansorge, Molosse d'Afrique du Sud. German: Ansorges Bulldoggfledermaus. Italian: Cherefónte di Ansòrge. Portuguese: Morcego de cauda livre de Ansorge.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Hildebrand *et al.* (2010: 281) recorded this species from the Koka site in southern Ethiopia.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it is likely to occur in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ac; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida ansorgei*] (Mickleburgh *et al.*, 2008ac; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004al; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016aa). 2008 - LC ver 3.1 (2001)

(Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species. In parts of West Africa, some populations may be threatened by overharvesting for subsistence food (Mickleburgh *et al.*, 2008ac; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ac) [in IUCN (2009)] report that in view of the species wide range it is presumably present in many protected areas (including Comoe National Park, Côte d'Ivoire). No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Chaerephon ansorgei is widely distributed over much of sub-Saharan Africa. It ranges from northeastern Côte d'Ivoire in the west, through much of the northern part of West and Central Africa (north of the Congo basin), to Ethiopia and East Africa, from here southwards as far as northeastern South Africa. It has been recorded between 400 and 2,000 m asl.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 673,792 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 541; Taylor *et al.*, 2018b: 62); Cameroon (Eisentraut, 1968: 171 - 1st record from West Africa); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 541); Côte d'Ivoire; Ethiopia; Mozambique (Monadjem *et al.*, 2010d: 541: Monadjem *et al.*, 2010c: 382); South Africa (Monadjem *et al.*, 2010d: 541); Sudan; Uganda (Kityo and Kerbis, 1996: 63); Zambia (Ansell, 1978: Monadjem *et al.*, 2010d: 541); Zimbawe (Cotterill, 2004a: 261: Monadjem *et al.*, 2010d: 541).

Presence uncertain: Namibia.

ECHOLOCATION:
Jacobs (1996) and Fenton and Bell (1981) reported a highest frequency of 28 kHz for individuals at Sengwa in Zimbabwe.

Taylor (2000: 67) reported call details as: long duration (15 ms), multi-harmonic (up to two), narrow bandwidth (16 - 28 kHz) shallow-FM calls, with low dominant frequency of 18 kHz, in a field guide to bats of Southern Africa.

For *Chaerephon ansorgei* from Mozambique, Taylor *et al.* (2013b: 18) reported the following parameters for 3 calls: F_{max}: 23.1 ± 3.5 (20.1 - 27.0) kHz, F_{min}: 186. ± 1.5 (16.9 - 19.8) kHz, F_{knee}: 21.5 ± 1.4 (19.9 - 22.6) kHz, F_{char}: 19.8 ± 1.1 (18.5 - 20.5) kHz, duration: 10.6 ± 1.2 (9.4 - 11.9) msec. And for 12 calls from Waterberg, South Africa: F_{max}: 22.1 ± 1.53 (19.5 - 243) kHz, F_{min}: 18.5 ± 0.92 (17.5 - 20.0) kHz, F_{knee}: 20.1 ± 1.05 (18.9 - 21.8) kHz, F_{char}: 19.0 ± 0.94 (17.8 - 20.5) kHz, duration: 6.4 ± 1.51 (4.5 - 9.3) msec.
At Farm Welgevonden (RSA), Taylor *et al.* (2013a: 556) report a F_{knee} value of 20 (19 - 22) kHz.
In the Soutpansberg area (RSA), Linden *et al.* (2014: 40) mentioned the following characteristics for *C.* cf. *ansorgei*: F_{min}: 17 - 20 kHz, F_{char}: 18 - 21 kHz, F_{knee}: 19 - 23, Slope: 24 - 212 OPS, duration: 4 - 12 msec.
20 calls from the Mapungubwe National Park (RSA) were recorded by Parker and Bernard (2018: 57): F_{char}: 18.21 ± 1.01 kHz, F_{max}: 20.92 ± 3.39 kHz, F_{min}: 17.59 ± 1.03 kHz, F_{knee}: 19.38 ± 1.49 kHz, duration: 10.07 ± 3.03 msec with 2.47 ± 1.43 calls/sec.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) and Rautenbach *et al.* (1993) agreed on 2*n* = 48, and the Y chromosome being acrocentric. However, Smith *et al.* (1986) reported FN = 66, BA = 20, and a subtelocentric X chromosome, whereas Rautenbach *et al.* (1993) reported for specimens from South African, FN = 68, BA = 22, and a submetacentric X chromosome.
Protein / allozyme - Unknown.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Southern yellow-billed hornbill (*Tockus leucomelas* Lichtenstein, 1842) as diurnal avian predator.

POPULATION:
Structure and Density - It appears to be generally uncommon, although colonies may contain hundreds of bats (Mickleburgh *et al.*, 2008ac; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008ac; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned lactating females in November-January and April.

PARASITES:
SIPHONAPTERA

Ischnopsyllidae: *Lagaropsylla anciauxi* Smit, 1957 from Katanga, Congo (Haeselbarth *et al.*, 1966: 190).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Cameroon, Congo (Democratic Republic of the), Ethiopia, Kenya, Malawi, Mozambique, Nigeria, Rwanda, South Africa, South Sudan, Uganda, Zimbabwe.

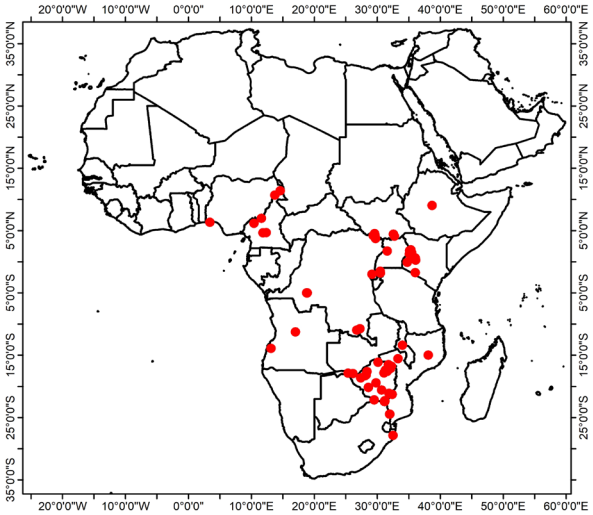


Figure 156. Distribution of *Chaerephon ansorgei*

Chaerephon atsinanana Goodman, Buccas, Naidoo, Ratrimomanarivo, Taylor and Lamb, 2010

*2010. *Chaerephon atsinanana* Goodman, Buccas, Naidoo, Ratrimomanarivo, Taylor and Lamb, Zootaxa, 2551: 21, figs 34, 6A, 7. Publication date: 28 July 2010. Type locality: Madagascar: Fianarantsoa: Farafangana: Collèges d'Enseignement Général (CEG) Fenoarivo [22 49.275 S 47 49.860 E, 10 m] [Goto Description]. Holotype: FMNH 185259: ad ♀, skull and alcoholic. Collected by: Fania H. Ratrimomanarivo; collection date: 26 April 2005. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 185260: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185261: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185262: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185263: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185264: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185265: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185266: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185267: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). Paratype: FMNH 185268: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Same locality as the type specimen (see Goodman *et al.*, 2010a: 21). - Etymology: The name *atsinanana* is derived from the Malagasy word meaning "from the east" (see Goodman *et al.*, 2010a: 23). (Current Combination)

? *Chaerephon pumilus:*

CONSERVATION ACTIONS:
On Madagascar, it has not been recorded from any protected areas, but it has been recorded from houses close to protected areas as *C. pumilus* (Mickleburgh *et al.* (2008dr) [in IUCN (2009)]).

GENERAL DISTRIBUTION:
Chaerephon atsinanana is known from numerous localities across the eastern half of Madagascar from near sea level to over 1,100 m (see Goodman *et al.*, 2010a: 26).
In Madagascar, the species is restricted to the humid areas of the island (in the north and east) and can be found up to 1,300 m asl. Its southernmost range in Madagascar is not well understood and it has not been recorded south of Moramanga (Goodman and Cardiff, 2004).

Native: Madagascar (Goodman *et al.*, 2010a: 26).

BIOGEOGRAPHY:
Chaerephon atsinanana is common in the mesic eastern portion of Madagascar, across an elevational range from near sea level to 1,100 m a.s.l. (Lamb *et al.*, 2012: 19).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 60) found that the triangular shaped baculum of this species could be subdivided into three morphotypes: morphotype A is more rounded than the flattened morphotype B, and morphotype C is similar to B, but with an indentation in the proximal base. The shaft curvature is more pronounced in types B and C as compared to type A. In all morphotypes, the distal portions are similar, gradually tapering from the midshaft towards a blunt tip. Length: 0.90 ± 0.066 (0.78 - 1.00) mm, width: 0.34 ± 0.056 (0.26 - 0.46) mm.

MOLECULAR BIOLOGY:
DNA - See Goodman *et al.* (2010a).
Karyotype - Unknown.
Protein / allozyme - Unknown.

Napier (2013) hypothesized that this species should show relatively low levels of intraspecific genetic structure as bats are strong fliers and are able to traverse the riverine and mountain barriers. However, she needed to reject this hypothesis as genetic distances of up to 8.14 % were found. She furthermore suggests that these differences are consistent with the existence of female philopatry.

HABITAT:
Goodman *et al.* (2010a: 26) report that all of the sites where this species is found, are in urban or at least rural areas and outside of natural forest. They were also unable to find a natural day-roost of this species. A further analysis by Lamb *et al.* (2012: 29) indicated that the predicted distribution pattern was rather patchy and limited to the Madagascar Lowland Forests ecoregion and furthermore strongly associated with human population centres and transport routes.

ROOST:
Wilkinson *et al.* (2012: 160) indicate that synanthropic structures are the typical roosts for this species on Madagascar.

DIET:
The faeces of five specimens examined by Rasoanoro *et al.* (2015: 64) contained the following volume percentages of prey: Coleoptera: 44.0 ± 5.08, Diptera: 8.3 ± 4.15, Hemiptera: 3.1 ± 1.36, Homoptera: 19.0 ± 4.42, Hymenoptera: 0.3 ± 0.31, and Lepidoptera: 25.4 ± 1.86.

Kemp *et al.* (2018: Suppl.) used DNA metacarcoding to detect insect pest species in the diet of these bats and found the following prey orders (in descending order): Coleoptera, Ephemeroptera, Lepidoptera (*Meyrickiella homosema* (Meyrick, 1887), *Leguminivora* sp., *Mythimna* sp., *Cydia choleropa* (Meyrick, 1913)), Diptera (*Simulium lineatum* (Meigen, 1804), *Culex* MBI-27, *Anopheles squamosus* Theobald, 1901, *Culex annulioris* Theobald, 1901), Orthoptera, Trichoptera, Blattodea, Hemiptera, Sarcoptiformes, Trombidiformes, Odonata, Siphonaptera, Hymenoptera.

POPULATION:
Structure and Density - There are no estimates of its population in Madagascar, but it is thought to be locally common in the eastern zone (Mickleburgh *et al.*, 2008dr; IUCN, 2009, as *C. pumilus*).
Trend - Unknown.

VIRUSES:
Wilkinson *et al.* (2012: 160) tested 20 individuals from the Madagascar using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids.

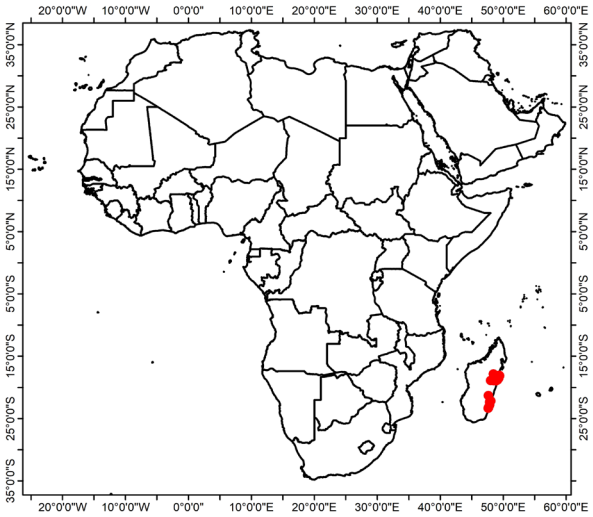


Figure 157. Distribution of *Chaerephon atsinanana*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Chaerephon bemmeleni (Jentink, 1879)

*1879. *Nyctinomus Bemmeleni* Jentink, Notes Leyden Mus., 1 (1): 125. Publication date: April 1879. Type locality: "Africa": "Liberia ??" [Goto Description]. Holotype: RMNH MAM.21649: ad ♀, skull and alcoholic. Collection date: 1875. - Comments: The type locality was originally mentioned as "Liberia", but see Kuhn (1965: 327), who doubts this, since the type specimen had come from a zoo. - Etymology: In honour of Mr. A.A. van Bemmelen, director of the Zoological Gardens at Rotterdam, who presented the type specimen to the museum (see Jentink, 1879b: 127).
1897. *[Nyctinomus (Nyctinomus)] Vemmeleni:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, nov. ed. 1, pt. 1: 146. Publication date: 1897. (Lapsus)
1903. *Nyctinomus cisturus* Thomas, Ann. Mag. nat. Hist., ser. 7, 12 (71): 502. Publication date: 1 November 1903. Type locality: Sudan: Equatoria province: 25 mi (37.5 km) N Gondokoro: Mangala (=Mongalla) [05 10 N 31 50 E, 500 m] [Goto Description]. Holotype: BMNH 1902.7.4.4: ad ♂. Collected by: W.L.S. Loat Esq. Original number: 2805. Presented/Donated by: W.L.S. Loat Esq.
? *Chaerephon bemmeleni:* (Name Combination, Current Combination)
? *Tadarida bemmeleni cistura:* (Name Combination)
? *Tadarida bemmeleni:* (Name Combination)

TAXONOMY:
Includes *cisturus*; see Koopman (1975: 425).

The data used by Herkt *et al.* (2017: Appendix S9) support the idea that *bemmeleni* includes more than one species. However, genetic tests to confirm this are not yet available, but material from the small overlapping area can clearly be allocated to the ssp. *cisturus*, rendering a large geographic gap between occurrence records of either population: one in West and western Central Africa (*bemmeleni*) and one in East Africa (*cisturus*).

COMMON NAMES:
Chinese: 腺尾犬吻蝠. Czech: morous liberijský. English: Gland-tailed Wrinkle-lipped Bat, Van Bemmelen's Wrinkle-lipped Bat, Gland-tailed Free-tailed Bat. French: Tadaride à glande caudale, Molosse à glandes caudales. German: Schwanzdrüsen-Bulldoggfledermaus, Bemmelens Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008am; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida bemmeleni*] (Mickleburgh *et al.*, 2008am; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004ba; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is threatened by habitat loss, largely through logging activities and the conversion of land to agricultural use (Mickleburgh *et al.*, 2008am; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008am) [in IUCN (2009)] report that it is present in Meru National Park, Kenya, and is presumably present in several more protected areas. Further studies are needed into the taxonomy, natural history, threats and distribution of this species.

GENERAL DISTRIBUTION:
Chaerephon bemmeleni is widely distributed in Africa from Sierra Leone in the west, then patchily through West and Central Africa to southern Sudan, Uganda, Kenya and Tanzania in the east. It has been recorded up to 1,700 m asl on Mount Nimba along the border of Côte d'Ivoire and Guinea (J. Fahr *pers. Comm.*, 2004 in Mickleburgh *et al.*, 2008am in IUCN, 2009).

Native: Cameroon; Congo (The Democratic Republic of the); Côte d'Ivoire; Guinea; Kenya (Start, 1969; as *T. cistura*); Liberia; Rwanda; Sierra Leone; Sudan; Tanzania; Uganda.
Presence uncertain: Burkina Faso; Central African Republic; Chad; Ethiopia; Guinea-Bissau; Mali; Nigeria; Senegal.

MOLECULAR BIOLOGY:
DNA - unknown.
Karyotype - Nagorsen *et al.* (1976) reported 2*n* = 48, Fna = 54, BA = 8, a submetacentric X chromosome and an acrocentric Y chromosome.

POPULATION:
Structure and Density - The abundance of *C. bemmeleni* is unclear, in parts of the range it seems to be a rare species that is found in small colonies consisting of a few individuals. In East Africa this species exhibits a clumped distribution,

yet is relatively abundant locally (Webala *et al.*, 2004).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008am; IUCN, 2009).

PARASITES:
Lainson and Naiff (2000: 128) and Duszynski (2002: 21) indicate that *C. bemmeleni* is the type host for *Eimeria levinei* Bray, 1958 (Apicomplexa).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Cameroon, Congo (Democratic Republic of the), Kenya, Liberia, Sierra Leone, South Sudan, Tanzania, Uganda.

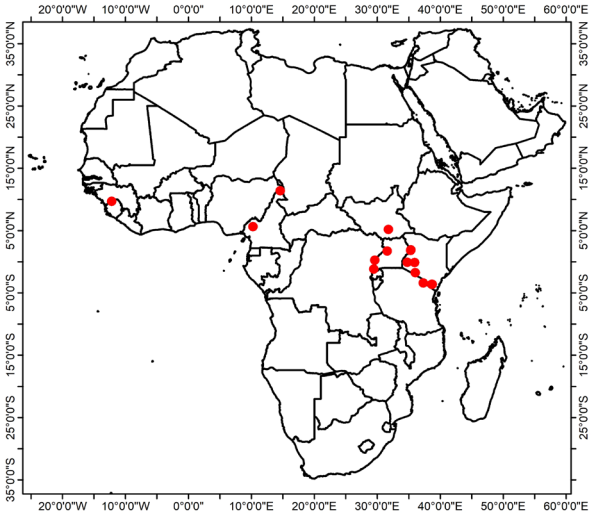


Figure 158. Distribution of *Chaerephon bemmeleni*

Chaerephon bivittatus (Heuglin, 1861)

*1861. *Nyctinomus bivittatus* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 4, 13. Publication date: 1861. Type locality: Eritrea: Kérén [ca. 15 45 N 38 20 E] [Goto Description]. Holotype: RMNH ??:. See Jentink (1888b: 203). Syntype: ZMB 2792a: skull and alcoholic. Collected by: Theodor Von Heuglin. Formerly SMNS, from "Abyssinia, Bogos[land]". See Turni and Kock (2008: 72). Syntype: ZMB 2792b: skull and alcoholic. Collected by: Theodor Von Heuglin. Formerly SMNS, from "Abyssinia, Bogos[land]". See Turni and Kock (2008: 72). Lectotype: SMNS 981: ad ♂, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. Dieterlen *et al.* (2013: 294) indicated this specimen to be the lectotype, referring to ICZN article 74.6, which would indicate that this status was established by Dobson (1878), who called specimen this "'type". However, Dobson (1878: 426) presents the measurements of an adult male, which he called the "type", but since there are two adult males (981 and 981b), it is not clear which of these two specimens was referred to by Dobson (1878). Paralectotype: SMNS 981a: ad ♀, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See Dieterlen *et al.* (2013: 294). Paralectotype: SMNS 981b: ad ♂, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See Dieterlen *et al.* (2013: 294), but see also note above. - Etymology: From the masculine scientific Latin adjective *bivittàtus*, meaning "bivittate", as the species is provided with two narrow longitudinal stripes on and behind the head (see Lanza *et al.*, 2015: 273).
1967. *Tadarida bivittata:* Ansell, Arnoldia Rhod., 2 (38): 29. (Name Combination)
2002. *Chaerephon bivittata:* Arroyo-Cabrales, Gregorin, Schlitter and Walker, 22 (2): 386.
2016. *Chaerophon bivittattus:* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 43. Publication date: 9 May 2016. (Lapsus)
? *Chaerephon bivittatus:* (Name Combination, Current Combination)
? *Tadarida bivittata bivittata:* (Name Combination)

TAXONOMY:
Revised by Eger and Peterson (1979).

COMMON NAMES:
Afrikaans: Gevlekte losstertvlermuis. Chinese: 斑犬吻蝠. Czech: morous skvrnitý. English: Spotted Wrinkle-lipped Bat, Spotted Free-tailed Bat, Spotted Gland-tailed Bat. French: Tadaride tachetée, Molosse tacheté. German: Gefleckte Bulldoggfledermaus, zweistreifige Doggengrämler. Italian: Cherefónte bivittàto. Portuguese: Morcego de cauda livre malhado.

ETYMOLOGY OF COMMON NAME:
So named because of the tiny white, and sometimes barely discernible, flecks on the upper parts of the body (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ad; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida bivittata*] (Mickleburgh *et al.*, 2008ad; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessed as *C. bivittata*] (Mickleburgh *et al.*, 2004an; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Mickleburgh *et al.*, 2008ad; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ad) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is presumably present in some East African protected areas. Further studies are needed into the abundance, distribution and natural history of this bat.

GENERAL DISTRIBUTION:
Chaerephon bivittatus is an East African species ranging from Eritrea and Ethiopia in the north, through southern Sudan, Uganda, Kenya and eastern Tanzania, to Zambia, Zimbabwe and Mozambique in the south.

Native: Eritrea; Ethiopia; Kenya; Malawi (Monadjem *et al.*, 2010d: 541); Mozambique (Crawford-Cabral, 1989; Simmons, 2005); Sudan; Tanzania; Uganda; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 541); Zimbabwe (Ansell, 1986; Monadjem *et al.*, 2010d: 541).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Peterson and Nagorsen (1975) reported 2*n* = 48, FN = 54, BA = 8, a metacentric X chromosome, and an acrocentric Y chromosome for specimens from Kenya and Zimbabwe.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - Although there is little information on the abundance of this species, it is common in collections suggesting that it is easily found (Mickleburgh *et al.*, 2008ad; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008ad; IUCN, 2009).

PARASITES:
Beaucournu and Kock (1996) mentioned the first record for the flea *Lagaropsylla anciauxi* Smit, 1957 on this bat.
Hastriter (2016: 15) described the flea *Araeopsylla smiti* from a *C. bivittatus* collected at Maji Moto, Kenya.

Copeland *et al.* (2011: 363) reported the rediscovery of the "terrible hairy fly" (*Mormotomyia hirsuta* (after 62 years) in guano produced by *C.* cf. *bivittatus* and *T. aegyptiaca* at Ukasi Hill, Kenya.

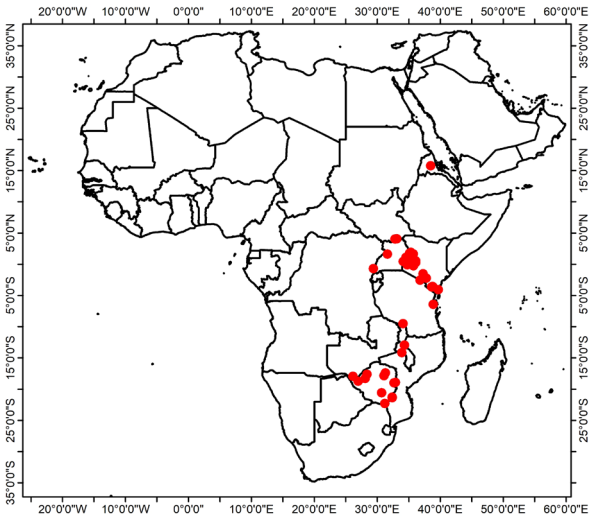


Figure 159. Distribution of *Chaerephon bivittatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Eritrea, Ethiopia, Kenya, Malawi, Mozambique, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe.

Chaerephon chapini J.A. Allen, 1917

*1917. *Chærephon (Lophomops) chapini* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 460, 461, text-fig. 9. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Faradje [03 44 N 29 43 E] [Goto Description]. Holotype: AMNH 48841: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 11 November 1912; original number: 1971.

1926. *Chaerephon (Lophomops) shortridgei* Thomas, Proc. zool. Soc. Lond., 1926, I: 289. Publication date: 29 April 1926. Type locality: Namibia: NW Ovamboland: 32 mi NW of Rehoboth Mission Station: Ukualukasi [17 32 S 14 37 E, 3 400 ft] [Goto Description].

Holotype: BMNH 1925.12.4.24: skin and skull. Collected by: Captain Guy Chester Shortridge; original number: 1389. - Comments: Considered a valid species by Peterson *et al.* (1995: 159), Goodman and Cardiff (2004: 236). - Etymology: I have named this striking species in honour of Capt. Shortridge, to whose energy and enthusiasm the great success of the South West African collecting expeditions has been almost wholly due, and who was greatly struck by its remarkable appearance (see Thomas, 1926).

1938. *Chærephon lancasteri* Hayman, Ann. Mag. nat. Hist., ser. 11, 1 (4): 383. Publication date: 1 April 1938. Type locality: Zambia: Loangwa Valley: Lundazi district: Lunzi River [ca. 11 S 33 E] [Goto Description]. Holotype: BMNH 1937.12.8.25: ad ♂, skin and skull. Collected by: D. Gordon Lancaster; collection date: August 1936; original number: 724. Notes: caught in hole in tree. - Comments: Kock (1969a: 140) situates the Lunzi river in Zambia, rather than in Zimbabwe.

2009. *Choerephon (Lopomops) langi:* ACR [Goto Description]. - Comments: *nomen nudum*.

? *Chaerephon chapini chapini:* (Name Combination)

? *Chaerephon chapini lancasteri:* (Name Combination)

? *Chaerephon chapini:* (Name Combination, Current Combination)

? *Chaerephon shortridgei:*

? *Tadarida chapini lancasteri:* (Name Combination)

? *Tadarida chapini:* (Name Combination)

TAXONOMY:
Included in *pumilus* by Kock (1969a: 139). See Fenton and Eger (2002).

COMMON NAMES:
Afrikaans: Bleek losstertvlermuis. Chinese: 查平犬吻蝠. Czech: morous chocholatý. English: Long-crested Free-tailed Bat, Chapin's Wrinkle-lipped Bat, Long-crested Wrinkle-lipped Bat, Crested Wrinkle-lipped Bat, Chapin's Free-tailed Bat, Pale Free-tailed Bat, Long-crested Gland-tailed Bat, Crested Free-tail Bat. French: Tadaride de Chapin, Molosse à crinière, Molosse pâle. German: Chapins Bulldoggfledermaus.

ETYMOLOGY OF COMMON NAME:
Named after Mr. James P. Chapin, co-organiser of the American Museum expedition to the former Belgian Congo that resulted in the discovery of the species (Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
No fossils are known (Fenton and Eger, 2002).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ae; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida chapini*] (Mickleburgh *et al.*, 2008ae; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004ag; IUCN, 2004). NT ver 3.1 (2001) [assessed as *Chaerephon shortridgei*] (Mickleburgh *et al.*, 2004ak; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this widespread species as a whole. It may be threatened in parts of its range through habitat loss and degradation (e.g. in northern Zimbabwe and parts of Zambia) (Mickleburgh *et al.*, 2008ae; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ae) [in IUCN (2009)] report that it has been recorded from Kruger National Park in South Africa, and from Mole National Park in Ghana and Comoe.

GENERAL DISTRIBUTION:
Chaerephon chapini has been widely recorded over much of sub-Saharan Africa. It has been collected from Côte d'Ivoire and Ghana in West Africa, southern Sudan, northeastern Democratic Republic of the Congo, Ethiopia, Uganda and Kenya, ranging south into southern Democratic Republic of the Congo and Congo, Angola, Zimbabwe, Zambia, Botswana and Namibia.

Native: Angola (Monard, 1935; Crawford-Cabral, 1989; Hill and Carter, 1941; Monadjem *et al.*, 2010d: 541); Botswana (Monadjem *et al.*, 2010d: 541); Cameroon (Bol A Anong *et al.*, 2011: 46; Bakwo Fils *et al.*, 2014: 3); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Fenton and Eger, 2002: 2; Monadjem *et al.*, 2010d: 541); Ethiopia; Ghana; Kenya (Fenton and Eger, 2002: 2); Namibia (Monadjem *et al.*, 2010d: 541); Sudan (Fenton and Eger, 2002: 2); Uganda;

Zambia (Ansell, 1969; Monadjem *et al.*, 2010d: 541); Zimbabwe (Monadjem *et al.*, 2010d: 541).

Bates *et al.* (2013: 338) reject the occurrence of *C. chapini* in the Republic of Congo as the "Marine Park Nature Reserve" was erroneously located in that country in ACR (2012) rather than in the DRC. The record from Cameroon is probably doubtful (Jakob Fahr, pers. comm.).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Fenton and Eger (2002).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Fenton and Eger (2002).

DETAILED MORPHOLOGY:
Baculum - Unknown
For a description of the crania, teeth, ears and tragus see Fenton and Eger (2002).

SEXUAL DIMORPHISM:
Sexual dimorphism in the structure of interaural crest, with females having a small crest (3 - 5 mm) and males a long, bicolored one (12 - 15 mm) (Fenton and Eger, 2002). Krutzsch (2000: 128) pointed out that this crest is also odoriferous in the breeding male.

ECHOLOCATION:
Jacobs (1996) and Fenton and Bell (1981) reported a highest frequency of 27 kHz for individuals at Sengwa in Zimbabwe.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 48, FN = 64, BA = 18, a subtelocentric X chromosome, and an acrocentric Y chromosome, for specimens from Namibia and Zimbabwe.
Protein / allozyme - Unknown.

HABITAT:
See Fenton and Eger (2002).

HABITS:
See Fenton and Eger, 2002).

Fenton and Griffin (1997: 248) recorded echolocation calls from "*Tadarida chapini*" at altitudes between 0 and 450 m above a *Brachystegia* woodland in Zimbabwe.

ROOST:
See Fenton and Eger (2002).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - In general there is little information on the abundance of this species over its range (Mickleburgh *et al.*, 2008ae; IUCN, 2009). It can be common in northwestern Zimbabwe, but it is not regularly recorded. The species is found in small colonies, with a single observation of a small group of breeding females.
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ae; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
See Fenton and Eger, 2002).

REPRODUCTION AND ONTOGENY:
See Fenton and Eger (2002).

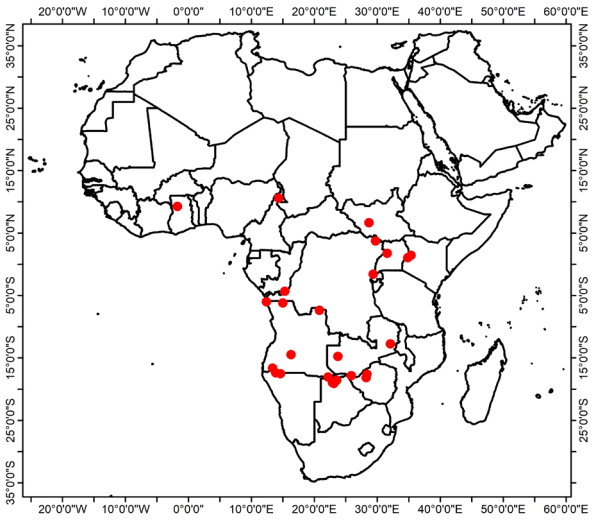


Figure 160. Distribution of *Chaerephon chapini*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Botswana, Cameroon, Congo (Democratic Republic of the), Ethiopia, Ghana, Kenya, Namibia, Rwanda, South Sudan, Uganda, Zambia, Zimbabwe.

Chaerephon gallagheri (Harrison, 1975)

*1975. *Tadarida (Chaerephon) gallagheri* Harrison, Mammalia, 39 (2): 313. Type locality: Congo (Democratic Republic of the): Kivu province: 30 km SW Kindu: Scierie Forest [03 10 S 25 46 E] [Goto Description]. Holotype: BMNH 1976.207: ad ♂. Collected by: Major Michael D. Gallagher; collection date: 14 November 1974; original number: MDG-3256. Presented/Donated by: ?: Collector Unknown. Formerly HZM 1.7797. Holotype: HZM

1.7797: ♂. Collected by: Major Michael D. Gallagher; collection date: 14 November 1974; original number: MDB-3256. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of Major M.D. Gallagher, the collector of the type specimen.

? *Chaerephon gallagheri:* (Name Combination, Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: morous kivuský. English: Gallagher's Wrinkle-lipped Bat, Gallagher's Free-tailed Bat, Zaïre Gland-tailed Bat. French: Tadaride de Gallagher, Molosse du Zaïre. German: Gallaghers Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Mickleburgh *et al.*, 2008ag; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) [assessed as *Tadarida gallagheri*] (Mickleburgh *et al.*, 2008ag; IUCN, 2009). 2004 - CR D ver 3.1 (2001) (Mickleburgh *et al.*, 2004ai; IUCN, 2004). 2002 - CR: B1+2c (Mickleburgh *et al.*, 2002a: 22). 1996 - CE (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are unclear. It may be threatened by habitat loss, through the conversion of forest to agricultural use and timber extraction, however, this needs to be confirmed (Mickleburgh *et al.*, 2008ag; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ag) [in IUCN (2009)] report that there are no direct conservation measures in place for this species. It is not known if the species is present within any protected areas. Additional studies are needed into the distribution, abundance, natural history and threats to this poorly known species.

GENERAL DISTRIBUTION:
Chaerephon gallagheri has only been recorded from the type locality of 'Scierie Forest, 30 km of southwest Kindu, Kivu' in the Democratic Republic of the Congo. It may range more widely distributed, however, other surveys in the general area have not recorded this species.

Native: Congo (The Democratic Republic of the) (Gallagher and Harrison, 1977; Harrison, 1975a).

POPULATION:
Structure and Density - There is little information on the abundance of this species (Mickleburgh *et al.*, 2008ag; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ag; IUCN, 2009).

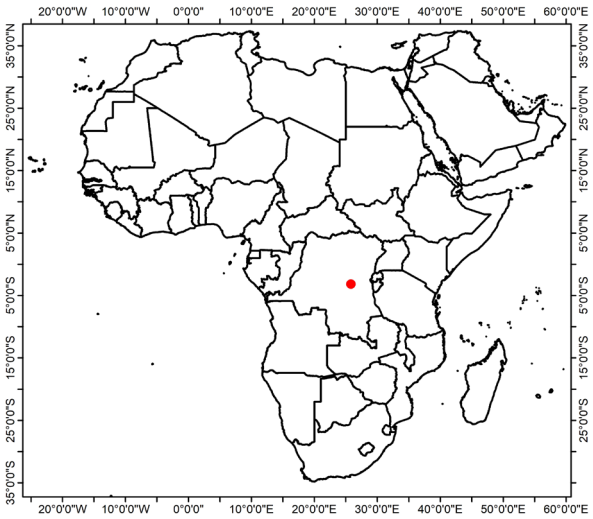


Figure 161. Distribution of *Chaerephon gallagheri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the).

Chaerephon jobimena Goodman and Cardiff, 2004

*2004. *Chaerephon jobimena* Goodman and Cardiff, Acta Chiropt., 6 (2): 230, fig 2, 3, 4. Type locality: Madagascar: Antsiranana province: Ankarana special reserve, 2.6 km E Andrafiabe: Andrafiaba cave, in forest near [12 55.9 S 49 03.4 E, ca. 50 m] [Goto Description]. Holotype: FMNH 169716: ad ♂, skin and skull. Collected by: Steven M. Goodman; collection date: 23 January 2001; original number: SMG 11932. See Goodman and Cardiff (2004: 230). - Etymology: From the northern dialects of Malagasy, with "*joby*" meaning dark or black and "*mena*" red. The combination refers to the two color morphs of this species (see Goodman and Cardiff, 2004: 230). (Current Combination)

TAXONOMY:
Lamb *et al.* (2011: 9) indicate that, although morphologically similar to other *Chaerephon* taxa, *jobimena* is genetically more similar to *Tadarida*.

COMMON NAMES:
Czech: morous malgašský. English: Black and Red Free-tailed Bat. French: Tadaride rouge ou noir. German: Variable Bulldoggfledermaus.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) because although it appears to be rather rare in the few areas where it is known to occur, it is widespread and its population status may not be related to the amount or state of native forest. Additional information are needed on its propensity for roosting in large colonies in synanthropic settings as this will be crucial to a better understanding of its conservation status (Andriafidison *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida jobimena*] (Andriafidison *et al.*, 2008l; IUCN, 2009).

MAJOR THREATS:
The threats to this species are not well known, but it is probably hunted in the south of Madagascar for food (Andriafidison *et al.*, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008l) [in IUCN (2009)] report that this species is known from in or near to four protected areas, but is never as common or as abundant as other sympatric molossid species (Goodman and Cardiff, 2004; Goodman *et al.*, 2005a) and its conservation status should be reviewed in the future when new data are available. In particular, information on its propensity to dwell in buildings is needed.

GENERAL DISTRIBUTION:
Chaerephon jobimena is endemic to Madagascar where it is found from the north-west to the south-west of the island. It is known to occur in areas with dry deciduous or spiny forest from 50 to 870 m above sea level (Goodman and Cardiff, 2004; Goodman *et al.*, 2005a). Although further surveys may reveal that this species is more widespread than currently known, it has yet to be recorded from some sites with extensive limestone caves, from where it would be expected based on habitat preference and distribution (Goodman and Cardiff, 2004; Goodman *et al.*, 2005a; Cardiff, 2006).
Native: Madagascar (Goodman and Cardiff, 2004; Goodman *et al.*, 2005a; Cardiff, 2006).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 61) report the following shape for the baculum of this species: the proximal portion is notably expanded. Its size decreases slightly in the mid-shaft portion, then more notably distally. The distal tip tapers to a rounded point. Length: 1.16 mm, width: 0.37 mm.

HABITAT:
Dammhahn and Goodman (2013: 108) indicate that this species' foraging habitat consists of open areas and the area above the forest canopy.

POPULATION:
Structure and Density - The population and local abundance of this species are not known, but at Ankarana the recorded roost is 1,200 individuals (S. G. Cardiff *pers. obs.*, in Andriafidison *et al.*, 2008l [in IUCN, 2009]). Forty individuals were recorded from a house roughly 10 km from Parc National de Namoroka (A. F. Kofoky *pers. obs.*, in Andriafidison *et al.*, 2008l [in IUCN, 2009]).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008l; IUCN, 2009).

PARASITES:
Hastriter (2016: 9) described the flea *Araeopsylla goodmani* from a male *C. jobimena* collected at Isalo, 3.8 km NW Ranohira, along Namaza River, Madagascar.

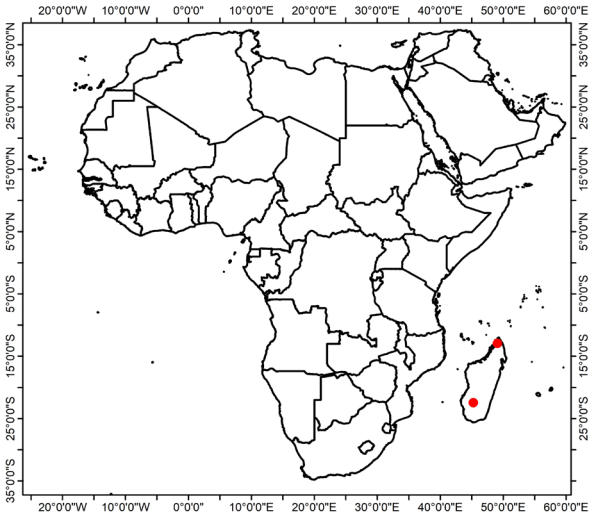


Figure 162. Distribution of *Chaerephon jobimena*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Chaerephon leucogaster (A. Grandidier, 1869)

*1869. *Nyctinomus leucogaster* A. Grandidier, Rev. Mag. Zool., ser. 2, 21: 337. Publication date: September 1869. Type locality: Madagascar: Mahab (?Mahabo) and Ménabé (E of Morondava) [20 23 S 44 40 E, 50 m] [Goto Description]. Neotype: FMNH 176137: ad ♂, skull and alcoholic. Collected by: Vola Razakarivony; collection date: 11 November 2002. - Comments: Ratrimomanarivo *et al.* (2009a: 28) mention "The only specimen possibly fitting the details of the Grandidier type is MCZ 45094, which is in poor condition and the original specimen label bears the following information: 'Cote Ouest' [= west coast], '*Nyctinomus pumelus* [sic]', 'collection Grandidier', and '1901'. Based on numerous characters, including aspects of external, cranial, and dental measurements as well as pelage and soft part coloration, this animal is referable to *C. leucogaster*. However, the collection details are too ambiguous to clearly conclude that this specimen can be considered the type of *C. leucogaster* described by Grandidier (1869) and, further, the skull is considerably damaged." They also select a neotype (FMNH 176137): "collected in the Menabe Region of western coastal Madagascar, specifically at Belo sur Mer (20°44.139'S, 44°00.266'E) at 10 m above sea level on 11 November 2002 by Vola Razakarivony. This site is approximately 80 km southwest of Mahabo. The animal is an adult male, the body was preserved in formalin and subsequently transferred to 70% ethanol, the skull has been extracted, cleaned, and is in excellent condition.". - Etymology: From the Greek "*leugos*" and "*gaster*" meaning white-bellied (see Kozhurina, 2002: 16).

1908. *Chœrephon websteri* Dollman, Ann. Mag. nat. Hist., ser. 8, 2 (12): 546. Publication date: 1 December 1908. Type locality: Nigeria: N Nigeria, on Bénoué river: Yola [09 12 N 12 29 E]. Holotype: BMNH 1908.10.6.8: ad ♀, skin and skull. Collected by: G.W. Webster; collection date: 27 July 1908; original number: 11.

1917. *Chærephon (Lophomops) cristatus* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 463, text-fig. 10 A, B. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Kinshasa province: near mouth of Congo River: Boma [05 50 S 13 03 E] [Goto Description]. Holotype: AMNH 48844: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 26 January 1915; original number: 2628.

1917. *Chærephon frater* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 456. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Kinshasa province: near Boma: Malela [05 57 S 12 38 E, 30 m] [Goto Description]. Holotype: AMNH 49275: ad ♀, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 8 July 1915; original number: 2613. Topotype: MCZ 17219: ♀, alcoholic (skull not removed). Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 8 July 1915. Presented/Donated by: ?: Collector Unknown. Topotype: MCZ 17221: ♀, alcoholic (skull not removed). Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 8 July 1915. Presented/Donated by: ?: Collector Unknown.

1928. *Chærophon (Lophomops) nigri* Hatt, Bull. Soc. zool. France, 53: 374, text-fig. B. Publication date: 10 December 1928. Type locality: Mali: Timbuctu district: on Niger River: Bourem [16 59 N 00 20 W] [Goto Description]. Holotype: MNHN 736a: ad ♂, alcoholic (skull not removed). Collected by: Th. Monod; collection date: 6 January 1928. Paratype: AMNH 90390: ad ♂, skin and skull. Collected by: Th. Monod; collection date: 6 January 1928; original number: M.S.A.D. 736b. See AMNH website.

1956. *Chaerephon nigri:* Aellen, Mém. IFAN, 48A: 32. (Name Combination)

? *Chaerephon frater:* (Alternate Spelling)

? *Chaerephon leucogaster:* (Name Combination, Current Combination)

? *Chaerephon pumila cristata:* (Name Combination)

? *Chaerephon pumila websteri:* (Name Combination)

? *Chaerephon websteri:* (Alternate Spelling)

? *Tadarida frater:* (Name Combination)

? *Tadarida leucogaster leucogaster:* (Name Combination)

? *Tadarida leucogaster websteri:* (Name Combination)

? *Tadarida leucogaster:* (Name Combination)

? *Tadarida pumila frater:*

? *Tadarida websteri:* (Name Combination)

TAXONOMY:
Included in *pumilus* by Koopman (1993a: 233), Bouchard (1998: 1).
Considered a valid species in the genus *Tadarida (C.)* by Peterson *et al.* (1995: 152) and Russ *et al.* (2001). Considered a valid species in the genus *Chaerephon* by Hutson *et al.* (2001: 33), Goodman and Cardiff (2004: 227), Lavrenchenko *et al.* (2004b: 141), and Simmons (2005).
Russ *et al.* (2001) distinguish it from *C. pumilus* on smaller size and different echolocation calls. Ammerman *et al.* (2012: 23) indicate that the separation between *leucogaster* and *pumilus* took place less than 2 million years ago.

COMMON NAMES:
Czech: morous bělobřichý. English: Grandidier's Free-tailed Bat, Madagascan white-bellied Free-tailed Bat. French: Tadaride de Madagascar à ventre blanc, Tadaride à ventre blanc, Petite tadaride de Madagascar. German: Grandidiers Bulldoggfledermaus.

CONSERVATION STATUS:
Global - DD ver 2.3 (1994).

GENERAL DISTRIBUTION:
Ethiopia to Ghana, Nigeria, Cameroon (Bol A Anong *et al.*, 2011: 46; Bakwo Fils *et al.*, 2014: 4), Congo (Bates *et al.*, 2013: 336), Congo (Democratic Republic of the Congo?), Mali, Madagascar (Russ *et al.*, 2001), Nosy Be and Nosy Komba (Rakotonandrasana and Goodman, 2007: 6).

O'Brien (2011: 288) reports it further from the Comoros, and the Tanzanian islands of Pemba, Unguja [=Zanzibar], and Mafia.

BIOGEOGRAPHY:
Chaerephon leucogaster is found across an elevational range of 0 - 920 m a.s.l., and is confined almost exclusively to the more extensive and drier western portion of Madagascar (Lamb *et al.*, 2012: 19).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 61) describe the baculum of *C. leucogaster* as "Eiffel tower shaped", with a bifurcated proximal tip that tapers abruptly to a distal point; length: 0.78 ± 0.072 (0.65 - 0.89) mm, width: 0.47 ± 0.055 (0.37 - 0.58) mm.

HABITAT:
Lamb *et al.* (2012: 29) indicate that the highly suitable habitat for this species was associated with low annual rainfall, high mean annual temperature, and high human influence.

Dammhahn and Goodman (2013: 108) indicate that this species' foraging habitat consists of open areas and the area above the forest canopy.

ROOST:
Ravelomanantsoa *et al.* (2019: 111) indicated that *Chaerephon leucogaster* uses human constructions for roosting.

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of four individuals in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

PARASITES:
BACTERIA
Gomard *et al.* (2016: 5) found 1 out of 94 tested bats to be positive for *Leptospira*.

SIPHONAPTERA
Ischnopsyllidae: *Lagaropsylla consularis* Smit, 1957 from Ethiopia, Kenya, Uganda, Congo and Congo (Democratic Republic of), Angola, Zimbabwe and Mozambique (Haeselbarth *et al.*, 1966: 190, host referred to as *Tadarida frater*).

VIRUSES:
Paramyxoviridae
Specimens from this species tested by Wilkinson *et al.* (2014: 8270) were found to be positive for paramyxoviruses.
Mélade *et al.* (2016b: 4) tested 94 Madagascan specimens, of which 6 were found positive for paramyxoviruses.

Rhabdoviridae
Mélade *et al.* (2016a: 6) tested 28 bats for *Duvenhage lyssavirus* and foud seroreactivlty in nine of them.

UTILISATION:
See Goodman *et al.* (2008d).

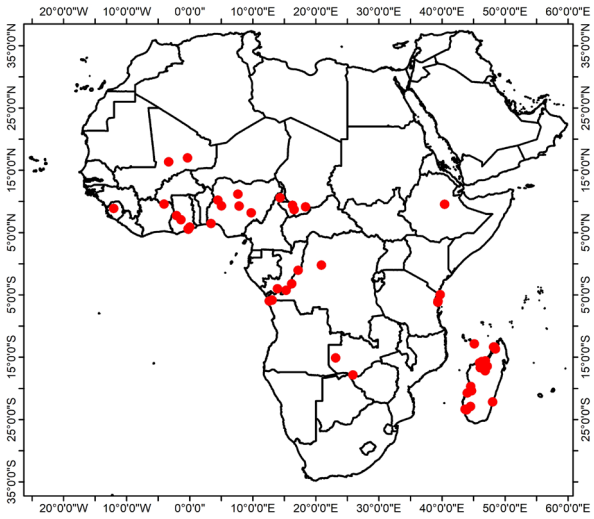


Figure 163. Distribution of *Chaerephon leucogaster*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Ghana, Madagascar, Mali, Mayotte, Nigeria, Sierra Leone, Tanzania, Zambia.

Chaerephon major (Trouessart, 1897)

*1897. *[Nyctinomus (Nyctinomus) pumilus] Var. Major* Trouessart, Catalogus Mammalium tam viventium quam fossilium, nov. ed. 1, pt. 1: 146. Publication date: 1897. Type locality: Sudan: N Sudan: 5th Cataract of the Nile [18 32 N 33 41 E] [Goto Description]. Holotype: BMNH 1849.2.8.36: Collected by: Sir Francis Galton. - Comments: Kock (1969a: 148) mentions "Nilus super = 5. Nil-Katarakt, nördlich Berber, Sudan" as original type locality. He also states that de Winton (1901a: 40) changed the type locality in "erster Kakarakt der Nil".). - Etymology: From the Latin "*maior*" (see Kozhurina, 2002: 16).

1901. *Nyctinomus Emini* de Winton, Ann. Mag. nat. Hist., ser. 7, 7 (37): 40. Publication date: 1 January 1901. Type locality: Tanzania: "Mosambiro" [=Usambiro] [03 00 S 32 34 E] [Goto Description]. Holotype: BMNH 1890.6.8.15: ad ♂, skin and skull. Collection date: 9 September 1889. Notes: Local name - 'Katunke'. - Comments: See Thorn *et al.* (2009: 72).

1917. *Chærephon (Lophomops) abæ* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 464, text-fig. 11. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Aba [03 53 N 30 17 E] [Goto Description]. Holotype: AMNH 48887: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 17 December 1911; original number: 1823.

1967. *Tadarida (Chaerephon) pumila:* Happold, Sudan Notes & Records, 48: 122. - Comments: Preoccupied by *pumilus* Cretzschmar, 1830 (see Simmons, 2005). Attribution to *major* seems strange.

? *Chaerephon abae:* (Alternate Spelling)

? *Chaerephon major:* (Name Combination, Current Combination)

? *Tadarida (Chaerephon) major:* (Name Combination)

? *Tadarida abae:* (Name Combination)

? *Tadarida major:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Chinese: 垂耳犬吻蝠. Czech: morous nubijský. English: Large Wrinkle-lipped Bat, Lappet-eared Wrinkle-lipped Bat, Lappet-eared Free-tailed Bat, Giant gland-tailed bat. French: Tadaride à oreillettes, Grand molosse à glandes caudales. German: Stirnlappen-Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ah; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida major*] (Mickleburgh *et al.*, 2008ah; IUCN, 2009).
2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*,

2004am; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There are no major threats to this species. Some populations are threatened by general habitat loss and disturbance of old buildings (Mickleburgh *et al.*, 2008ah; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ah) [in IUCN (2009)] report that the species has a wide range, and likely occurs in some protected areas, although this needs to be confirmed. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Chaerephon major is a lowland species is found throughout much of West Africa (including Senegal, Liberia, Côte d'Ivoire, Mali, Burkina, Ghana, Togo, Benin, Niger, and Nigeria), as well as a narrow distribution following the Nile from northern Sudan to Uganda. A second population is known from the east of Lake Victoria in eastern Uganda, western Kenya, and north-western Tanzania. A third, apparently disjunct, population is present in southeastern Kenya and northeastern Tanzania.

The records from Liberia should be re-examined as they may represent a different species, while the record from Malawi is doubtful (J. Fahr *pers. comm.* 2004 in Mickleburgh *et al.*, 2008ah in IUCN, 2009).

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Burkina Faso (Kangoyé *et al.*, 2015a: 617); Cameroon (Bakwo Fils *et al.*, 2014: 4); Congo (The Democratic Republic of the); Côte d'Ivoire; Ghana; Guinea; Kenya; Liberia; Mali; Niger; Nigeria; Senegal; Sudan; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 63); Zambia (Monadjem *et al.*, 2010d: 541).

ECHOLOCATION:
From Maroua, Cameroon, Manga Mongombe (2012: 79) and Bakwo Fils *et al.* (2018: 4) reported for 16 calls a call type of FM and the following parameters: F_{max}: 39.3 ± 6.9 (31.9 - 53.1) kHz, F_{min}: 37.4 ± 6.7 (25.9 - 49.0) kHz, F_{mean}: 36.4 ± 6.7 (28.7 - 51.0) kHz, F_{knee}: 38.2 ± 7.3 (29.9 - 53.1) kHZ, F_{char}: 33.7 ± 7.3 (26.2 - 49.0) kHz, and duration: 1.66 ± 0.40 (0.85 - 2.73) msec.

POPULATION:
Structure and Density - This is a relatively common species, found in fairly small colonies (Mickleburgh *et al.*, 2008ah; IUCN, 2009).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008ah; IUCN, 2009).

PARASITES:
Beaucournu and Kock (1996) reported the first record for the flea *Lagaropsylla anciauxi* Smit, 1957 on "*Tadarida major*" from Burkina Faso.

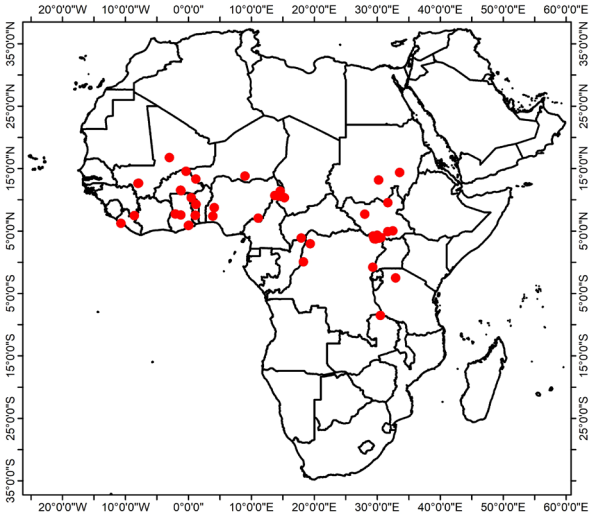


Figure 164. Distribution of *Chaerephon major*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Burkina Faso, Cameroon, Central African Republic, Congo (Democratic Republic of the), Ghana, Liberia, Mali, Niger, Nigeria, South Sudan, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Chaerephon nigeriae Thomas, 1913

*1913. *Chærephon nigeriæ* Thomas, Ann. Mag. nat. Hist., ser. 8, 11 (63): 319. Publication date: 1 March 1913. Type locality: Nigeria: Northern region: Zaria province [ca. 11 01 N 07 44 E] [Goto Description]. Holotype: BMNH 1911.3.22.1: ad ♀. Collected by: A.C. Francis Esq. Presented/Donated by: A.C. Francis Esq. - Etymology: From the genitive scientific Latin feminine substantive *nigèriae*, meaning "from Nigeria", as the species was described from a Nigerian specimen (see Lanza *et al.*, 2015: 277).
1957. *Tadarida (Chearephon) spillmani:* Ansell, Ann. Mag. nat. Hist., ser. 12 (10): 539. (Lapsus)
1988. *Tadarida chaeraphon nigeriae:* Okafor, Misc. Zool., 12: 11. (Lapsus)
2004. *Tadarida (Chaeraphon) nigeriae:* Okafor, Igbinosa and Ezenwaji, Anim. Res. Int., 1 (1): 64. Publication date: April 2004. (Name Combination, Lapsus)

? *Chaerephon nigerae:* (Lapsus)
? *Chaerephon nigeriae:* (Current Spelling)
? *Tadarida (Chaerephon) nigeriae nigeriae:* (Name Combination)
? *Tadarida nigeriae nigeriae:* (Name Combination)
? *Tadarida nigeriae:* (Name Combination)

TAXONOMY:
See Willis *et al.* (2002, Mammalian Species, 710).

This may be a complex of two distinct species, with *Chaerephon nigeriae* in the north of the known distribution and *C. spillmanni* in the south. We follow Simmons (2005) in currently recognizing *spillmanni* Monard, 1933 as a subspecies of *C. nigeriae*.

Herkt *et al.* (2017: Appendix S9) found that the localities in the southern part of the distribution area suggest rather different ecological niches than those for the northern part, which would suggest that more than one species might be included.

COMMON NAMES:
Afrikaans: Nigeriese losstertvlermuis. Azande (DRC): Fulo. Czech: morous nigerijský. English: Nigerian Free-tailed Bat, Nigerian Wrinkle-lipped Bat. French: Tadaride du Nigeria, Molosse du Nigéria. German: Nigeria-Bulldoggfledermaus. Italian: Cherefónte nigeriàno.

ETYMOLOGY OF COMMON NAME:
The species was originally described from a specimen from Nigeria (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008ai; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida nigeriae*] (Mickleburgh *et al.*, 2008ai; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004af; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2004 - considered a vagrant not assessed, not recorded in SA (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species (Mickleburgh *et al.*, 2008ai; IUCN, 2009). The ability of the species to exploit buildings as roosts, and its association with cleared rainforest in Nigeria, suggests that it is relatively resistant to anthropogenic impacts (Willis *et al.*, 2002).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ai) [in IUCN (2009)] report that in view of the species wide range, it is presumably present in some protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Chaerephon nigeriae is widely distributed over much of sub-Saharan Africa. It ranges from Sierra Leone in the west to Ethiopia in the east, being recorded as far south as Angola, Botswana and Zimbabwe. There are some additional records from the Arabian Peninsula in Yemen and western Saudi Arabia. The species has been found at elevations of up to 1,000 m asl, and possibly occur higher.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,133,308 km^2.

Native: Angola (Crawford-Cabral, 1989; Al-Jumaily, 2002: 55; Monadjem *et al.*, 2010d: 541; Taylor *et al.*, 2018b: 60); Botswana (Archer, 1977; Al-Jumaily, 2002: 55; Monadjem *et al.*, 2010d: 541); Burkina Faso (Kangoyé *et al.*, 2012: 6024; 2015a: 618); Burundi; Cameroon; Central African Republic (Al-Jumaily, 2002: 55); Chad (Al-Jumaily, 2002: 55); Congo; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Al-Jumaily, 2002: 55; Monadjem *et al.*, 2010d: 541); Côte d'Ivoire (Beaucournu and Fahr, 2003: 157; but see Al-Jumaily, 2002); Ethiopia (Al-Jumaily, 2002: 55); Ghana (Al-Jumaily, 2002: 55); Guinea (Al-Jumaily, 2002: 55); Malawi (Happold and Happold, 1997b: 823; Al-Jumaily, 2002: 55); Mali (Al-Jumaily, 2002: 55); Mozambique; Namibia (Al-Jumaily, 2002: 55; Monadjem *et al.*, 2010d: 541); Niger (Al-Jumaily, 2002: 55); Nigeria (Al-Jumaily, 2002: 55); Saudi Arabia (Nader and Kock, 1980); Sierra Leone (Al-Jumaily, 2002: 55); Sudan; Tanzania (Al-Jumaily, 2002: 55); Uganda (Al-Jumaily, 2002: 55); Yemen (Al-Jumaily, 2002: 55; Benda *et al.*, 2011b: 46); Zambia (Ansell, 1957; Ansell and Ansell, 1973; Cotterill, 2004a: 261; Al-Jumaily, 2002: 55; Monadjem *et al.*, 2010d: 541); Zimbabwe (Al-Jumaily, 2002: 55; Monadjem *et al.*, 2010d: 542).

Presence uncertain: Togo (Al-Jumaily, 2002: 55).

ECHOLOCATION:
See Taylor (1999b).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 48, FN = 62, BA = 16, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from Namibia and Zimbabwe

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - This species is typically found in small groups of 10 to 15 animals, with maternity roosts being formed of up to 25 bats (Mickleburgh *et al.*, 2008ai; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ai; IUCN, 2009).

PARASITES:
BACTERIA
Bartonellae
Kamani *et al.* (2014: 628) tested 16 Nigerian *C. nigeriae* animals, and found 2 of them testing positive for *Bartonella* DNA.

Helminths
Okafor *et al.* (2004: 64) investigated the helminth parasite load of 857 *C. nigeriae* specimens from Nigeria and found 658 (76.78 %) of them to be infected by 9 species: Nematodes: *Rictularia chaerephoni, Histostrongylus coronatus, Capillaria annulosa* Dujardin, 1845, *Cheiropteronema globocephala* Sandground, 1929, *Litosoma pujoli* Bain, 1966; Trematodes: *Posthodendrium panouterus, Castroia nyctali* Gvosdev, 1954; Cestodes: *Hymenolepis kerivoulae* (Prudhoe and Manger, 1969), *Oochoristica agamae* Bayliss, 1919.

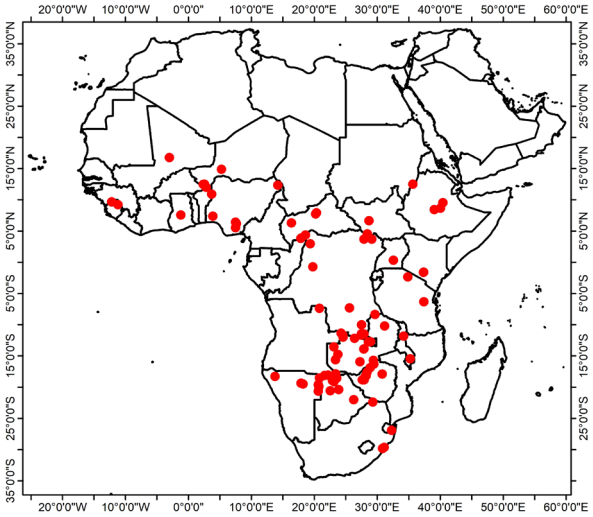


Figure 165. Distribution of *Chaerephon nigeriae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Kenya, Mali, Namibia, Niger, Nigeria, Sierra Leone, South Africa, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe.

Chaerephon nigeriae nigeriae Thomas, 1913

*1913. *Chærephon nigeriæ* Thomas, Ann. Mag. nat. Hist., ser. 8, 11 (63): 319. Publication date: 1 March 1913. Type locality: Nigeria: Northern region: Zaria province [ca. 11 01 N 07 44 E] [Goto Description]. - Etymology: From the genitive scientific Latin feminine substantive *nigèriae*, meaning "from Nigeria", as the species was described from a Nigerian specimen (see Lanza *et al.*, 2015: 277).
? *Chaerephon nigeriae nigeriae:* (Name Combination, Current Combination, Current Spelling)
? *Tadarida (Chaerephon) nigeriae nigeriae:* (Name Combination)
? *Tadarida nigeriae nigeriae:* (Name Combination)

GENERAL DISTRIBUTION:
E Côte d'Ivoire, Ghana, Benin, Togo, Nigeria, Cameroon, Central African Republic to NE Democratic Republic of the Congo; Niger; Chad; Ethiopia; Saudi Arabia (Harrison and Bates, 1991: 64).

Subsaharan Africa to NE Zaire: see Horácek *et al.* (2000: 137). E Côte d'Ivoire, Ghana, Benin, Togo, Nigeria, Cameroon, Central African Republic, N Zaire, Niger, Chad, Ethiopia: see Willis *et al.* (2002: 2).

Chaerephon nigeriae spillmanni (Monard, 1933)

*1933. *Nyctinomus spillmanni* Monard, Bull. Soc. Neuchât. Sci. nat., 57: 51 (for 1932?). Publication date: 1933. Type locality: Angola: South-Central Angola: Vila da Ponte [14 25 S 16 15 E].
1963. *Tadarida (Chaerephon) spillmanni:* Hayman. (Name Combination, Current Spelling)
1965. *Nyctinimus spillmani:* Koopman, Am. Mus. Novit., 2219: 21. Publication date: 22 June 1965. (Lapsus)
1967. *Tadarida nigeriae spillmanni:* Ansell, Arnoldia Rhod., 2 (38): 25. (Name Combination)
? *Chaerephon nigeriae spillmani:* (Lapsus)
? *Chaerephon nigeriae spillmanni:* (Name Combination, Current Combination)
? *Tadarida (Chærephon) spillmani:* (Name Combination, Alternate Spelling)

GENERAL DISTRIBUTION:
Southern Africa (Angola (Horácek *et al.*, 2000: 137), Namibia (Willis *et al.*, 2002: 2), Botswana (Willis *et al.*, 2002: 2), Zimbabwe (Wilson and La Val, 1974: 2), Zambia (Willis *et al.*, 2002: 2), S Democratic Republic of the Congo (Willis *et al.*, 2002: 2), Tanzania (Horácek *et al.*, 2000: 137).

PARASITES:
SIPHONAPTERA
Ischnopsyllidae: *Lagaropsylla lipsi* Smit,1957 known only from the vicinity of Elisabethville, Katanga, Congo (Haeselbarth *et al.*, 1966: 191).

Chaerephon pumilus (Cretzschmar, 1826)

*1826. *Dysopes pumilus* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 69, pl. 27a. Type locality: Eritrea: Massawa [15 37 N 39 26 E] [Goto Description]. Lectotype: SMF 4311: ♀, skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1825. Old catalog II.K.3.a: see Mertens (1925: 20). - Comments: The publication date of Cretzschmar's work is sometimes indicated as "1826" (as mentioned on the title page), but also as "1827", "1828", "1830-1831". - Etymology: From the masculine Latin adjective *pùmilus*, meaning "of short stature, dwarf or pygmy" as the species is a particularly small African molossid (see Lanza *et al.*, 2015: 282).
1838. *Nyctinomus pusilus:* Lesson, Compléments de Buffon, ed. 2, Paris, 1: 328. Publication date: 1838. (Lapsus)
1852. *Dysopes dubius* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 60, pl. 15, fig. 2. Publication date: 1852. Type locality: Mozambique: South bank of Zambezi River: Sena [17 28 S 35 01 E] [Goto Description]. Holotype: ZMB 85539: juv, skull only. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. Pullus specimen; see Turni and Kock (2008: 72). - Comments: Preoccupied by *dubius* A. Smith, 1833 (see Simmons, 2005). Allen (1939a: 111) also mentioned *Nyctinomus dubius* A. Smith, 1833 as a separate species. Turni and Kock (2008: 72) state that no other African molossid collected was ever identified with *D. dubius* until Ellerman *et al.* (1953: 68) synonymized it without any comment. Peters´ species description on the *pullus* specimen ZMB 85539 is very questionable, so they conclude that *dubius* is a *nomen dubium*.
1852. *Dysopes limbatus* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 56, pl. 14. Publication date: 1852. Type locality: Mozambique: Mozambique Island [15 03 S 40 46 E] [Goto Description]. Syntype: BMNH 1907.1.1.704:. Syntype: ZMB 537/85520: ad ♂, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008) [skin: ZMB 537 / skull: ZMB 85520]. Syntype: ZMB 538/85519: ad ♀, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008) [skin: ZMB 538 + skull: ZMB 85519]. Syntype: ZMB 539: juv, skin only. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). - Comments: Peters (1852: 56) mentions "Africa orientalis, Insula Mozambique, Sena at 15° ad 17° Let. Aust.", and Roberts (1951: 98) "Mozambique Island and Sena"). Possibly valid as a subspecies. Considered a valid species by Peterson *et al.* (1995: 159).
1877. *Nyctinomus [(Nyctinomus)] limbatus:* Dobson, Proc. zool. Soc. Lond., 1876, IV: 724. Publication date: April 1877. (Name Combination)

1877. *Nyctinomus [(Nyctinomus)] pumilus:* Dobson, Proc. zool. Soc. Lond., 1876, IV: 723. Publication date: April 1877. (Name Combination)

1878. *Nyctinomus limbatus:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 428. - Comments: . (Name Combination)

1901. *Nyctinomus gambianus* de Winton, Ann. Mag. nat. Hist., ser. 7, 7 (37): 39. Publication date: 1 January 1901. Type locality: The Gambia: "Gambia" [Goto Description]. Holotype: BMNH 1889.10.7.3:.

1904. *Nyctinomus hindei* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (75): 210. Publication date: 1 March 1904. Type locality: Kenya: Fort Hall [=Muranga] [00 43 S 37 09 E, 4 000 ft] [Goto Description]. Holotype: BMNH 1903.3.2.4: ad ♂. Collected by: Mrs. Hildegarde Hinde; collection date: 1 January 1903; original number: 134. Presented/Donated by: Mrs. Hildegarde Hinde. - Comments: Possibly valid as a subspecies. Considered a valid species by Peterson *et al.* (1995: 159). Thomas (1904a: 210) mentions 2 specimens.

1916. *Chaerephon pumilus naivashæ* Hollister, Smiths. Misc. Coll., 66 (1) (2406): 4. Publication date: 10 February 1916. Type locality: Kenya: Naivasha Station [00 43 S 36 26 E] [Goto Description]. Holotype: USNM 166658: ad ♂, skull and alcoholic. Collected by: John Alden Loring; collection date: 7 August 1909; original number: 6955. Topotype: ROM 36466: ad ♂, skin and skull. Collected by: John George Williams; collection date: 10 July 1965. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 36467: ad ♀, skin and skull. Collected by: John George Williams; collection date: 17 July 1965. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 36468: ad ♀, skin and skull. Collected by: John George Williams; collection date: 17 July 1965. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 36469: ad ♀, skin and skull. Collected by: John George Williams; collection date: 17 July 1965. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 36470: ad ♂, skin and skull. Collected by: John George Williams; collection date: 17 July 1965. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 36471: ad ♀, skin and skull. Collected by: John George Williams; collection date: 10 August 1965. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 36472: ad ♀, skin and skull. Collected by: John George Williams; collection date: 10 August 1965. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41842: juv ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41843: juv ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41844: juv ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41845: juv ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41846: juv ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41847: juv ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41848: juv ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41849: juv ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41850: ad ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41851: ad ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41852: ad ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41853: ad ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection

date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41854: ad ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41855: ad ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41856: ad ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41857: ad ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41858: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41859: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41860: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41861: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41862: juv ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41863: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41864: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41865: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41866: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41867: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41868: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41869: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41870: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41871: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41872: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41873: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41874: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41875: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41876: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41877: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41878: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?:

Collector Unknown. Topotype: ROM 41879: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41880: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41881: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41882: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41883: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41884: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41885: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41889: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41890: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41891: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41892: ad ♂, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41893: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41894: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41895: ad ♀, skull and alcoholic. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41896: ad ♂, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41897: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41898: ad ♀, alcoholic (skull not removed). Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41899: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41900: ad ♂, complete skeleton. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41901: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41902: ad ♀, complete skeleton. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41903: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41904: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41905: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41906: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41907: ad ♀, skin and skull. Collected by: Randolph

L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 41908: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 9 August 1967. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47000: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47001: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47002: ad ♂, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47003: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47004: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47005: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47006: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47007: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47008: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47009: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47010: ad ♂, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47011: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47012: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47013: ad ♂, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47014: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47015: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47016: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47017: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47018: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47019: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47020: ad ♂, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. Topotype: ROM 47021: ad ♀, skin and skull. Collected by: John George Williams; collection date: 30 June 1968. Presented/Donated by: ?: Collector Unknown. - Comments: Considered a valid species by Peterson *et al.* (1995: 157).

1926. *Chaerophon pumilus elphicki* Roberts, Ann. Transv. Mus., 11: 245. Publication date: 14 September 1926. Type locality: South Africa: SE Transvaal province: Barberton district: Malelane Estate [25 29 S 31 31 E] [Goto Description]. Holotype: TM 2488: ad ♂, skin and skull. Collected by: Captain G.J. Elphick; collection date: 30 March 1920.

1932. *Choerephon (Lophomops) langi* Roberts, Ann. Transv. Mus., 15 (1): 17. Publication date: 1 October 1932. Type locality: Botswana: N Bechuanaland, Ngamiland,: Tsotsoroga Pan [18 40 S 24 25 E] [Goto Description]. Holotype: TM 6554: ad ♂, skin and skull. Collected by: The Vernay-Lang Kalahari Expedition 1930; collection date: 29 June 1930; original number: 870. - Comments: Possibly valid as a subspecies.

1951. *Tadarida (Chaerephon) faini* Hayman, Rev. Zool. Bot. afr., 45 (1-2): 82. Publication date: 22 December 1951. Type locality: Congo (Democratic Republic of the): Oriental province:

Uele district: Upper Congo, between Blukwa and Lake Albert: Wago Forest [ca. 01 44 N 30 39 E] [Goto Description]. Holotype: RMCA 20509: ad ♂, skin and skull. Collected by: Dr. Alexandre Fain; collection date: 1 June 1951; original number: 1. Paratype: BMNH 1951.629: ad ♀, skin and skull. Collected by: Dr. Alexandre Fain; original number: 2. Presented/Donated by: ?: Collector Unknown. - Comments: Possibly valid as a subspecies.

1975. *Chaerophon limbatus:* Durette-Desset and Chabaud, Ann. Parasit., 50 (3): 315. (Lapsus)
1999. *Chaerephon pumilla:* Dumont, Etzel and Hempel, Mammalia, 63 (2): 159. (Lapsus)
2017. *Chaerophon pumiluss:* Waruhiu, Ommeh, Obanda, Agwanda, Gakuya, Ge, Yang, Wu, Zohaib, Hu and Shi, Virol. Sin., 32 (2): 5. Publication date: 6 April 2017. (Lapsus)
? *Chaerephon cf. pumilus:*
? *Chaerephon limbatus:* (Name Combination)
? *Chaerephon pumila hindei:* (Name Combination)
? *Chaerephon pumila langi:* (Name Combination)
? *Chaerephon pumila limbata:* (Alternate Spelling)
? *Chaerephon pumila limbatus:* (Name Combination)
? *Chaerephon pumilus elphicki:* (Name Combination)
? *Chaerephon pumilus hindei:* (Name Combination)
? *Chaerephon pumilus langi:* (Name Combination)
? *Chaerephon pumilus limbatus:* (Name Combination)
? *Chaerephon pumilus naivashae:* (Alternate Spelling)
? *Chaerephon pumilus pumilus:* (Name Combination)
? *Chaerephon pumilus sensu lato:*
? *Chaerephon pumilus:* (Name Combination, Current Combination)
? *Chaerephon pusillus:*
? *Chaerophon pumilus:* (Name Combination)
? *Tadarida (Chaerephon) pumila frater:* (Name Combination)
? *Tadarida (Chaerephon) pumila:* (Name Combination)
? *Tadarida faini:* (Name Combination)
? *Tadarida limbata:* (Name Combination)
? *Tadarida naivashae:* (Name Combination)
? *Tadarida pumila elphicki:*
? *Tadarida pumila faini:* (Name Combination)
? *Tadarida pumila frater:* (Name Combination)
? *Tadarida pumila hindei:* (Name Combination)
? *Tadarida pumila langi:* (Name Combination)
? *Tadarida pumila limbata:* (Name Combination)
? *Tadarida pumila naivashae:* (Name Combination)
? *Tadarida pumila pumila:* (Name Combination)
? *Tadarida pumila pumila-limbata:*
? *Tadarida pumila pumila-naivashae:*
? *Tadarida pumila websteri:* (Name Combination)
? *Tadarida pumila:* (Name Combination)

TAXONOMY:



Figure 166. *Chaerephon pumilus*.

See Bouchard (1998, Mammalian Species, 574). Formerly included *pusillus*; see Hayman and Hill (1971: 64), but see Goodman and Ratrimomanarivo (2007: 391). The description date is sometimes mentioned as "1830 or 1831" (see Happold and Happold (1997b: 823). Peterson *et al.* (1995: 162) consider *pumilus* not to include most of the forms occurring on Madagascar. Horácek *et al.* (2000: 136) include *pumilus* in the genus *Tadarida*, subgenus *Chaerephon*. Taylor (1999b), Aspetsberger *et al.* (2003: 250; 252) indicate that cryptic species might exist within the genus *Chaerephon* (more specifically in *pumilus*), but find it premature to identify them already. Jacobs *et al.* (2004ar: 17)

identified five haplotypes, but indicate they represent only one species.

Naidoo *et al.* (2013c: 134) indicate that southeast African *C. pumilus s.l.* contains several well-suported sympatric genetic lineages (they identified three clades), which exibit paraphyly with the Malagasy *C. leucogaster*. They were not able to to distinguish these clades based on echolocation characteristics (p. 137), but suggest that these stable sympatric lineages might be the result of female philopatry or roost faithfulness.

Naidoo *et al.* (2016) used cyt *b*, control region, and Rag2 data on a large number of representatives from the *Chaerephon pumilus* species complex from islands in the western Indian Ocean, and eastern and southeastern Africa. They found that *Chaerephon pumilus* s.s. (Eritrea and Yemen) is specifically distinct from the following taxa/samples: *C. pumilus* from southeastern Africa, the syntype of *C. limbatus*, the holotypes of *C. elphicki* and *C. langi*, and the topotype of *C. naivashae*. They suggest (p. 642) that additional evidence from more variable nuclear markers is necessary to resolve the issue of the number of species present in this complex. The genetic differentiation is probably the result of habitat fragmentation during glacial maxima when the ancestral population was separated over isolated subtropical forests (Schoeman and Monadjem, 2018: 4).

COMMON NAMES:
Afrikaans: Klein losstertvlermuis. Chinese: 小犬吻蝠. Czech: morous malý, tadarida malá. English: Little Free-tailed Bat, Lesser Free-tailed Bat, Little Wrinkle-lipped Bat, White-bellied Free-tailed Bat. French: Petite tadaride, Petit molosse à glandes caudales, Tadaride bornée. German: Kleine Bulldoggfledermaus, Zwerg-Doggengrämler, Sena-Doggengrämler, Gesäumte Doggengrämler. Italian: Cherefónte pigmèo. Kiluba (DRC): Kasusu. Nyungwe: Kalemawalema (Malawi; but not specific). Portuguese: Morcego pequeno de cauda livre.

ETYMOLOGY OF COMMON NAME:
From the Latin "*pumilus*" meaning dwarf, because it is the smallest of the molossids occuring in the (southern African sub)region (see Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a broad range of habitats, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008dr; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) assessed as *Tadarida pumila* (Mickleburgh *et al.*, 2008dr; IUCN, 2009).
2004 - LC ver 3.1 (2001) assessed as *Chaerephon pumila* (Mickleburgh *et al.*, 2004ah; IUCN, 2004).
1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016a). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There are no major threats to the species. In some parts of its range, it is threatened from persecution as a pest, especially since it roosts in buildings (Mickleburgh *et al.*, 2008dr; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dr) [in IUCN (2009)] report that in view of its wide range it seems probable that this species is present in some protected areas.

GENERAL DISTRIBUTION:
This widespread species is found from Senegal in the west of its range, eastwards to Yemen and southwestern Saudi Arabia, and as far south as South Africa, where Babiker Salata (2012: 49) found that its distribution is stongly associated with the mean temperature of the coldest quarter. It has been recorded from the island of Bioko and the Annobon Islands (Equatorial Guinea), Pemba and Zanzibar (Tanzania).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 809,867 km^2.

Records from Western Cape Province are rejected by Jacobs and Fenton (2001), since these represent *Sauromys petrophilus*.
Records from the Seychelles [Aldabra] (Hutson, 2004a) and the Comoros (Louette, 2004; Goodman, 2007; ACR, 2006, 2007, 2008, 2009, 2010) are rejected by Goodman *et al.* (2010a) since these represent *C. pusillus*.
Records from Madagascar (Bouchard, 1998; Russ *et al.*, 2001; Goodman and Cardiff, 2004; ACR, 2006, 2007, 2008, 2009,2010) are now assigned to *Chaerephon atsinanana* (Goodman *et al.*, 2010a).

Native:
Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 542; Taylor *et al.*, 2018b: 62); Benin (Capo-Chichi *et al.*, 2004: 164); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 542); Burkina Faso (Kangoyé *et al.*, 2015a: 618); Burundi; Cameroon (Bakwo Fils *et al.*, 2014: 4): Chad; Congo (Bates

et al., 2013: 336); Congo (The Democratic Republic of the) (Allen, 1917; Schouteden, 1944; Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 542); Côte d'Ivoire; Equatorial Guinea [Annobón, Bioko]; Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 132); Gambia (Emms and Barnett, 2005: 50); Ghana; Guinea; Guinea-Bissau (Monard, 1939; Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 73); Kenya; Liberia (Fahr, 2007a: 104); Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988: 46; Monadjem *et al.*, 2010d: 542); Mali (Meinig, 2000: 105); Mozambique (Smithers and Lobão Tello, 1976; Lopes and Crawford-Cabral, 1992; Monadjem *et al.*, 2010d: 542; Monadjem *et al.*, 2010c: 382); Namibia (Monadjem *et al.*, 2010d: 542); Niger; Nigeria; Rwanda; Sao Tomé and Principe [Sâo Tomé] (Juste and Ibáñez, 1993b: 906; Rainho *et al.*, 2010a: 37); Saudi Arabia; Senegal; Sierra Leone; Somalia; South Africa (De Graaf, 1960; Monadjem *et al.*, 2010d: 542); Sudan; Swaziland (Monadjem *et al.*, 2010d: 543); Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 62); Yemen (Benda *et al.*, 2011b: 47); Zambia (Ansell, 1969; Ansell, 1973; Ansell, 1978; Monadjem *et al.*, 2010d: 543); Zimbabwe (Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 543).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data: Fa: 38.95 mm, mass: 10.5 g, wing loading: 12.4 N/m^2, aspect ratio: 7.3.

DETAILED MORPHOLOGY:
Baculum - Unknown
Brain - Amrein *et al.* (2007) from specimens collected from Bénin reported moderate proliferating cell activity, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus, with doublecortin (DCX) they detected young migrating neuron in the subgrannular layer of the hippocampus. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. No NeuroD was detected in the hippocampal granule cells (Amrein *et al.*, 2007). Kruger *et al.* (2010a) describe, based on three brains from Kenya, using immunohistochemical methods, the nuclear organization of the cholinergic, catecholaminergic and serotonergic systems. Kruger *et al.* (2010b) describes, based on three brains from Kenya, the distribution of Orexin-A immunoreactive cell bodies and terminal networks.

SEXUAL DIMORPHISM:
Chaverri *et al.* (2018: 1944) [referring to Bouchard, 2001b] indicates that the sexes can be distinguished by scent produced from the interaural and muzzle glandular areas.

ECHOLOCATION:
Frequency modulated call. In Kenya, Taylor *et al.* (2005) reported a peak frequency of 25.6 (1.7) kHz from Kivoko. In Tanzania, Aspetsberger *et al.* (2003) reported a maximum frequency of 22.7 (3.3) kHz from Amani Nature Reserve. In Swaziland, Taylor (1999b) reported a maximum frequency of 32.9 (4.5) kHz from Mlawula, and maximum frequencies at three different localities around Durban in South Africa of 43.0 (1.0) kHz, 28.7 (1.8) kHz and 28.7 (2.5) kHz. Fenton *et al.* (2004) reported a highest frequency of 29 (4.6) kHz for a locality in Durban, South Africa. Rainho *et al.* (2010a: 21) reports the calls [as *Tadarida pumila*] of 32 individuals from Sao Tomé. Bohmann *et al.* (2011: 1) [referring to Monadjem *et al.* (2010d)] mention peak frequencies between 25 - 40 kHz. Schoeman and Waddington (2011: 291) mention a peak frequency of 28.2 ± 1.5 kHz and a duration of 10.8 ± 0.2 msec for specimens from Durban, South Africa. From the Durban area, Naidoo *et al.* (2011: 23) report F_{peak} = 24.7 ± 1.0 kHz and a duration of 12.4 ± 0.9 msec.

Taylor *et al.* (2013b: 18) recorded the following parameters for 8 calls from specimens from Swaziland: F_{max}: 27.7 ± 4.40 (23.0 - 32.8) kHz, F_{min}: 23.3 ± 2.38 (20.9 - 27.4) kHz, F_{knee}: 26.2 ± 3.34 (22.6 - 30.8) kHz, F_{char}: 24.3 ± 2.91 (21.5 - 28.1) kHz, duration: 8.3 ± 2.10 (5.3 - 11.9) msec, and for 6 calls from KwaZulu-Natal, South Africa: F_{max}: 31.6 ± 4.05 (24.6 - 36.7) kHz, F_{min}: 24.5 ± 1.55 (21.7 - 26.5) kHz, F_{knee}: 28.9 ± 2.51 (24.4 - 31.3) kHz, F_{char}: 25.6 ± 1.57 (22.7 - 27.3) kHz, duration: 8.4 ± 1.71 (6.6 - 11.0) msec. From Swaziland also, Monadjem *et al.* (2017c: 179) reported the following values: F_{min}: 23.3 ± 1.41 (20.8 - 26.5) kHz, F_{knee}: 26.1 ± 2.09 (22.5 - 29.6) kHz, F_c: 24.0 ± 1.53 (21.3 - 27.2) kHz and duration: 9.0 ± 2.10 (3.9 - 12.6) msec. They were able to detect these calls up to a distance of 15 m.

At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 29 (24 - 31) kHz.
Linden *et al.* (2014: 40) mentioned the following parameters for the Soutpansberg area (RSA): F_{min}: 21 - 27 kHz, F_{char}: 22 - 28 kHz, F_{knee}: 23 - 31 Khz, Slope:13 - 124 OPS, duration: 5 - 12 msec.
20 calls from Mapungubwe National Park (RSA) were recorded by Parker and Bernard (2018: 57) with the following characteristics: F_{char}: 26.65 ± 2.53 kHz, F_{max}: 34.87 ± 5.75 kHz, F_{min}: 24.67 ± 2.68 kHz, F_{knee}: 29.72 ± 3.05 kHz, duration: 8.80 ± 2.65 msec, with 4.24 ± 1.89 calls/sec.

Monadjem *et al.* (2011: 32) reported values for two calls from a *Chaerephon* cf. *pumilus* from western Uganda: F_{min}: 24.95 kHz, F_{max}: 27.78 kHz, F_{char}: 25.22 kHz, F_{knee}: 75.61 kHz, and duration 8.4 msec.

Two calls from specimens from the Aberdares Range in Kenya were reported by Eisenring *et al.* (2016: SI 2) with PF: 26.3 ± 2.8 (24.4 - 28.3), HF: 32.6 ± 1.2 (31.8 - 33.5), LF: 20.9 ± 0.4 (20.6 - 21.1), DT: 0.1 ± 0.1 (0.0 - 0.1), DF: 11.8 ± 1.5 (10.7 - 12.9).

From Maroua, Cameroon, Manga Mongombe (2012: 79) reported for 3 calls a call type of FM and the following parameters: F_{max}: 44.2 ± 3.4 (40.4 - 47.0) kHz, F_{min}: 38.2 ± 2.6 (35.3 - 40.4) kHz, F_{mean}: 41.2 ± 3.0 (37.9 - 43.7) kHz, F_{knee}: 44.1 ± 3.4 (40.4 - 47.0) kHZ, F_{char}: 39.1 ± 2.4 (36.5 - 41.2) kHz, and duration: 1.32 ± 0.11 (1.26 - 1.45) msec.

Two calls by bats from the Kalahari Desert had the following characteristics: F_{char}: 22.9 ± 0.3 kHz, F_{max}: 25.0 ± 0.1 kHz, Fmin: 22.4 ± 0.4 kHz and duration: 5.6 ± 1.5 msec (Adams and Kwiecinski, 2018: 4).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Đulic and Mutere (1973a), Smith *et al.* (1986), Rautenbach *et al.* (1993) and Sreepada *et al.* (2008) all reported 2*n* = 48, and an acrocentric Y chromosome. However, while Đulic and Mutere (1973a) and Smith *et al.* (1986) reported FN = 58, BA = 12, Rautenbach *et al.* (1993) reported FN = 66, BA = 20. And, while Đulic and Mutere (1973a) and Rautenbach *et al.* (1993) reported a metacentric X chromosome, Smith *et al.* (1986) reported a submetacentric X chromosome. The work of Rautenbach *et al.* (1993) included specimens from the Western Cape that have subsequently been reidentified as *Sauromys petrophilus* (Jacobs and Fenton, 2001: 134), hence these karyotypic variations should be viewed with caution.

Reddy (2008: ii) used the cytochrome *b* (845 nucleotides) and D-loop (314 nucleotides) regions of the mitochondrial DNA to assess the phylogenetic relationships within *C. pumilus* (southern Africa) and in relation to *Chaerephon* species from Madagascar (*C. pumilus, C. leucogaster*). The result indicates the possibility of cryptic species in southern African *C. pumilus*, which are closer related to the Malagasy *C. leucogaster* than to the Malagasy *C. pumilus*.

In South Africa, Naidoo *et al.* (2015b) were able to retrieve a strong mitochondrial structure, but only little nuclear genetic structure, which suggests a single interbreeding population. They found these data to be consistent with female philopatry, secondary contact between diverged genetic lineages and introgression.

Protein / allozyme - Unknown.

HABITAT:
Noer *et al.* (2012: 1) found that *C. pumilus* prefered to forage over sugarcane fields rather than over savanna, riparian forest and urban areas. To reach their foraging grounds, they traveled up to 4.2 km from their roost, and their mean activity area encompases 976 to 1319 ha.

HABITS:
Bouchard (2001b: 109) found that, in scent-choise-experiments, only males were able to distinguish the gender of conspecifics as well as the difference between roostmates and strangers. Females did not show any preference during these experiments.

ROOST:
Taylor *et al.* (1999: 67) found these bats to be roosting in a variety of roofs in the Durban area: from corrugated iron to tiles, between the tiles and the plastic lining underneath, or in any convenient crevices between rafters and brickwork. These roofs were located at a height of 3 to 12 m.

In the Mount Nimba area, Monadjem *et al.* (2016y: 367) found a roost in the roof of a school at 540 m.

DIET:
Based on DNA analysis of 59 fecal pellets collected between April and May (austral summer) in the Simunye region of Swaziland, Bohmann *et al.* (2011) reported insects from 24 families (belonging to seven orders) being taken as prey. The highest frequency of occurrence was for Lepidoptera (52.5 %), Diptera (40.7 %), and Hemiptera (18.6 %). Within the Lepidoptera, Noctuidae (Owlet moths - 25.4 %), Nymphalidae (Brush-footed butterflies 30.5 %) and Crambidae (Grass moths - 10.2 %) were found the most. Within the Diptera, it were representatives of the Culicidae (Mosquitoes - 27.1 %), which occurred most frequently, followed by the Tephritidae (Fruit flies and kin - 10.2 %). In the Hemiptera, both Lygaeidae (Chinch bugs and seed bugs) and Pentatomidae (Stink bugs) were found in 10.2 % of the fecal pellets.

Naidoo *et al.* (2011: 26) reported the following volume percentages in the bat's diet at Umbilo River (KwaZulu Natal, RSA): in summer: Lepidoptera (9.9 ± 9.5), Coleoptera (47.7 ± 30.5), Hemiptera (32.8 ± 6.9), Diptera (5.4 ± 8.3), and Trichoptera (4.2 ± 7.2); in winter: Lepidoptera (30.3

± 16.0), Coleoptera (19.5 ± 16.5), Hemiptera (8.0 ± 7.4), Diptera (24 ± 7.7), Trichoptera (6.5 ± 10.4), and Hymenoptera (11.8 ± 11.1).

In the Limpopo province (RSA), Taylor *et al.* (2017b: 246, 252 - 254) found the diet to contain 21 prey items, covering five insect orders: Coleoptera (unmatched), Hemiptera (*Macrorhaphis acuta* + *Nezara viridula* + unmatched), Lepidoptera (*Toxocampinae tathorhynchus* + *Isturgia roraria* + *Sena* sp. + *Sena prompta* + *Cortyta canescens* + *Enmonodia capensis* + *Leucania imperfecta* + *Pericyma atrifusa* + *Rhesala moestalis* + *Spodoptera exigua* + *Maurilia arcuata* + *Stenoptilia* sp. + unmatched), Orthoptera (Tettigoniinae + unmatched) and Blattodea (unmatched). They also remarked that the diet of *C. pumilus* varies geographically.

From Maroua (Cameroon), and based on fecal analyses, Bol A Anong (2013: 31) reported the diet to include Hemiptera (35.60%), Coleoptera (34.81%), Lepidoptera (17.00%), Diptera (10.22%), Hymenoptera (1.55%) and Orthoptera (0.02%).

PREDATORS:
At the Kruger Park, Rautenbach *et al.* (1990: 17) reported that "*Tadarida pumila*" was regularly taken as prey by a pair of African goshawks (*Accipiter tachiro* (Daudin, 1800)). On some occasions, 1 to 5 bats were taken per evening (see Kemp and Rautenbach, 1987).
Mikula *et al.* (2016: Supplemental data) mention the following avian predators for "*Tadarida pumila*": African goshawk (*Accipiter tachiro* (Daudin, 1800)), Fox kestrel (*Falco alopex* (Heuglin, 1861)), Lanner falcon (*Falco biarmicus* Temminck, 1825), Eurasian hobby (*Falco subbuteo* Linnaeus, 1758), Common kestrel (*Falco tinnunculus* Linnaeus, 1758), Wahlberg's eagle (*Hieraaetus wahlbergi* (Sundevall, 1851)), Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850), Black kite (*Milvus migrans* (Boddaert, 1783)).

POPULATION:
Structure and Density - The colonies of this species range from a few animals (between 5 and 20) to hundreds of individuals (Mickleburgh *et al.*, 2008dr; IUCN, 2009).
Trend - 2008 Unknown (Mickleburgh *et al.*, 2008dr; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
van der Merwe *et al.* (1986: 355) indicate that in Transvaal *C. pumilus* has an extended breeding of 8 months. They found females to be polyoestrous and could have up to three pregnancies (one young) per breeding season. Implantation only occurs in the right uttering horn and the gestation period was about 60 days. The young are weaned before 21 days of age and females become sexually mature at the age of 5 to 12 months.

Happold and Happold (1989b: 133) found that in Malawi, *Tadarida pumila* can have up to 5 births per year, all followed by a post-partum oestrus.

Krutzsch (2000: 95) refers to Marshall and Corbet (1959), who pointed out that in Uganda spermatogenesis was not continuous in all males (as *Tadarida (Chaerephon) hindei*). They also indicated that it is one of the best known virtually continuous breeding molossids.

le Grange *et al.* (2011: 173 - 174) indicate that *C. pumilus* is a seasonal polyoestrous bat, which reduces the number of reproductive cycles per season with increasing latitute.

In Ethiopia, Kruskop *et al.* (2016: 61) found a maternity colony with both pregnant and lactating females (one even in both stages) on 9 November 2012.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births in early November, late January and April.

MATING:
McWilliam (1988a) and McCracken and Wilkinson (2000: 331) indicate that there is a correlation between the male body size and the harem size, where larger males have larger harems, consisting of up to 21 females). McWilliam (1988a) also suggests that the harem might be kin groups.

PARASITES:
BACTERIUM
Gram-negative bacterium - Cassel-Béraud and Richard (1988), Cassel-Beraud *et al.* (1989: 234), and Sara (2002: 41) reported *Alkalescens dispar*, *Aeromonas hydrophila*, *Citrobacter freundii*, *Enterbacter aerogens*, *Enterobacter agglomerans*, *Enterobacter cloacae*, *Enterobacter intermedius*, *Enterobacter* sp., *Escherichia coli*, *Hafnia alvei*, *Klebsiella oxytoca*, *Klebsiella pneumoniae*, *Kluyvera* sp., *Koserella trabulsii*, *Proteus mirabilis*, *Proteus morganii*, *Proteus rettgeri*, *Proteus vulgaris*, *Providencia* sp., *Pseudomonas* spp., *Salmonella enterica* subsp. *enterica*, *Salmonella enteritidis*, and *Serratia marcescens*.

APICOMPLEXA
Lainson and Naiff (2000: 128) and Duszynski (2002: 20) indicate that "*Nyctinomus limbatus / C. pumila*" is the type host of *Eimeria dukei* Lavier, 1927.

ACARI

Laelapidae: Taufflieb (1962: 112) reported *Chelanyssus aethiopious* Hirst, 1921 from "*Tadarida limbata*" from Brazzaville, Congo.
Sarcoptidae: Fain (1959d: 149) described *Notoedres (Notoedres) tadaridae* from "*Tadarida (Chaerephon) faini*" from Mount Wago, near Blukwa, Haut-Ituri, DRC.
Trombiculidae: Stekolnikov (2018a: 163) reported *Microtrombicula nyctinomi* (Taufflieb, 1960) from a bat from Brazzaville, Congo.

HEMIPTERA
Cimicidae: Haeselbarth *et al.* (1966: 9) found a great number of *Loxaspis barbara* (Roubaud, 1913) in a roost, near Mopti, Former French Sudan (Haute Senegal-Niger). *Loxaspis miranda* Rothschild, 1912 recorded in Uganda (Haeselbarth *et al.*, 1966: 10, host referred to as *Tadarida limbata*).
Polyctenidae: *Hypoctenes clarus* Jordan, 1922, from Congo (Haeselbarth *et al.*, 1966: 18, host referred to as *Tadarida limbata*).

DIPTERA
Streblidae: *Raymondia seminuda* Jobling, 1954 in Nairobi, Kenya (Haeselbarth *et al.*, 1966: 103, host referred to as *Tadarida faini*).
Nycteribiidae: *Basilia ansifera* Theodor, 1956 mainly a West African species, reaching Lake Victoria in the east and Lake Nyasa in the south, nearly all localities lie between 15° latitude north and south (Haeselbarth *et al.*, 1966: 110). *Dipseliopoda biannulate* (Oldroyd, 1953) distributed over the tropical parts of Africa and recorded from localities in Nigeria, Cameroon, the Congo and the Sudan and Kenya (Haeselbarth *et al.*, 1966: 116, host referred to as *Tadarida faini*).

SIPHONAPTERA
Ischnopsyllidae: *Lagaropsylla consularis* Smit, 1957 from Ethiopia, Kenya, Uganda, Congo and Congo (Democratic Republic of), Angola, Zimbabwe and Mozambique (Haeselbarth *et al.*, 1966: 1990, host referred to as *Tadarida limbata*), Malawi (Beaucournu and Kock, 1996), Madagascar (Hastriter, 2016: 16). *Lagaropsylla idae* Smit ,1957 widespread in tropical Africa (Haeselbarth *et al.*, 1966: 190, host referred to both *C. pumilus* as well as *Tadarida limbata*). *Lagaropsylla oblique* Smit, 1957 from Sierra Leone, Cameroon and the Congo (Haeselbarth *et al.*, 1966: 191, host referred to as *Tadarida limbata*).

NEMATODA
Durette-Desset and Chabaud (1975: 315) described *Molinostrongylus benexae* from a "*Chaerophon limbatus*" from Périnet, Madagascar.

TREMATODA
Prosthodendrium (Prosthodendrium) chilostomum madagascariense was described by Richard (1966: 423) from a "*Chaerophon limbatus*" from Périnet, Madagascar.

VIRUSES:
Conrardy *et al.* (2014) tested 6 bats sampled in Kenya for the presence of adenoviruses, rhabdoviruses and paramyxoviruses, all samples tested negative.

In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Chaerephon pumilus*: Astroviruses and Coronaviruses.

In Uganda, Kading *et al.* (2018: 3) found neutralizing antibodies against dengue 2 virus (DENV-2) and non-specific Flaviviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 to 1999, for antibody to SARS-CoV in sera in 35 individuals from Limpopo Province, South Africa, none were tested positive (0/35) and 18 individuals from Mpumalanga Province, South Africa, none tested positive (0/18) and one individual from Bandundu Province, DRC, not tested positive (0/1). Tong *et al.* (2009) report the detection of coronavirus RNA from fecal material of this species in Kenya and was found to be distantly related to the human coronavirus 229E.
Anthony *et al.* (2017b: Suppl.) mention the alpha-coronavirus: Charephon_CoV_KY22

Filoviridae
Ebolavirus:
EFSA AHAW Panel (EFSA Panel on Animal Health and W (2017: 5) refer to Swanepoel *et al.* (1996), who experimentally inoculated the virus in this bat.

Goldstein *et al.* (2018: 1084) described a new *Ebolavirus* from three Sierra Leonan *C. pumilus* and one *Mops condylurus*: Bomali virus (BOMV). They were sampled in human dwellings in small villages in the Bomali district. This virus might infect humans, but it is not known (yet) whether it is virulent in humans too.

Flaviviridae
Flavivirus
Bukalasa bat virus - Williams *et al.* (1964) report the isolation of the virus in Uganda, 1964, from the salivary glands of *Chaerephon pumilus*. Reported by de Jong *et al.* (2011: 10) and Luis *et al.* (2013: suppl).
Dakar bat virus - Kemp *et al.* (1974) report the isolation of the virus from Nigeria, 1974, from the salivary glands and organ pools of *Chaerephon*

pumilus. Reported by de Jong *et al.* (2011: 10) and Luis *et al.* (2013: suppl).
Entebbe bat virus. - Peat and Bell (1970) report the isolation of the virus in Uganda, 1957, from the salivary glands of *Chaerephon pumilus*. Reported by de Jong *et al.* (2011: 10).
Zika virus (ZIKV) - Malmlov *et al.* (2019: 2) refer to Shepherd and Williams (1964) who examined 44 *pumilus* specimens in Uganda, of which 16 had antibodies against ZIKV.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Horton *et al.* (2014: Table S1) tested 25 Tanzanian *Chaerephon pumilus* specimens but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus). Kia *et al.* (2014: 1) tested 33 specimens from Kanke (Nigeria), and found one of them to test positive for Lagos bat virus and one for Shimoni bat virus.

Togaviridae
Alphavirus
de Jong *et al.* (2011: 10) reported Chikungunya virus occurring on *C. pumilus*. Luis *et al.* (2013: suppl.) also reported this virus, but used *Tadarida pumila* as name for the bat.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mayotte, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

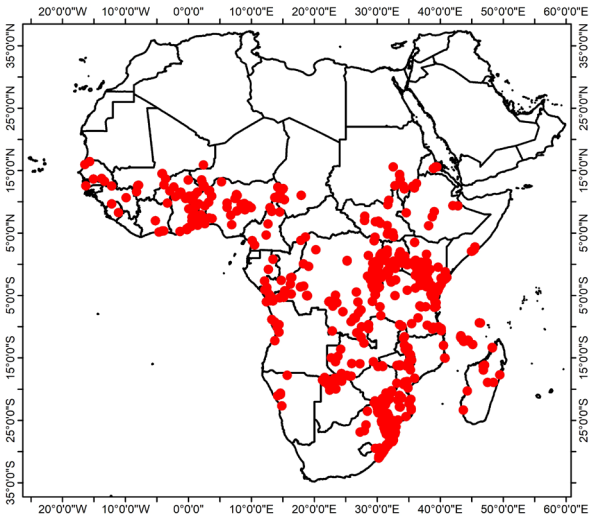


Figure 167. Distribution of *Chaerephon pumilus*

Chaerephon pusillus (Miller, 1902)

1838. *Nyctinomus pusilus:* Lesson, Compléments de Buffon, ed. 2, Paris, 1: 328. Publication date: 1838. (Lapsus)
1879. *Nyctinomus pumilus:* Gunther. Publication date: 1879.
*1902. *Nyctinomus pusillus* Miller, Proc. Biol. Soc. Wash., 15: 245. Publication date: 16 December 1902. Type locality: Seychelles: Aldabra Island [Goto Description]. Holotype: USNM 20991: ♀, skull and alcoholic. Collected by: Dr. William Louis Abbott. Presented/Donated by: ?: Collector Unknown. Holotype: USNM 37852: ad ♀, skull and alcoholic. Collected by: Dr. William Louis Abbott. Alcoholic catalogued: 30 June 1893, skull catalogued: 12 February 1900. Poole and Schantz (1942: 120) also mention the number as 20991/37852, and furthermore indicate "Type designated by No. 37852/20997, an error for 20991/37852".
1971. *Tadarida pumila:* Hayman and Hill. Publication date: 1971.
1981. *Tadarida (Chaerephon) pumila:* Freeman. Publication date: 1981.
2004. *Chaerephon pumila:* Louette. Publication date: 2004.
2004. *Tadarida pumilus:* Louette. Publication date: 2004.
2007. *Chaerephon pusillus:* Goodman and Ratrimomanarivo. (Name Combination, Current Combination)
? *Chaerephon pumila:*
? *Chaerephon pumilus:*

TAXONOMY:
Included in *pumilus* by most other authors, but its status has been revised by Goodman and Ratrimomanarivo (2007: 391) and Goodman *et al.* (2010a: 21).

COMMON NAMES:
Czech: morous seychelský. English: Seychelles Free-tailed bat. French: Tadaride des Seychelles. German: Seychellen Bulldoggfledermaus.

GENERAL DISTRIBUTION:
C. pusillus was restricted to the Seychelles, but recent molecular work (Goodman *et al.*, 2010a) indictes that the populations on the Comore Islands should assigned to *C. pusillus* and not *C. pumilus*.
Louette (2004) recorded as *Tadarida pumilus* occurs on at least three of the Comore Islands (Grande Comore, Anjouan, and Mayotte. Goodman *et al.* (2010c: 126) also recorded *Charephon pusillus* from Moheli. Its known elevational range is 15 to 250 m on Grande Comore, 5 to 410 m on Anjouan, 5 to 10 m on Moheli, and 10 to 90 m on Mayotte (Goodman *et al.*, 2010c: 126).

Native: Comoros (Louette, 2004; Goodman *et al.*, 2010c: 126); Seychelles (Goodman *et al.*, 2010c: 126).

ROOST:
On the Comoros, Goodman *et al.* (2010c: 127) did not find a single roost in a natural location, but rather all were synanthropic (see also Wilkinson *et al.*, 2012: 160). The roosts sites were often in the attics of public buildings (schools, civic centers, and hospitals).

MIGRATION:
Goodman *et al.* (2010c: 128) interviewing a director of a primary school on Mitsamiouli mentioned that the presence of bats in the school attic is very seasonal, and as the cold season approaches the site is abanodoned.

POPULATION:
Structure and Density - On Aldabra, the population might be fewer than 250 animals (Mickleburgh *et al.*, 2008dr; IUCN, 2009, as *C. pumilus*).
Trend - Unknown.

REPRODUCTION AND ONTOGENY:
Goodman *et al.* (2010c: 126) provide data that indicates possible inter island seasonal variation in breeding in the Comoros. On 14 November 2006, all of the 10 individuals caught in a colony in central Moroni were female and all reaching term in their pregnancy with single embryos measuring 17 - 20 mm. The same colony was visited on the 28 March 2007, an additional 10 individuals were captured, all of which were females of which five had placental scars, four assumed to be sub-adults without placental scars, and one had a tiny embryo. Juste (unpublished data in Goodman *et al.* (2010c: 127)) report that the site was visited in December 2005, and all of the 20 individuals caught were female. As no males were caught on the two visits with a 5 month difference, Goodman *et al.* (2010c: 127) presumes that this site is a maternity colony.

Between 20 November and 26 November 2006, Goodman *et al.* (2010c: 127) visited five different *C. pusillus* colonies on Anjouan and in contrast to the Moroni site, these colonies contained both males and females. At three of the sites on Anjouan, females out numbered males with a consistent sex ratio in each case of 0.5, and at one site the sex ratio was 1.0, and the fifth site it was 1.6. Goodman *et al.* (2010c: 127) found at all the colonies, the breeding females were reaching term, with embryos ranging in crown-rump length from 17 - 23 mm, and at one site neonates were present. Of the 25 males captured at the Anjoun sites, all were adult, only seven (28 %) had scrotal testes and convoluted epididymides. The only evidence of non-synchronized breeding in *C. pusillus* on Anjouan was a free-flying animal captured at Patsi on 20 November with a single embryo measuring 1 mm in crown rump length.

Goodman *et al.* (2010c: 127) report on a visit between 28 November and 2 December 2006 that two separate colonies on Moheli were visited and both male and females were captured and the sex ratios were 0.57 and 0.66. At the first colony visited 28 November, of the seven females captured, four had recently given birth and were lactating and three had single embryos measuring 24 mm in crown-rump length. At the second site visited on the 2 December, all of the females were still pregnant with single embryos and with crown-rump length of 19 - 22 mm. Of the males handled from these two colonies, three of 12 (25 %) were in breeding condition with largely scrotal testes with enlarged epididymides.

On Mayotte, between 27 February and 1 March 2007, two colonies were visited and both had males and females, not one of the females showed signs of active reproduction, in serveral cases the females had remaining lactation tissue and placental scars or large mammae and placental scars, indicating that they had recently terminated a breeding period, also none of the males caugth were in reproductive condition (Goodman *et al.*, 2010c). Four different colonies were visted on Grande Comore between 29 March and 1 April 2007, and in all cases, both sexes were found in each and the sex ratio varied from 0.15 to 2.3, with one exeption none of the individuals showed active signs of reproduction, although many of the females had large mammae and placental scars. The exeption was a female captued on the 29 March in estrous (Goodman *et al.*, 2010c: 127).

PARASITES:
Lagadec *et al.* (2012: 1696) found this species to be infected by *Leptospira* bacteria.

Hutson (2004a: 130) mentions an endemic ectoparasitic polyctenid bug, *Hypoctenes hutsoni* Maa, 1970.

VIRUSES:
Astroviridae
Hoarau *et al.* (2018: 1) tested 58 bats from the Comoros, found none of them to test positive for this group of viruses.

Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 20 individuals from the Comoros using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids.

Rhabdoviridae
Of the 19 bats from Anjouan that were tested by Mélade *et al.* (2016a: 6), two showed seroreactivity to *Lagos bat lyssavirus*, and two of seven other bats showed the same reaction to *Duvenhage lyssavirus*. On Mayotte, one out of three were positive for these two viruses.

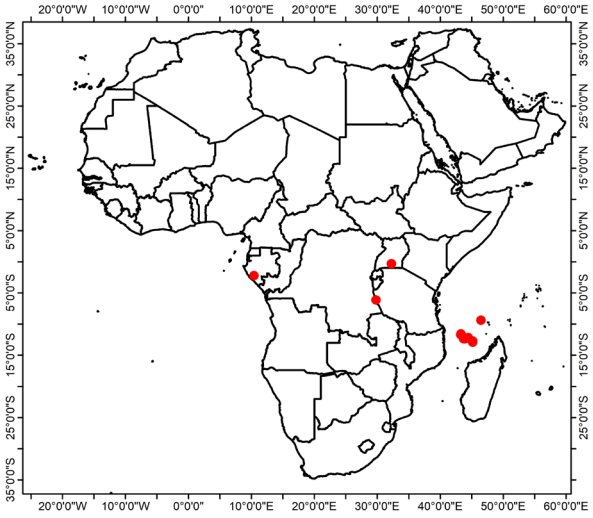


Figure 168. Distribution of *Chaerephon pusillus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Comoros, Gabon, Mayotte, Seychelles, Tanzania, Uganda.

Chaerephon russatus J.A. Allen, 1917

*1917. *Chærephon russatus* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 458, text fig. 25. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Medje [02 25 N 27 18 E, 800 m] [Goto Description]. Holotype: AMNH 48925: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 8 September 1910; original number: 993. Topotype: MCZ 17386: ♀, skin and skull. Collected by: ?: Collector Unknown; collection date: 8 September 1910. Presented/Donated by: ?: Collector Unknown. Topotype: MCZ 17387: ♀, skin and skull. Collected by: ?: Collector Unknown; collection date: 8 September 1910. Presented/Donated by: ?: Collector Unknown.
? *Chaerephon russata:* (Alternate Spelling)
? *Chaerephon russatus:* (Current Combination, Current Spelling)
? *Tadarida russata:* (Name Combination)

TAXONOMY:
See Simmons (2005).

Gregorin and Cirranello (2015: 10) suggest that *Chaerephon russatus* is the basalmost branch of the *Chaerephon* + *Mops* clade within the Molossidae.

COMMON NAMES:
Chinese: 赤犬吻蝠. Czech: morous guinejský. English: Russet Wrinkle-lipped bat, Russet Free-tailed Bat. French: Tadaride rousse. German: Rostfarbene Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Mickleburgh *et al.*, 2008bu; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) assessed as *Tadarida russata* (Mickleburgh *et al.*, 2008bu; IUCN, 2009). 2004 - NT ver 3.1 (2001) assessed as *C. russata* (Mickleburgh *et al.*, 2004aj; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
It is presumably threatened by habitat loss in parts of its West African range, although further studies are needed to confirm this (Mickleburgh *et al.*, 2008bu; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bu) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. The species has been recorded from the Hell's Gate National Park in Kenya and Tai National Park in Côte d'Ivoire. Further studies are needed into the distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Chaerephon russatus has only been recorded from a dozen or so, widely dispersed, localities. It has been recorded from the Tai National Park in Côte d'Ivoire in the west to the Hell's Gate Canyon National Park in Kenya.

Native: Cameroon; Congo (The Democratic Republic of the); Côte d'Ivoire (Beaucournu and Fahr, 2003: 157); Ghana; Guinea (1st record: Decher *et al.*, 2016: 275); Kenya.

POPULATION:
Structure and Density - It is believed to be a quite rare species that occurs in small colonies (Mickleburgh *et al.*, 2008bu; IUCN, 2009).

Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bu; IUCN, 2009).

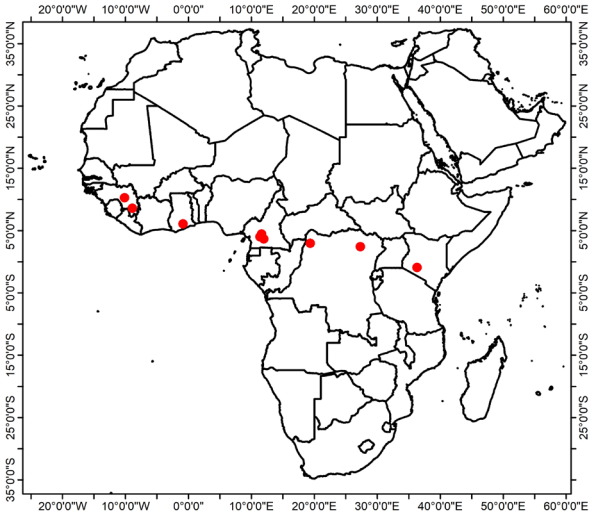


Figure 169. Distribution of *Chaerephon russatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Guinea, Kenya.

Chaerephon tomensis (Juste and Ibáñez, 1993)

*1993. *Tadarida (Chaerephon) tomensis* Juste and Ibáñez, J. Mamm., 74 (4): 901, figs 1 - 2. Publication date: November 1993. Type locality: São Tomé and Principé: São Tomé Island: 3 km NW Guadalupe: Praia das Conchas [00 24 N 06 37 E] [Goto Description]. Holotype: EBD MAM 18256: ♀, complete skeleton. Collected by: Javier Juste and Antonio Ayong; collection date: 22 April 1988; original number: B7085. Paratype: EBD MAM 17371: ♀. Collected by: Javier Juste and Carlos J. Ibáñez Uargui; collection date: 11 April 1988. From Agua Izé. Paratype: EBD MAM 17734: ♀. Collected by: Javier Juste and Antonio Ayong; collection date: 22 April 1988. - Etymology: Referring to the island of São Tomé, where the species occurs.
? *Chaerephon tomensis:* (Name Combination, Current Combination)
? *Tadarida tomensis:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: morous tomášský. English: São Tomé Free-tailed Bat. French: Tadaride de São Tomé. German: São Tomé-Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Endangered (EN B1ab(iii) ver 3.1 (2001)) because its extent of occurrence is less than 1000 km^2, all individuals are in a single location (the island of São Tomé), and there is continuing decline in the extent and quality of its lowland habitat (Mickleburgh *et al.*, 2008dl; IUCN, 2009).

Assessment History - 2008 - EN B1ab(iii) ver 3.1 (2001) [assessed as *Tadarida tomensis*] (Mickleburgh *et al.*, 2008dl; IUCN, 2009). 2004 - CR B1ab(I,iii) ver 3.1 (2001) (Mickleburgh *et al.*, 2004cy; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is believed to be threatened by general habitat loss resulting from coastal development, including tourism activities, conversion of land to agricultural use and possible port construction. The species may be competing with the much more abundant species *Chaerephon pumilus* (J. Juste *pers. comm.,* 2008 in Mickleburgh *et al.*, 2008dl in IUCN, 2009), with further studies into this relationship needed (Mickleburgh *et al.*, 2008dl; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dl) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed into the distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Chaerephon tomensis has been recorded from two lowland localities, Praia das Conchas (3 km NW of Guadalupe) and Agua Izé, in the northern part of São Tomé Island, of São Tomé and Príncipe. Extensive surveys have not located the species elsewhere on the island.

Native: São Tomé and Principe [São Tomé] (Rainho *et al.*, 2010a: 40).

POPULATION:
Structure and Density - It seems to be a very rare species that, despite considerable trapping effort, is currently only known from the type series of three specimens (J. Juste *pers. comm.,* 2008 in Mickleburgh *et al.*, 2008dl [in IUCN, 2009]).

Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008dl; IUCN, 2009).

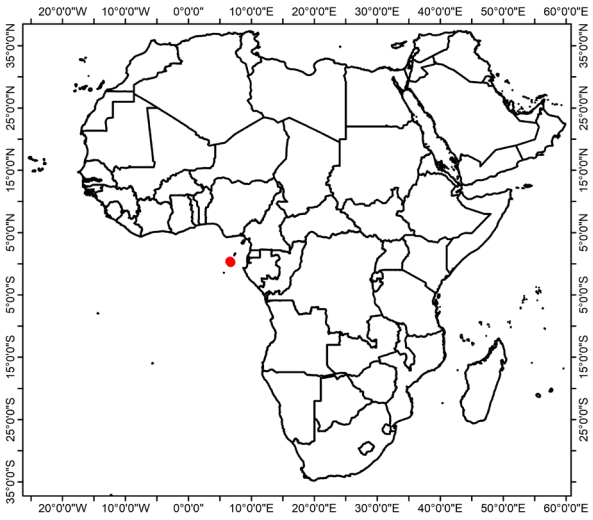


Figure 170. Distribution of *Chaerephon tomensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
São Tomé and Principé.

Genus ***Mops*** Lesson, 1842

*1842. *Mops* Lesson, Nouv. Tabl. Regn. Anim. Mammifères, 18. Publication date: 1842. - Comments: Type species: *Mops indicus* Lesson, 1842 (=*Molossus mops* de Blainville, 1840; Genotype *Mops indicus* Lesson = *Dysopes mops* F. Cuvier; listed in synonymy of *Nyctinomus* by Miller, 1907, Bull. U.S. Nat. Mus., 57, p. 251; but listed as a genus with distinct characters by Thomas, 1913, J. Bombay Nat. Hist. Soc., 22, p. 91). - Etymology: From the masculine German substantive *Mops*, meaning "pug", a small companion dog resembling a bulldog, corresponding to the French "carlin" and the Italian "carlino"; the name refers to the wrinkled lips characteristic of the genus *Mops* and the family Molossidae. According to one seemingly erroneous interpretation, from the Malaysian substantive *mòps*, meaning "bat" (see Lanza *et al.*, 2015: 293). (Current Combination)

TAXONOMY:
Formerly included in *Tadarida*; for synonyms see Freeman (1981b: 158). See also Legendre (1984). Harrison and Bates (1991: 64), Ansell and Dowsett (1988: 45), Corbet and Hill (1992: 157), Grubb *et al.* (1998: 93) and Horácek *et al.* (2000: 137), who include *Mops* as subgenus in *Tadarida*. A key is provided by Dunlop (1999: 1, Mammalian Species, 615).

In their molecular phylogeny study, Lamb *et al.* (2011: 9) found strong support for the monophyly of the *Chaerephon* + *Mops* taxa, but not for either of the genera separated. They also found some indications that certain *Mops* species are ancestral and *Chaerephon* species more derived. Their results suggest that *Chaerephon* should not be considered a subgenus of *Tadarida*, nor a genus on itself. They suggest combining *Chaerephon* (except *Chaerephon jobimena*) together with *Mops* into a single genus pending a more complete study.

The morphological study by Gregorin and Cirranello (2015: 10) was unable to resolve the relations within the genus *Mops*, but it supports the monophyly of the genus.

Known species within the genus *Mops*: †***rusingae*** Arroyo-Cabrales, Gregorin, Schlitter and Walker, 2002; ***bakarii*** Stanley, 2009; ***brachypterus*** (Peters, 1852); ***condylurus*** (A. Smith, 1833); ***congicus*** J. A. Allen, 1917; ***demonstrator*** (Thomas, 1903); ***leucostigma*** G. M. Allen, 1918; ***midas*** (Sundevall, 1843); *mops* (de Blainville, 1840) – western Malaysia, Sumatra, Borneo perhaps Java (Simmons, 2005: 443); ***nanulus*** J. A. Allen, 1917; ***niangarae*** J. A. Allen, 1917; ***niveiventer*** Cabrera and Ruxton, 1926; ***petersoni*** (El Rayah, 1981); *sarasinorum* (A. Meyer, 1899) –

Sulawesi (Indonesia) and adjacent small islands, Philippines (Simmons, 2005: 443); ***spurrelli*** (Dollman, 1911); ***thersites*** (Thomas, 1903); ***trevori*** J. A. Allen, 1917.

COMMON NAMES:
Czech: velcí morousi. English: Mops Bats, Greater Free-tailed Bats, Mops Free-tailed Bats. French: Tadarides. Italian: Pipistrèllo carlìno.

SEXUAL DIMORPHISM:
El-Rayah (1980: 163) confirmed the sexual dimorphism in the premolar size reported earlier: in males the first lower premolar is larger at the base than the second lower premolar, whereas in females this is the opposite.

†***Mops rusingae*** (Arroyo-Cabrales, Gregorin, Schlitter and Walker, 2002)

*2002. *Tadarida rusingae* Arroyo-Cabrales, Gregorin, Schlitter and Walker, J. Vert. Paleont., 22 (2): 382. Type locality: Kenya: Rusinga Island, west; KNM Locality 114 [00 20 S 34 06 E] [Goto Description]. - Comments: Hiwegi formation; late Early Miocene, ca. 17.5 - 18.0 Ma. - Etymology: The species name is derived from the specific locality where the holotype was collected, Rusinga Island (see Arroyo-Cabrales *et al.*, 2002).
2003. *Tadarida (Mops) rusingae:* Czaplewski, Morgan and Naeher, Acta Chiropt., 5 (1): 65. (Name Combination)
2008. *Mops rusingae:* Van Cakenberghe and Seamark, African Chiroptera Report. Publication date: July 2008. (Name Combination, Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The holotype was found in the Hiwegi formation; late Early Miocene deposits, dating between 17.5 to 18.0 Mya (Arroyo-Cabrales *et al.*, 2002).

Subgenus *Mops (Mops)* Lesson, 1842

*1842. *Mops* Lesson, Nouv. Tabl. Regn. Anim. Mammifères, 18. Publication date: 1842. - Comments: Type species: *Mops indicus* Lesson, 1842 (=*Molossus mops* de Blainville, 1840; Genotype *Mops indicus* Lesson = *Dysopes mops* F. Cuvier; listed in synonymy of *Nyctinomus* by Miller, 1907, Bull. U.S. Nat. Mus., 57, p. 251; but listed as a genus with distinct characters by Thomas, 1913, J. Bombay Nat. Hist. Soc., 22, p. 91). - Etymology: From the masculine German substantive *Mops*, meaning "pug", a small companion dog resembling a bulldog, corresponding to the French "carlin" and the Italian "carlino"; the name refers to the wrinkled lips characteristic of the genus *Mops* and the family Molossidae. According to one seemingly erroneous interpretation, from the Malaysian substantive *mòps*, meaning "bat" (see Lanza *et al.*, 2015: 293). (Current Combination)
1917. *Allomops* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 470, text-fig. 12 - 15. Publication date: 29 September 1917 [Goto Description]. - Comments: Type species: *Chærephon (Allomops) osborni* Allen, 1917 (=*Nyctinomus condylurus* A. Smith, 1833).
1951. *Tadarida (Mops):* Ellerman and Morrison-Scott. (Name Combination)
? *Mops (Mops):* (Name Combination)

Mops (Mops) condylurus (A. Smith, 1833)

*1833. *Nyctinomus Condylurus* A. Smith, S. Afr. Quart. J., ser. 2, 1 (2): 54. Publication date: November 1833. Type locality: South Africa: KwaZulu-Natal: Port Natal [=Durban], near [29 52 S 31 00 E] [Goto Description]. - Etymology: From the masculine scientific Latin adjective made up of the masculine Greek substantive "*κονδύλς*" (kóndylos), meaning "knob, knuckle" and the feminine Green substantive "*ούρά*" (urá), meaning "tail" as, according to Smith (1833: 54) the tail is "[…] enlarged and wrinkled at the point" (see Lanza *et al.* (2015: 298).
1864. *Dysopes hepaticus* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 31 (7): 14. Type locality: Sudan: Bahr-el-Ghazal province: Country of the Req natives: Djur River [Goto

Description]. - Comments: Meester *et al.* (1986: 74): "Allen (1939a), who regards it as a synony of *bivittata*. Hayman and Hill (1971) regard it as unidentifiable, but point out that Kock (in litt) believes that it probably represents *condylurus*. The latter view is expressed also by Kock (1969a) and Koopman (1975)".

1870. *Nyctinomus angolensis* Peters, J. Sci. mat. phys. nat., ser. 1, 3 (10): 124. Publication date: December 1870. Type locality: Angola: Quenza river [= Quanza River] [09 20 S 13 00 E] [Goto Description]. Holotype: ZMB 4904: ad ♂, skull and alcoholic. Collected by: Toulson (Museum Bocage). Formerly Mus. Bocage; see Turni and Kock (2008: 70). - Comments: Considered a synonym of *leucostigma* by Peterson *et al.* (1995: 168). Roberts (1951: 97), and Ansell and Dowsett (1988: 47) assigned it to Gunther, 1870, 1871. According to Meester *et al.* (1986: 74) "Günther 1871, Zoological Record (1870): 8. Quenza River [="?Cuanza River], Angola. Usually wrongly attributed to Peters, 1870, but see Cabrera and Ruxton, Ann. Mag. Nat. Hist., (9) 17: 595, 1926." According to Peterson *et al.* (1995)? "Kaudern, 1915: Ark. Zool., 9 (18): 77", but Peters, 1870 according to Simmons (2005).

1911. *Chærephon emini* Wroughton, Ann. Mag. nat. Hist., ser. 8, 8 (46): 458. Publication date: 1 October 1911. Type locality: Sudan: Rosieres [11 52 N 34 23 E]. - Comments: Not of de Winton, 1901: see Meester *et al.* (1986: 74).

1917. *Chærephon (Allomops) osborni:* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 470. Publication date: 29 September 1917. (Name Combination, Lapsus)

1917. *Mops (Allomops) osborni* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 470, 473, text-fig. 12 - 14, 26. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Kinshasa (near Leopoldville) [04 18 S 15 18 E, 350 m] [Goto Description]. Holotype: AMNH 49230: ad ♂, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 22 December 1914; original number: 2570. Paratype: AMNH 49244: ad ♀. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown.

1936. *Mops angolensis wonderi* Sanborn, Field Mus. Nat. Hist., Zool. Ser., (362) 20 (14): 114. Publication date: 15 August 1936. Type locality: Mali: 7 km E Bamako: Sotuba [12 36 N 07 55 W] [Goto Description]. Holotype: FMNH 42138: ad ♀, skin and skull. Collected by: Frank C. Wonder; collection date: 13 April 1934; original number: 814. - Comments: Considered a valid subspecies by Grubb *et al.* (1998: 93).

1939. *Mops osborni occidentalis* Monard, Arq. Mus. Bocage, 10: 78. Publication date: March 1939. Type locality: Guinea-Bissau: Mansoa [12 04 N 15 19 W] [Goto Description]. Syntype: NMBA 5268: ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 11-12 December 1937; original number: 226. See Oakeley (1998: 2). From Mansoa (see Monard, 1939: 78). Syntype: NMBA 5269: ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 11-12 December 1937; original number: 275. See Oakeley (1998: 2). From Mansoa (see Monard, 1939: 78). Syntype: RMCA 15307: ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 1937; original number: 223. From Mansoa (see Monard, 1939: 78). Syntype: RMCA 15308: ♀, alcoholic (skull not removed). Collected by: Dr. Albert Monard; original number: 498. From Contubo-el (see Monard, 1939: 78). - Comments: The type locality is either Mansoa [12 04 N 15 19 W], Contubo-el [12 22 N 14 34 W] or Pitche [12 20 N 13 57 W]. Monard (1939: 78) does not mention a holotype, but a series of specimens from Mansoa (14), Cotubo-el (5) and Pitche (9).

1939. *Mops osborni occidentalis f. fulva* Monard, Arq. Mus. Bocage, 10: 80. Publication date: March 1939. Type locality: Guinea-Bissau: Mansoa [12 04 N 15 19 W] [Goto Description]. Syntype: NMBA 5270: ♀, alcoholic (skull not removed). Collected by: Dr. Albert Monard; collection date: 11-12 December 1937; original number: 232. Monard (1939: 80) mentions a series of 10 specimens (nrs 228 to 237, 5 MM + 5 FF) from Mansoa and 1 M (nr 781) from Pitche. Syntype: RMCA 15309: ♂, alcoholic (skull not removed). Collected by: Dr. Albert Monard; original number: 229. Monard (1939: 78) mentions a larger series: nrs 215 to 227, 275 (13 MM + 1 F from Mansoa); 494 to 498 (1 M + 4 FF) from Contubo-el; 77. - Comments: The type locality is either Mansoa [12 04 N 15 19 W] or Pitche [12 20 N 13 57 W]. Grubb *et al.* (1998: 93) indicate that Monard's quadrinominal name was validated, in accordance with International Code of Zoological Nomenclature Articke 45 (g)(ii)(1), by its use as a trinomial (Freeman (1981b: 159). Monard (1939: 80) mentions a series of 10 specimens (nrs 228 to 237, 5 ♂♂ + 5 ♀♀) from Mansoa and 1 ♂ (nr 781) from Pitche.

1942. *Mops angolensis orientis* G.M. Allen and Loveridge, Bull. Mus. comp. Zool., 89 (4): 151, 166. Publication date: February 1942. Type locality: Tanzania: SE Tanzania, Mtwara, Rovuma river: Kitaya [300 ft] [Goto Description]. Holotype: MCZ 38829: ad ♂, skin and skull. Collected by: Professor Arthur Loveridge; collection date: 3 April 1939. See Allen and Loveridge (1942: 166). Helgen and McFadden (2001: 146) also mention 9 paratypes (MCZ 38826 - 38828, 38830 - 38835 (4 FF+ 5 MM, skin and skull): see Helgen and McFadden (2001: 145). Paratype: MCZ 38826: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38827: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38828: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38830: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38831: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38832: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38833: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38834: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. Paratype: MCZ 38835: Collected by: Professor Arthur Loveridge. Presented/Donated by: ?: Collector Unknown. - Comments: Possibly valid as a subspecies.
1962. *Tadarida angolensis:* Taufflieb, Bull. Inst. Rech. Sci. Congo, 1: 112. (Name Combination)
1979. *Tadarida condylura:* Ansell, The Puku, 3: 13. (Name Combination)
1981. *Mops osborni fulva:* Freeman, Field. Zool., n.s. 7: 159. (Name Combination)
? *Mops (Mops) condylurus:* (Name Combination, Current Combination)
? *Mops angolensis:*
? *Mops condylura angolensis:* (Name Combination, Alternate Spelling)
? *Mops condylura condylura:* (Name Combination, Alternate Spelling)
? *Mops condylura orientis:* (Name Combination, Alternate Spelling)
? *Mops condylura osborni:* (Name Combination, Alternate Spelling)
? *Mops condylurus orientis:* (Name Combination)
? *Mops condylurus osborni:* (Name Combination)
? *Mops condylurus wonderi:* (Name Combination)
? *Mops condylurus:* (Name Combination)
? *Tadarida (Mops) condylura:* (Name Combination)
? *Tadarida condylura condylura:* (Name Combination)
? *Tadarida condylura osborni:* (Name Combination)

TAXONOMY:

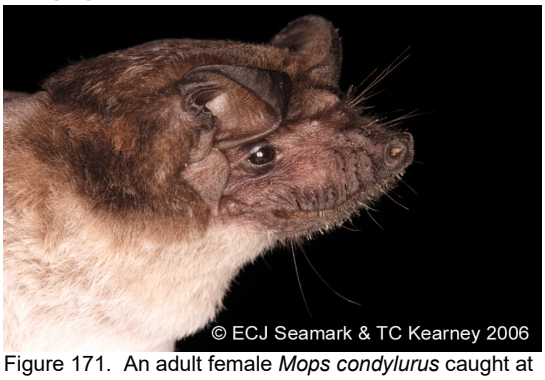


Figure 171. An adult female *Mops condylurus* caught at Mlawula-NR, Swaziland.

Includes *angolensis* and *leucostigma*, but see Peterson *et al.* (1995: 168).

In their analyses, Ammerman *et al.* (2012: 20) found that *Mops condylurus* from clusters with *M. leucostigma* from Madagascar when present, and these two form a close relationship with African *Chaerephon* and not other *Mops*. They also indicate that the two species separated from one another less than 2 million years ago (Ammerman *et al.*, 2012: 23).

COMMON NAMES:

Afrikaans: Angola-losstertvlermuis, Angolase Losstervlermuis. Chinese: 安哥拉犬吻蝠. Czech: morous angolský. English: Angolan Mops Bat, Knob-tailed Mops Bat, Angolan Free-tailed Bat, Knob-tailed Nyctinome. French: Tadaride d'Angola, Molosse d'Angola. German: Angola-Bulldoggfledermaus, Centralafrikanische Doggengrämler. Italian: Carlìno condilùro. Portuguese: Morcego de cauda livre.

ETYMOLOGY OF COMMON NAME:

Originally described from the former Natal province, it might more appropriately have been called the Natal free-tailed bat, but this name is taken by *Mormopterus acetabulosus*.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Gunnell *et al.* (2015a: 20) report on a right distal humerus from a Pleistocene deposit at Olduvai Gorge (Tanzania), which they assigned to *Mops* cf. *M. condylurus*.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008af; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida condylura*] (Mickleburgh *et al.*, 2008af; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004aq; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016b). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There are no major threats to this species. Some colonies roosting within buildings are possibly threatened by general persecution (Mickleburgh *et al.*, 2008af; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008af) [in IUCN (2009)] report that this species is present in a number of protected areas. No direct conservation actions are currently needed for the species as a whole.

GENERAL DISTRIBUTION:
Mops condylurus is widely distributed over much of sub-Saharan Africa. It ranges from Senegal, the Gambia and Mali in the west, to the Sudan, Ethiopia and Somalia in the east; from here it ranges southwards through much of eastern and southern Africa, as far south as eastern South Africa and Swaziland. The species appears to be largely absent from the Congo Basin.

Monadjem *et al.* (2010d) does not record any specimens occuring in Namibia.

Besides *Mops condylurus*, Taylor *et al.* (2018b: 63) also mention *Mops* cf. *condylurus* from Angola, whose echolocation calls do not match any known species.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,057,626 km^2. In the RSA, Babiker Salata (2012: 49) found that its distribution is stongly associated with the mean temperature of the coldest quarter.

Native: Angola (Lopes and Crawford-Cabral, 1992; Monadjem *et al.*, 2010d: 543; Taylor *et al.*, 2018b: 62); Benin (Capo-Chichi *et al.*, 2004: 163); Botswana (Monadjem *et al.*, 2010d: 543); Burkina Faso (Kangoyé *et al.* (2012: 6025; 2015a: 618); Burundi; Cameroon (Bakwo Fils *et al.*, 2014: 4); Congo (Bates *et al.*, 2013: 336); Congo (The Democratic Republic of the) (Allen, 1917; Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 543); Côte d'Ivoire; Ethiopia (Lavrenchenko *et al.*, 2004b: 141); Gambia (Emms and Barnett, 2005: 50); Ghana; Guinea (Fahr *et al.*, 2006b: 245; Decher *et al.*, 2016: 275); Guinea-Bissau (Seabra, 1900a; Monard, 1939; Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 75); Kenya; Liberia (Fahr, 2007a: 104); Malawi (Happold *et al.*, 1988; Happold and Happold, 1997b: 823; Monadjem *et al.*, 2010d: 543); Mali; Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 543; Monadjem *et al.*, 2010c: 382); Namibia; Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa (De Graaf, 1960; Monadjem *et al.*, 2010d: 544); Sudan; Swaziland (Monadjem *et al.*, 2010d: 544); Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 62); Zambia (Monadjem *et al.*, 2010d: 544); Zimbabwe (Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 3422).

Presence uncertain: Madagascar.

DENTAL FORMULA:
Dorst (1949: 47-48, fig 2) discussed the milk dentition of this species (as *Mops angolensis*) and indicated that the incisors are quite different from both the canines and premolars, as the prior are tricuspid and the latter are peg-like.

DETAILED MORPHOLOGY:
Baculum - Unknown
Brain - Amrein *et al.* (2007) from specimens collected from Bénin reported sparse proliferating cell activity, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus, with doublecortin (DCX) they detected young migrating neuron in the subgrannular layer of the hippocampus. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. No NeuroD was detected in the hippocampal granule cells (Amrein *et al.*, 2007).

FUNCTIONAL MORPHOLOGY:
Maloney *et al.* (1999: 385) indicate that *M. condylurus* is well adapted to tolerated high

ambivalent temperatures, which may enable them to exploit thermally challenging roost sites and allow them to survive in habitats where less stressful roosts are limited.

Buffenstein *et al.* (1999: 15) found that urine voided prior to feeding in summer was 22% more concentrated than that in autumn, suggesting that periods of exposure to high temperatures were more stressful. The urine produced was up to eight times more concentrated than plasma.

SEXUAL DIMORPHISM:
Chaverri *et al.* (2018: 1944) [referring to Bouchard, 2001b] indicates that the sexes can be distinguished by scent produced from the interaural and muzzle glandular areas.

ECHOLOCATION:
5.Bohmann *et al.* (2011: 1) [referring to Monadjem *et al.* (2010d)] mention peak frequencies between 26 - 35 kHz. Schoeman and Waddington (2011: 291) mention a peak frequency of 24.8 ± 1.5 kHz and a duration of 15.7 ± 2.1 msec for specimens from Durban, South Africa. From the same area, Naidoo *et al.* (2011: 23) mention a F_{peak} of 25.8 ± 0.5 kHz and a duration of 6.8 ± 1.8 msec.

In Swaziland, Taylor *et al.* (2013b: 18) recorded the following parameters for 6 calls: F_{max}: 34.8 ± 2.78 (31.5 - 38.6) kHz, F_{min}: 25.8 ± 1.79 (23.9 - 28.2) kHz, F_{knee}: 30.2 ± 2.16 (27.4 - 32.4) kHz, F_{char}: 27.3 ± 1.98 (24.9 - 29.3) kHz, duration: 5.5 ± 1.40 (3.4 - 7.2) msec. Additional values reported by Monadjem *et al.* (2017c: 179) are: F_{min}: 25.1 ± 1.68 (23.5 - 26.1) kHz, F_{knee}: 30.1 ± 2.03 (28.1 - 32.1) kHz, F_c: 27.3 ± 1.56 (25.9 - 28.8) kHz and duration: 4.3 ± 2.08 (2.2 - 6.4) msec. These calls could be detected up to 30 m away.

At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 30 (27 - 32) kHz.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg range (RSA): F_{min}: 24 - 28 kHz, F_{char}: 25 - 29 kHz, F_{knee}: 27 - 32 kHz, Slope: 40 - 160 OPS, duration: 3 - 7 msec. From the Mapungubwe National Park (RSA), Parker and Bernard (2018: 57) recorded 6 calls with: F_{char}: 29.12 ± 0.70 kHz, F_{max}: 30.72 ± 1.52 kHz, F_{min}: 28.45 ± 0.50 kHz, F_{knee}: 29.82 ± 0.97, duration: 15.44 ± 3.78 msec, at 5.57 ± 1.11 calls/sec.

From Maroua, Cameroon, Manga Mongombe (2012: 79) and Bakwo Fils *et al.* (2018: 4) reported for 12 calls a call type of FM and the following parameters: F_{max}: 37.8 ± 3.8 (33.9 - 41.6) kHz, F_{min}: 34.2 ± 4.9 (30.1 - 40.0) kHz, F_{mean}: 36.4 ± 4.5 (31.0 - 41.0) kHz, F_{knee}: 38.2 ± 4.7 (33.9 - 41.5) kHZ, F_{char}: 33.67 ± 5.1 (30.1 - 40.0) kHz, and duration: 0.78 ± 0.89 (0.57 - 0.88) msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Đulic and Mutere (1973a) described the karyotype as having a diploid number of 2*n* = 48, aFN = 56, BA = 10, X = SM, Y = A. While Smith *et al.* (1986) found that the fundamental number was aFN = 66, BA = 20, this is supported by Rautenbach *et al.* (1993). Koubínová (2013: 7) mentioned: 2*n* = 48 and FN = 54.
Protein / allozyme - Unknown.

HABITAT:
Noer *et al.* (2012: 1) indicate that *M. condylurus* prefers to forage over sugarcane fields rather than over savanna, riparian forest and urban areas. They also indicated that the bats travel up to 4.8 km from their roosts during their foraging trips. Their activity area ranges from 1,190 to 1,437 ha.

HABITS:
Bouchard (2001b: 109) found that, in scent-choise-experiments, both males and females were able to distinguish the gender of conspecifics as well as the difference between roostmates and strangers. Chaverri *et al.* (2018: 1944) [referring to Ravel *et al.*, 2010] further indicate that there is an inverse relation between the number of individuals that can be recognized based on olfactory cues and the size of the colony. This would suggest that recognition is based on individual signatures rather than on group signatures.

ROOST:
In the Mount Nimba area, Monadjem *et al.* (2016y: 368) found a roost in the roof of a school at 540 m.

Bronner *et al.* (1999: 1) investigated the roost microclimates in three man-made structures in South Africa. The ambient temperature in these varied from below 10°C to over 40°C, but the bats preferred zones where the temperature was between 35 and 40°C, where they could maintain their basal metabolic rate.

DIET:
Based on DNA analysis of 30 fecal pellets collected between April and May (austral summer) in the Simunye region of Swaziland, Bohmann *et al.* (2011) reported insects from 24 families (belonging to seven orders) being taken as prey. The highest frequency of occurrence was for Lepidoptera (47.6 %), Diptera (26.7 %), and Hemiptera (20 %). Within the Lepidoptera, Noctuidae (Owlet moths - 23.3 %), Nymphalidae (Brush-footed butterflies - 17.6 %) and Geometridae (Geometer moths - 10 %) were found the most. Within the Diptera, it were primarly

representatives of Drosophilidae (Pomace flies - 6.5 %) and Muscidae (House flies and alike - 6.5 %). Within the Hemiptera, Lygaeidae (Chinch bugs and seed bugs) and Pentatomidae (Stink bugs) were found in 6.7 % of the pellets.

From Maroua (Cameroon), and based on fecal analyses, Bol A Anong (2013: 32) reported the diet to include Coleoptera (63.49%), Hemiptera (27.64%), Diptera (7.42%), Lepidoptera (0.05%) and Hymenoptera (0.40%).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention "*Tadarida condylura*" to be preyed upon by: African goshawk (*Accipiter tachiro* (Daudin, 1800)), Eurasian hobby (*Falco subbuteo* Linnaeus, 1758), Wahlberg's eagle (*Hieraaetus wahlbergi* (Sundevall, 1851)), Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850).

Bronner *et al.* (1999: 8) reported on the presence of an Eastern Tiger Snake (*Telescopus semiannulatus semiannulatus* Smith, 1849) in a colony of *M. condylurus*.

POPULATION:
Structure and Density - This is a common species (Mickleburgh *et al.*, 2008af; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008af; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Mutere (1968, 1973b: 271) reported that "*T. condylura*" has a bimodal breeding rhythm in Uganda (pregnancies during December-March and June-September and births in March and September), which is correlated with the rainfall pattern (April-May and October-November), and that the gestation period for this species is about two months. He also indicated [in Krutzsch (2000: 95)] that the testicular position (intra-abdominal or scrotal) showed no significant seasonal variation in sperm production.

Happold and Happold (1989b: 133) indicate that "*Tadarida condylura*" is monotocous in Malawi, where it has two births per year. They also found that the interval between births decreases with increasing latitude.

Mutere (1973b) mentioned that the pattern of reproduction is not followed by a postpartum oestrous, whereas Happold and Happold (1989b) mention the opposite.

Wyant and Adams (2007) present data on prenatal growth, development, and skeletal ossification, by intergrating data from changes in body size, wing area, and skeletogenesis, from specimens collected from east African countries.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births between early September and early May.

PARASITES:
Lima *et al.* (2012: 858) described a new species of *Trypanosoma* from Mozambican *Mops condylurus*: *T. (Schizotrypanum) erneyi*. This parasite was also found in two unidentified *Tadarida* specimens.

Höhne *et al.* (1975: 505) found *Listeria monocytogenes* bacteria in two out of 234 "*Tadarida condylura*" specimens from Lomé, Togo.

HEMIPTERA
Cimicidae: *Loxaspis miranda* Rothschild, 1912 were found in the hollow trunk of a *Borassus* palm containing many dead *T. condylura*, at the Fambani river, near mouth of Zambesi, in Mozambique (Haeselbarth *et al.*, 1966: 10).

SIPHONAPTERA
Ischnopsyllidae: *Lagaropsylla idea* Smit, 1957 widespread in tropical Africa (Haeselbarth *et al.*, 1966: 1990; Beaucournu and Kock, 1996). *Lagaropsylla leleupi* Smit, 1957 from Bugesera, Burindi (Haeselbarth *et al.*, 1966: 191). *Lagaropsylla obliqua* Smit, 1957 from Sierra Leone, Cameroon and the Congo (Haeselbarth *et al.*, 1966: 191).

Lagaropsylla incerta (Rothschild, 1900) was reported from Madagascar by Beaucournu and Kock (1996).

ACARI
Laelapidae: Taufflieb (1962: 112) reported *Chelanyssus aethiopious* Hirst, 1921 from a "*Tadarida angolensis* [=*Mops osborni*]".
Sarcoptidae: *Notoedres tadaridae* Fain, 1959 was found by Fain and Aellen (1994: 64) on a "*Tadarida condylura*" specimen from Tandara, DRC.
Trombiculidae: Stekolnikov (2018a: 69, 172) reported *Holubicula toroensis* Daniel and Vercammen-Grandjean, 1985 on a bat from Uganda, and *Microtrombicula tadarida* Vercammen-Grandjean, 1965 on a bat from Rwanda.

VIRUSES:
Astroviridae
Viruses belonging to this family were recorded by Waruhiu *et al.* (2017) from these bats in Kenya, and in one (out of 52) tested by Hoarau *et al.* (2018: 2) in Mozambique.

Bunyaviridae
Sudi *et al.* (2018: 3) refer to Krüger *et al.* (2015), who reported the presence of Lompole virus (LMPV) in *Mops condylurus* from the DRC (although the latter authors didn't identify the bats involved).

Caliciviridae
Viruses belonging to this family were recorded by Waruhiu *et al.* (2017) from these bats in Kenya.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in 19 individuals from Limpopo Province, South Africa, three were tested positive (3/19, 15.8 %) and 96 individuals from Mpumalanga Province, South Africa, 11 tested positive (11/96, 11.9 %) (14/115, 12.2 %).
Anthony *et al.* (2017b: Suppl.) mention the alpha-coronavirus Charephon_CoV_KY22.

Filoviridae - Filo viruses
Ebolavirus
Muyembe-Tamfum *et al.* (2012: 9) refer to Pourrut *et al.* (2005) who found ZEBOV-specific antibodies in this species.
Saéz *et al.* (2014) indicate that the two-year old boy, who was patient zero for the 2014 Ebola outbreak in West Africa may have been infected while playing in a hollow tree housing a colony of *M. condylurus*. However, Wood *et al.* (2015: 9-10) find "the suggestion that *Mops condylurus* was the source of infection in the index human case in Guinea noteworthy if somewhat speculative."

Goldstein *et al.* (2018: 1084) described a new *Ebolavirus* from three Sierra Leonan *C. pumilus* and one *Mops condylurus*: Bomali virus (BOMV). They were sampled in human dwellings in small villages in the Bomali district. This virus might infect humans, but it is not known (yet) whether it is virulent in humans too.
Forbes *et al.* (2019: 955) reported this virus from one *M.condylurus* from Kenya (out of 16 *M. condylurus* + 92 other bats collected).

Flaviviridae
Flavivirus
de Jong *et al.* (2011: 10) reported Bukalasa bat virus, Dakar bat virus, Entebbe bat virus. The latter two are also reported by Luis *et al.* (2013: suppl.), Blitvich and Firth (2017: 3). In Uganda, Kading *et al.* (2018: 3) found neutralizing antibodies against Dengue 2 virus (DENV-2) and non-specific Flaviviruses.
Dakar virus - Kemp (1975: 616) mentions that this virus was isolated in Nigeria on *M. condylurus* for the first time on 25 January 1966.

Zika virus (ZIKV) - Malmlov *et al.* (2019: 2) refer to Shepherd and Williams (1964) who examined 36 Ugandan *condylurus* specimens of which 26 had antibodies against ZIKV.

Pegivirus (BPgV)
1 of 10 specimens from the Democratic Republic of Congo examined by Quan *et al.* (2013: Table S5) (10.0 %) was infected by clade G type *Pegivirus*. Of the same 10 specimens, 2 were infected by clade K type

Paramxoviridae
Viruses belonging to this family were recorded by Waruhiu *et al.* (2017) from these bats in Kenya.

Peribunyaviridae
Orthobunyavirus
Fagre and Kading (2019: 4) report that Bunyamwera virus (BUNV) was found either by virus isolation or molecular/serologic evidence.

In their overview tables, Maganga *et al.* (2014a: 8) and Willoughby *et al.* (2017: Suppl.) reported that the following viruses were already found on *M. condylurus*: Bukalasa bat virus, Dakar bat virus, Entebbe bat virus, Coronavirus (SARS-CoV), Bunyamwera orthobunyavirus, West Nile virus, Yellow fever virus, Zaïre Ebola, Zika virus.

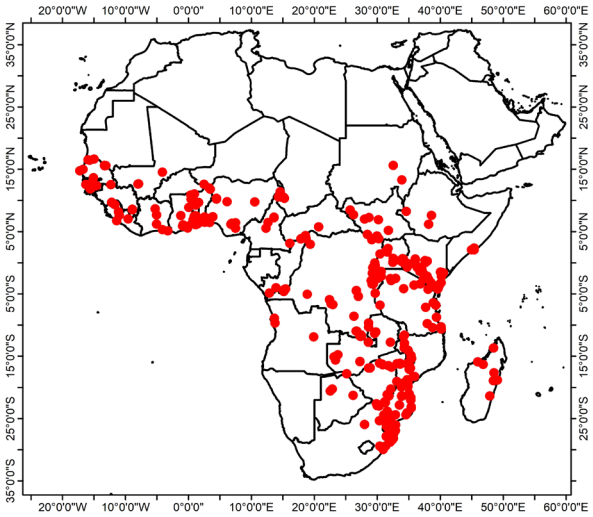


Figure 172. Distribution of *Mops* (*Mops*) *condylurus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Mops (Mops) congicus J.A. Allen, 1917

*1917. *Mops congicus* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 467, pl. 55. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Medje [02 25 N 27 18 E, 800 m] [Goto Description]. Holotype: AMNH 48893: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 8 September 1910; original number: 966.
? *Mops (Mops) congicus:* (Name Combination, Current Combination)
? *Mops congica:* (Alternate Spelling)
? *Tadarida congica:* (Name Combination)

TAXONOMY:
Does not include *trevori*; see Peterson (1972).

COMMON NAMES:
Czech: morous konžský. English: Medje Mops Bat, Medje Free-tailed Bat, Medje Greater Free-tailed Bat. French: Tadaride de Medje. German: Kongo-Bulldoggfledermaus, Medje-Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bp; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida congica*] (Mickleburgh *et al.*, 2008bp; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004bx; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
It is threatened in parts of its range by habitat loss, largely resulting from logging activities and conversion of land to agricultural use (Mickleburgh *et al.*, 2008bp; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bp) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Further studies are needed into the distribution, abundance, natural history, and threats to this poorly known species.

GENERAL DISTRIBUTION:
Mops congicus has been patchily recorded in Central Africa. It is found from southern Cameroon, east into the northern part of the Democratic Republic of the Congo and western Uganda.

Earlier records of this species from Ghana and Nigeria are now allocated to *Mops trevori* (Simmons, 2005).

Native: Cameroon; Congo (The Democratic Republic of the); Uganda.

POPULATION:
Structure and Density - The species has been rarely collected. While a single large colony of approximately several dozen bats has been reported, it is suspected to generally occur in much smaller roosts (Mickleburgh *et al.*, 2008bp; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bp; IUCN, 2009).

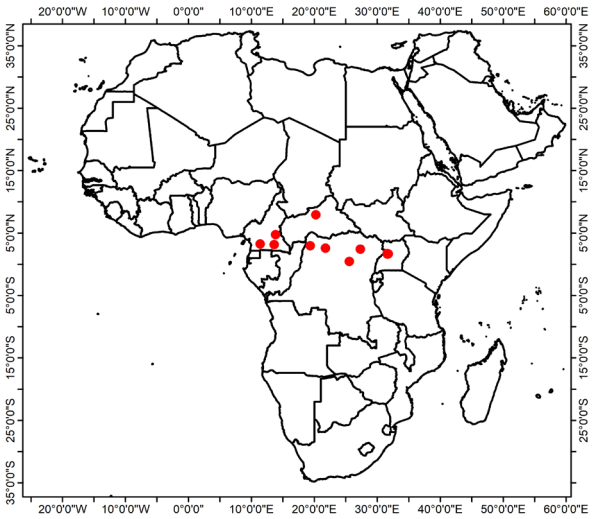


Figure 173. Distribution of *Mops* (*Mops*) *congicus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Cameroon, Central African Republic, Congo (Democratic Republic of the), Uganda.

Mops (Mops) demonstrator (Thomas, 1903)

*1903. *Nyctinomus demonstrator* Thomas, Ann. Mag. nat. Hist., ser. 7, 12 (71): 504. Publication date: 1 November 1903. Type locality: Sudan: Equatoria province: 25 mi (37 km) N of

Gondokoro: Mongalla [05 10 N 31 50 E, 500 m] [Goto Description]. Holotype: BMNH 1902.7.4.3: ad ♂. Collected by: W.L.S. Loat Esq. Presented/Donated by: W.L.S. Loat Esq.

1917. *Mops (Allomops) faradjius* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 476. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Faradje [03 44 N 29 43 E] [Goto Description]. Holotype: AMNH 49222: ad ♂, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 1 November 1913; original number: 3015. - Comments: One of the skull labels mentions 12 January 1913, which probably is an error.

? *Mops (Mops) demonstrator:* (Name Combination, Current Combination)

? *Mops demonstrator:* (Name Combination)

? *Mops demostrator:* (Lapsus)

? *Tadarida (Mops) demonstrator:* (Name Combination)

? *Tadarida demonstrator:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: morous mongallanský. English: Mongalla Mops Bat, Mongallan Mops Bat, Mongalla Free-tailed Bat. French: Tadaride de Mongalla. German: Mongalla-Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bs; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida demonstrator*] (Mickleburgh *et al.*, 2008bs; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004az; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
In part of its range this species is threatened by habitat loss, mostly the cutting of larger roosting trees from savanna. It may also be threatened by encroaching desertification in the northern limits of its range (Mickleburgh *et al.*, 2008bs; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bs) [in IUCN (2009)] report that this species has been recorded from the Garamba National Park in the Democratic Republic of the Congo (Freeman, 1981b), and may be present in additional protected areas. There is a need to protect suitable large roosting trees in savanna. Further research is needed to better understand the distribution, natural history and major threats to this species.

GENERAL DISTRIBUTION:
Mops demonstrator has been patchily recorded from West Africa (Côte d'Ivoire, Ghana and Burkina Faso) and Central to East Africa (Cameroon, eastern Democratic Republic of the Congo, western Uganda and Sudan).

A record from the Gambia appears to be in error (Koopman, 1989b; Grubb *et al.*, 1998).

Native: Burkina Faso (Kangoyé *et al.*, 2015a: 618); Cameroon; Congo (The Democratic Republic of the); Côte d'Ivoire; Ghana; Sudan; Uganda.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) reported 2*n* = 48, FN = 54, BA = 8, a submetacentric X chromosome and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - This species is rarely recorded. Animals are usually found singly or as small groups of up to 12 bats (Mickleburgh *et al.*, 2008bs; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bs; IUCN, 2009).

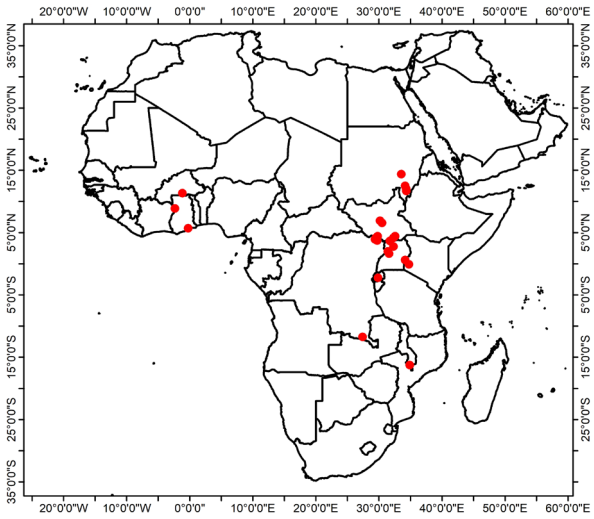


Figure 174. Distribution of *Mops* (*Mops*) *demonstrator*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Burkina Faso, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Kenya, Malawi, Rwanda, South Sudan, Sudan, Uganda.

Mops (Mops) leucostigma (G.M. Allen, 1918)

*1918. *Chaerephon leucostigma* G.M. Allen, Bull. Mus. comp. Zool., 61 (14): 513. Publication date: 27 February 1918. Type locality: Madagascar: Tananarive [=Antananarivo] [18 55 S 47 31 E, 1 300 m]. Holotype: MCZ 16344: ad ♀, skin and skull. Collected by: Dr. Frederik Roelker Wulsin; collection date: December 1915. See Peterson *et al.* (1995: 168); Helgen and McFadden (2001: 145). Paratype: MCZ 16345: ♂, skin and skull. See Helgen and McFadden (2001: 145). - Comments: Ratrimomanarivo *et al.* (2008: 66 - 67) mentions the following: "In his description of *Mops leucostigma*, Allen (1918) cited two specimens - the holotype (MCZ 16344), which was sexed as a 'female' and the paratype (MCZ 16345), which was sexed as a 'male' (also see Helgen & McFadden, 2001). We examined these two specimens. In Allen's description he specifically states, 'The skull is provided with a prominent sagittal crest, which in the type, though partly broken, must have been at least a millimetre high.' This is an accurate description of the MCZ 16344. In members of the genus *Mops* in general (Freeman, 1981) and in *M. leucostigma* specifically (this study), adult males are distinctly larger than adult females and have a prominent and more developed occipital and sagittal crests. Based on size, skull shape, and the development of the occipital and sagittal crests, the holotype is a male and the paratype a female. Given that all of the collection data for the holotype (MCZ 16344) and paratype (MCZ 16345) are identical, we strongly suspect that the museum labels for these two specimens have been accidentally exchanged before the publication of Allen (1918).".

2018. *Mops leucogaster:* Kemp, López-Baucells, Rocha, Wangensteen, Andriatafika, Nair and Cabeza, Agric. Ecosyst. Environ., 269: 88 (for 2019). Publication date: 1 October 2018. (Lapsus)

? *Mops (Mops) leucostigma:* (Name Combination, Current Combination)

? *Mops condylura leucostigma:* (Name Combination, Alternate Spelling)

? *Mops leucostigma:* (Name Combination)

? *Tadarida (Mops) leucostigma:* (Name Combination)

? *Tadarida leucostigma:* (Name Combination)

TAXONOMY:
Included in *condylurus* by Koopman (1993a: 236), but considered a valid species in *Tadarida (M.)* by Peterson *et al.* (1995: 152) and Russ *et al.* (2001). Considered a valid species in the genus *Mops* by Hutson *et al.* (2001: 34), Goodman and Cardiff (2004: 227), Simmons (2005).

COMMON NAMES:
Czech: morous běloskvrnný. English: Madagascar White-bellied Free-tailed Bat, Malagasy White-bellied Free-tailed Bat, White-shouldered bat. French: Tadaride à queue libre de Madagascar. German: Gefleckte Bulldoggfledermaus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Gunnell *et al.* (2014: 3) refer to fossils material from the Andrahomana cave on Madagascar.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its large distribution range, and its ability both to tolerate persecution and to persist in a variety of habitats in many parts of its range (Andriafidison *et al.*, 2008m; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida leucostigma*] (Andriafidison *et al.*, 2008m; IUCN, 2009). 2000 - DD ver 2.3 (1994).

MAJOR THREATS:
In some areas it is hunted for food (Goodman *et al.*, 2008d) or persecuted, but these are not thought to be serious threats (Andriafidison *et al.*, 2008m; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008m) [in IUCN (2009)] report that this species is known from Kirindy CFPF and Parc National de Zombitse-Vohibasia (Goodman *et al.*, 2005a). It is also common in villages adjacent to several protected areas (Goodman *et al.*, 2005a; Russ *et al.*, 2003).

GENERAL DISTRIBUTION:
Mops leucostigma is known from Madagascar and the Comoros archipelago (Mohéli and Anjouan islands). On Madagascar it is found from the north to the southwest of the island (Eger and Mitchell, 2003; Peterson *et al.*, 1995) including the islands of Nosy Be and Nosy Komba (Rakotonandrasana and Goodman, 2007: 6). Recorded at an elevation span of 5 to 1,300 m above sea level (Allen, 1918b; Eger and Mitchell, 2003).

Native: Madagascar (Eger and Mitchell, 2003; Peterson *et al.*, 1995; Rakotonandrasana and Goodman, 2007: 6); Comoros (Ratrimomanarivo *et al.*, 2008: 57).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 62) describe the baculum as displaying a distinct "m"-shape; length: 0.75 ± 0.097 (0.56 - 0.86) mm, width: 1.09 ± 0.137 (0.83 - 1.35) mm.

HABITAT:
Dammhahn and Goodman (2013: 108) indicate that this species' foraging habitat consists of open areas and the area above the forest canopy.

MIGRATION:
Reher *et al.* (2019: 121) found that *M. leucostigma* was only present in the Vintany Cave (southwestern Madagascar) during the rainy season, whereas other species such as *Triaenops menamena* and *Miniopterus mahafaliensis* were present in both the dry and wet season.

DIET:
Rakotondramanana *et al.* (2015: 78) report the following insect orders (by volume percent, by frequency percent): Coleoptera (64.0, 100.0); Lepidoptera (30.0, 100.0); Trichoptera (6.0, 60.0).

Kemp *et al.* (2018: Suppl.) used DNA metacarcoding to detect insect pest species in the diet of these bats and found the following prey orders (in descending order): Coleoptera, Diptera (*Simulium lineatum* (Meigen, 1804)), Lepidoptera (*Anthozela* sp., *Celsumaria elongata* Brown, 2017, *Spodoptera mauritia* (Boisduval, 1833)), Blattodea, Hemiptera (*Yanga guttulata* (Signoret, 1860)), Ephemeroptera, Sarcoptiformes, Orthoptera, Hymenoptera, Mesostigmata, Trombidiformes, Trichoptera.

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of two individuals in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

POPULATION:
Structure and Density - The population and local abundance of this species are not known (Andriafidison *et al.*, 2008m; IUCN, 2009).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008m; IUCN, 2009).

VIRUSES:
Paramyxoviridae
Specimens from this species tested by Wilkinson *et al.* (2014: 8270) were found to be positive for paramyxoviruses.
11 out of 68 Madagascan specimens tested by Mélade *et al.* (2016b: 4) were positive for paramyxoviruses.

Rhabdoviridae
Mélade *et al.* (2016a: 6) tested 20 bats for *Lagos bat lyssavirus* and found positive reactions in two of them.

UTILISATION:
See Goodman *et al.* (2008d).

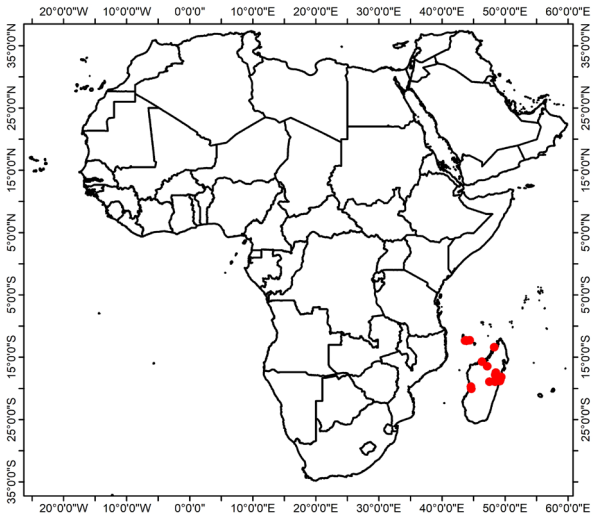


Figure 175. Distribution of *Mops* (*Mops*) *leucostigma*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Comoros, Madagascar.

Mops (Mops) midas (Sundevall, 1843)

*1843. *Dysopes midas*Sundevall, Kongl. Svenska Vet.-Akad. Hand., ser. 3, 30: 207, pl. 2, fig. 7 [for 1842]. Publication date: 1843. Type locality: Sudan: Blue Nile Province: E-bank White Nile: Valid Sohey [= Wad Shala]: restricted by Turni and Kock (2008: 68). [14 34 N 13 48 E]. Syntype: BMNH 1846.6.2.20: ad ♂, skin and skull. Formerly Stockholm Museum (ZSM no. 523), locality: Bahr el Abiad. See Turni and Kock (2008: 68). Syntype: ZMB 535: skin only. Collected by: Hedenborg; collection date: 1831 - 1835. From [Dar] Sennar, Sudan; see Turni and Kock (2008: 68). Syntype: ZSM. Collected by: Hedenborg; collection date: 1846. See Turni and Kock (2008: 68). Syntype: ZSM, skin only. Collected by: Hedenborg; collection date: 1836. See Turni and Kock (2008: 68). - Comments: Horácek *et al.* (2000: 137) mention "Bahr-el-Abiad, White Nile" as type locality. Meester *et al.* (1986: 73): "Bahr-el-Abiad (White Nile), Sudan. Kock (1969a: 154) suggests that the type locality is at Jebel el Funj, between the White and Blue Nile, and Koopman (1975, and in litt.) restricts it to the east (not west, as shown in 1975: 429) bank of the White Nile at 11 45 N 33 30 E, Blue Nile Province, Sudan."). El-Rayah (1980: 264) believes the restriction to Jebel el Funj is incorrect as Sundevall described the type locaility as Bahr el-Abiad which is the area south of Omdurman (15 19 N 32 29 E) and commonly known as Bahar Abiad and restricts the type locality to the vicinity of Jebel Aulia (15 19 N 32 31 'E). For a deeper discussion on the type locality, see Turni and Kock (2008: 68). - Etymology: According to a legend the mythological King Midas of Phrygia offended Apollo, so the god turned Midas' ears into those of a donkey, i.e. in very long ears; which in this species are relatively large (see Lanza *et al.*, 2015: 304).

? *Mops (Mops) midas:* (Name Combination, Current Combination)

? *Mops midas:* (Name Combination)

? *Tadarida (Mops) midas:* (Name Combination)

? *Tadarida midas:* (Name Combination)

TAXONOMY:



Figure 176. A female *Mops midas* (TM 48104) caught at Makalali Game Reserve, Limpopo Province, South Africa.

Dunlop (1999), following Koopman (1994), recognizes two subspecies: *M. m. midas* (Sundevall 18437) occuring over most of the range and *M. m. miarensis* (Grandidier, 1869) occuring in Madagascar (Peterson *et al.* (1995). Although *miarensi* has previously been considered a subspecies endemic to the island of Madagascar (Simmons (2005), Ratrimomanarivo *et al.* (2007) found no distinctive or taxonomically definitive differences between populations of *Mops midas*

occurring on the African continent and Madagascar.

COMMON NAMES:
Afrikaans: Midas se losstertvlermuis, Midas-losstertvlermuis. Chinese: 米达犬吻蝠. Czech: morous oslí. English: Midas Mops Bat, Midas Bat, Midas Free-tailed Bat, Sundevall's Free-tailed Bat, Midas Groove-cheeked Bat. French: Tadaride Midas, Molosse Midas, Tadarida de Midas, Molosse de Midas. German: Midas-Bulldoggfledermaus, Sennaarische Doggengrämler. Italian: Carlìno Mìda.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
No known fossils (Dunlop, 1999).

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its widespread but patchy distribution. The species is locally hunted and persecuted, but it is not thought to be declining fast enough to place it in a higher category of threat (Jenkins *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida midas*] (Jenkins *et al.*, 2008a; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004ax; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Taylor *et al.*, 2016a). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
This species is thought to be locally threatened by general persecution, collection for food and habitat loss (Jenkins *et al.*, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Jenkins *et al.* (2008a) [in IUCN (2009)] report that there is a need to protect large trees and other known roosting sites for this species (this does not apply to populations on Madagascar). In Madagascar, it is known from Beza Mahafaly and Zombitse-Vohibasia National Parks.

GENERAL DISTRIBUTION:
Mops midas is a widespread lowland, savanna species ranging from West Africa eastwards to East Africa and southwards into southern Africa. It has been recorded from the Arabian Peninsula. It is present on Madagascar (including the island of Nosy Be), where it is generally distributed in the drier western and southern habitats of the island below 150 m asl (Ratrimomanarivo *et al.*, 2007). In South Africa, the species' distribution is mostly affected by precipitation seasonality (Babiker Salata, 2012: 49). Taylor *et al.* (2018b: 63) predict that the species might also occur in Angola.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 441,324 km^2.

Native: Benin; Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 544); Burkina Faso (Kangoyé *et al.*, 2015a: 618); Burundi; Central African Republic; Chad; Congo (The Democratic Republic of the); Eritrea (Lavrenchenko *et al.*, 2004b: 133); Ethiopia; Gambia; Ghana; Kenya; Madagascar (Peterson *et al.*, 1995; Rakotonandrasana and Goodman, 2007: 6); Malawi (Ansell and Dowsett, 1988: 47; Monadjem *et al.*, 2010d: 544); Mali; Mozambique; Namibia (Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 544); Niger; Nigeria; Rwanda; Saudi Arabia; Senegal; South Africa (Monadjem *et al.*, 2010d: 544); Sudan; Swaziland (Shapiro and Monadjem, 2015: "1")): Tanzania; Togo; Uganda; Zambia (Ansell, 1973; Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 544); Zimbabwe (Monadjem *et al.*, 2010d: 544).

BIOGEOGRAPHY:
Samonds *et al.* (2012: 5356) indicate that *M. midas* seems to have migrated multiple times between the African continent and Madagascar.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Dunlop (1999).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Dunlop (1999).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 62) describe the baculum as an elongated rod, which has a notable twist to the mid-shaft in a lateral view. The distal tip is rounded, and the proximal tip terminates in a blunt point length: 1.90 ± 0.091 (1.80 - 2.05) mm, width: 0.39 ± 0.058 (0.32 - 0.46) mm.

For a description of the crania, teeth, ears and tragus, and wingshape and aspect ratio see Dunlop (1999).

SEXUAL DIMORPHISM:
Sexual dimorphism in *M. midas* occurs primarily in the stronger development of the sagittal and lambdoidal crests (Kingdon, 1974; Smithers, 1983; Dunlop, 1999), as well as the greater length and width of the skull (Peterson *et al.*, 1995) in males.

ECHOLOCATION:
See Dunlop (1999) and Taylor (1999b).

In Waterberg, South Africa, Taylor *et al.* (2013b: 18) recorded the following parameters for 6 calls: F_{max}: 14.5 ± 1.45 (12.7 - 16.2) kHz, F_{min}: 12.8 ± 0.82 (11.7 - 13.7) kHz, F_{knee}: 13.8 ± 1.02 (12.5 - 15.0) kHz, F_{char}: 13.1 ± 0.88 (12.0 - 14.0) kHz, duration: 10.3 ± 2.89 (7.8 - 15.8) msec.
At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 14 (12 - 15) kHz.
Linden *et al.* (2014: 40) reported the following parameters from the Souhpansberg range (RSA): F_{min}: 12 - 14 kHz, F_{char}: 12 - 14 kHz, F_{knee}: 12 - 15 kHz, Slope: 32 - 66 OPS, duration: 8 - 16 msec.
At the Mapungubwe National Park (RSA), Parker and Bernard (2018: 57) recorded 13 calls: F_{char}: 13.11 ± 1.04 kHz, F_{max}: 14.66 ± 1.46 kHz, F_{min}: 12.33 ± 1.42 kHz, F_{knee}: 13.71 ± 0.98 kHz, duration: 14.79 ± 3.78 msec, with 4.29 ± 2.73 calls/sec.

From Swaziland, the following values were reported by Monadjem *et al.* (2017c: 179): F_{min}: 11.8 ± 0.50 (11.3 - 12.5) kHz, F_{knee}: 13.1 ± 1.08 (11.9 - 14.5) kHz, F_c: 12.3 ± 0.72 (11.6 - 13.4) kHz and duration: 14.2 ± 3.89 (9.0 - 20.7) msec.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) described the karyotype as having a diploid number of 2*n* = 48, aFN = 66, BA = 20, X = SM, Y = A, this is supported by Rautenbach *et al.* (1993).
Protein / allozyme - Unknown.

HABITAT:
See Dunlop (1999).

HABITS:
See Dunlop, 1999).

ROOST:
See Dunlop (1999).

MIGRATION:
May make local migrations, as they only appear in parts of their range (northeastern Congo) at the end of the dry season (Allen *et al.*, 1917; Dunlop, 1999).

DIET:
In the Limpopo province (RSA), Taylor *et al.* (2017b: 246, 252 - 254) found 93 prey items spread over seven insect orders: Lepidoptera (100 % [found in all faecal pellets] and covering 17 families: *Synemon austera* + *Talanga sexpunctalis* + *Antaeotricha* sp. + *Elachista* sp. + *Araeopteron* sp. + *Dyops subdifferens* + *Eublemma* sp. + *Peridrome orbicularis* + *Spargaloma sexpunctata* + *Eutelia polychorda* + *Lophoptera* sp. + *Phlegetonia callichroma* + *Acanthovalva inconspicuaria* + *Achrosis pyrrhularia* + *Aethalura punctulata* + *Cabera AH02SA* + *Chiasmia interrupta* + *Ennominae* sp. + *Eupithecia* sp. + *Isturgia arizeloides* + *Isturgia roraria* + *Isturgia pulinda* + *Scopula atricapilla* + *Hyblaea puera* + *Gonometa postica* + *Sena* sp. + *Sena prompta* + *Xenopseustis* sp. + *Acronicta psi* + *Adisura marginalis* + *Athetis ignava* + *Bastilla torrida* + *Bryophila AH01Pe* + *Chasmina lispodes* + *Chasmina* sp. + *Condica parista* + *Copitarsia* + *Cortyta canescens* + *Enmonodia capensis* + *Grammodes stolida* + *Harrisimemna trisignata* + *Heterochroma BioLep767* + *Hypotacha* sp. + *Leucania BioLep10* + *Leucania BioLep162* + *Leucania multilinea* + *Leucania Poole05* + *Leucania porphyrodes* + *Mythimna consanguis* + *Mythimna convecta* + *Mythimna impura* + *Mythimna oxygala* + *Mythimna nigrisparsa* + *Mythimna obsoleta* + *Mythimna* sp. + *Niphonyx segregata* + *Hadenini* sp. + *Ophiusa tirhaca* + *Pandesma robusta* + *Paratrachea laches* + *Pericyma atrifusa* + *Polia piniae* + *Rhesala moestalis* + *Spodoptera exigua* + *Tycomarptes* sp. + *Xanthodes malvae* + *Garella nilotica* + *Maurilia arcuata* + *Meganola dentata* + *Meganola baracoana* + *Pseudosomera noctuiformis* + *Stenoptilia* sp. + *Phycitinae* + *Copaxa lavendera* + *Pseudautomeris irene* + *Agrius convolvuli* + *Cochylidia implicitana* + *Platphalonidia felix* + unmatched), Coleoptera (67 % - *Cybister tripunctatus* + unmatched), Hemiptera (29 % - *Macrorhaphis acuta* + *Nezar viridula* + unmatched), Diptera, Orthoptera (Tettigoniinae), Blattodea (25 % - *Pycnoscelus* sp. + unmatched) and Neuroptera (29 % - unmatched).

POPULATION:
Structure - Verschuren (1957) found females outnumbered males in the roost at a ratio of four to one.
Density - Smithers, 1983) reported *M. midas* roosting in groups of up to several hundred; however, Verschuren, 1957) only recorded groups of 10-20 individuals leaving roosts. In Madagascar, no large colonies have been found and it is thought to be a locally common species with a patchy distribution. The maximum recorded colony was near Amboasary of 600 individuals (Jenkins *et al.*, 2008a; IUCN, 2009).
Trend - 2008 - Decreasing (Jenkins *et al.*, 2008a; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
See Dunlop (1999).

REPRODUCTION AND ONTOGENY:
See Dunlop (1999).

Krutzsch (2000: 127) indicates that this species is polyoestrous.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] suggest that the birth season runs from December to March.

MATING:
See Dunlop (1999).

PARASITES:
Several mites have been recorded for this species, including *Chelanyssus aethiopicus* (Family Macronyssidae) and *Nycteriglyhus tadaridae* (Family Rosensteiniidae) (Anciaux de Faveaux, 1971; 1976a). Bat fleas (Siphonaptera) have also been recorded (Dunlop, 1999). *Lagaropsylla hoogstraali* (Ischnopsyllidae: Ischnopsyllinae) was found amongst a batch of fleas taken from *M. midas* in the Kruger National Park, South Africa in the Pafuri area (Segerman and Braack, 1988).

SIPHONAPTERA
Ischnopsyllidae: *Lagaropsylla hoogstraali* Smit, 1957 from Rwanda (Haeselbarth *et al.*, 1966: 190), and Madagascar (Hastriter, 2016: 17).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in 15 individuals from Limpopo Province, South Africa, none were tested positive (0/15).
One out of two specimens tested by Geldenhuys *et al.* (2013: 517) in Makhado, Limpopo, RSA was found to be positive for CoV.

Paramyxoviridae
Mélade *et al.* (2016b: 4) tested 19 Madagascan specimens of which one was positive for paramyxoviruses.

UTILISATION:
In Madagascar, Goodman *et al.* (2008d) found that these bats were caught, cooked and then fed to domestic pigs.

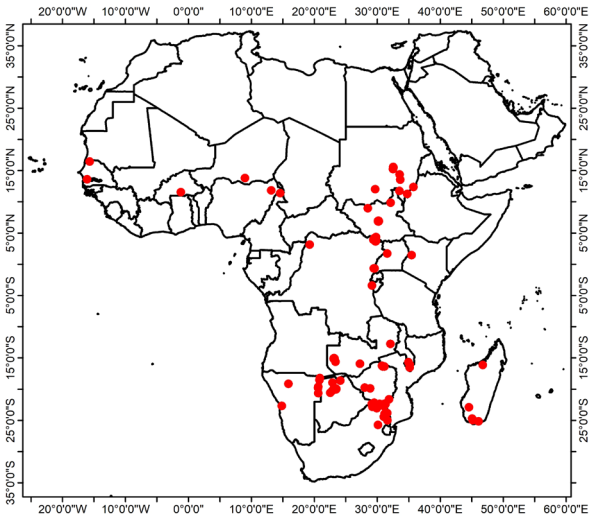


Figure 177. Distribution of *Mops* (*Mops*) *midas*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Botswana, Burkina Faso, Cameroon, Congo (Democratic Republic of the), Ethiopia, Kenya, Madagascar, Malawi, Namibia, Niger, Nigeria, Senegal, South Africa, South Sudan, Sudan, Uganda, Zambia, Zimbabwe.

Mops (Mops) midas miarensis (A. Grandidier, 1869)

*1869. *Nyctinomus Miarensis* A. Grandidier, Rev. Mag. Zool., ser. 2, 21: 337. Publication date: September 1869. Type locality: Madagascar: between Soua-haze and Soua-hané [sic]: Miari [probably Miary near Tuléar] [Goto Description]. Holotype: MNHN 29: ad ♀. Presented/Donated by: ?: Collector Unknown. Holotype: MNHN ZM-MO-1997-1851: ad ♀, alcoholic (skull not removed). Collected by: Alfred Grandidier. See Peterson *et al.* (1995: 174). Number 229 in Rode (1941).
1870. *Nyctinomus unicolor* A. Grandidier, Rev. Mag. Zool., ser. 2, 22: 49. Publication date: February 1870. Type locality: Madagascar: "Madagascar" [Goto Description].
? *Mops (Mops) midas miarensis:* (Name Combination, Current Combination)
? *Mops miarensis:* (Name Combination)
? *Mops midas miarensis:* (Name Combination)

GENERAL DISTRIBUTION:
E, SW, S Madagascar.

Mops (Mops) midas midas (Sundevall, 1843)

*1843. *Dysopes midas*Sundevall, Kongl. Svenska Vet.-Akad. Hand., ser. 3, 30: 207, pl. 2, fig. 7 [for 1842]. Publication date: 1843. Type locality: Sudan: Blue Nile Province: E-bank White Nile: Valid Sohey [= Wad Shala]: restricted by Turni and Kock (2008: 68). [14 34 N 13 48

E]. Syntype: BMNH 1846.6.2.20: ad ♂, skin and skull. Formerly Stockholm Museum (ZSM no. 523), locality: Bahr el Abiad. See Turni and Kock (2008: 68). Syntype: ZMB 535: skin only. Collected by: Hedenborg; collection date: 1831 - 1835. From [Dar] Sennar, Sudan; see Turni and Kock (2008: 68). Syntype: ZSM. Collected by: Hedenborg; collection date: 1846. See Turni and Kock (2008: 68). Syntype: ZSM, skin only. Collected by: Hedenborg; collection date: 1836. See Turni and Kock (2008: 68). - Comments: Horácek *et al.* (2000: 137) mention "Bahr-el-Abiad, White Nile" as type locality. Meester *et al.* (1986: 73): "Bahr-el-Abiad (White Nile), Sudan. Kock (1969a: 154) suggests that the type locality is at Jebel el Funj, between the White and Blue Nile, and Koopman (1975, and in litt.) restricts it to the east (not west, as shown in 1975: 429) bank of the White Nile at 11 45 N 33 30 E, Blue Nile Province, Sudan."). El-Rayah (1980: 264) believes the restriction to Jebel el Funj is incorrect as Sundevall described the type locaility as Bahr el-Abiad which is the area south of Omdurman (15 19 N 32 29 E) and commonly known as Bahar Abiad and restricts the type locality to the vicinity of Jebel Aulia (15 19 N 32 31 'E). For a deeper discussion on the type locality, see Turni and Kock (2008: 68). - Etymology: According to a legend the mythological King Midas of Phrygia offended Apollo, so the god turned Midas' ears into those of a donkey, i.e. in very long ears; which in this species are relatively large (see Lanza *et al.*, 2015: 304).

? *Mops (Mops) midas midas:* (Name Combination, Current Combination)
? *Mops midas midas:* (Name Combination)
? *Tadarida midas midas:* (Name Combination)

GENERAL DISTRIBUTION:
Continental Africa; Arabia.

Mops (Mops) niangarae J.A. Allen, 1917

*1917. *Mops niangaræ* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 468. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Niangara [03 24 N 27 52 E] [Goto Description]. Holotype: AMNH 48901: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 12 December 1910; original number: 1313. - Etymology: Referring to the locality where the type specimen was found.

? *Mops (Mops) niangarae:* (Name Combination, Current Combination)
? *Mops niangarae:* (Current Spelling)
? *Tadarida congica niangarae:* (Name Combination)

TAXONOMY:
Peterson (1972) and Thorn *et al.* (2009: 68) included this species in *trevori*. Hayman and Hill (1971) listed it as a subspecies of *Tadarida congica* (=*Mops congicus*). Freeman (1981b: 111, 159) considered it a distinct species pending collection of additional specimens.

Additional studies are needed into the systematic status of *Mops niangarae*, especially with regards to its relationship to *M. trevori* (see Hayman and Hill, 1971; Peterson, 1972; Freeman, 1981b; Simmons, 2005).

COMMON NAMES:
Czech: morous niangaranský. English: Niangara Mops Bat, Niangaran Mops Bat, Niangara Free-tailed Bat. French: Tadaride du Niangara. German: Niangara-Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing problems with its taxonomy, and lack of recent information on its extent of occurrence, ecological requirements and threats (Mickleburgh *et al.*, 2008bq; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) [assessed as *Tadarida niangarae*] (Mickleburgh *et al.*, 2008bq; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004bj; IUCN, 2004). 2002 - CR B1+2c (Mickleburgh *et al.*, 2002a: 22). 1996 - DD (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are currently unknown (Mickleburgh *et al.*, 2008bq; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bq) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Additional studies are needed into the distribution, natural history and threats to this little-known bat.

GENERAL DISTRIBUTION:
Mops niangarae is known only from the holotype collected from "Niangara, northeastern Belgian Congo" (Democratic Republic of the Congo near the border with Sudan) (Allen *et al.*, 1917; Lang and Chapin, 1917a).

Native: Congo (The Democratic Republic of the) (Allen *et al.*, 1917; Lang and Chapin, 1917a).

POPULATION:
Structure and Density - It is known only from the holotype.
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bq; IUCN, 2009).

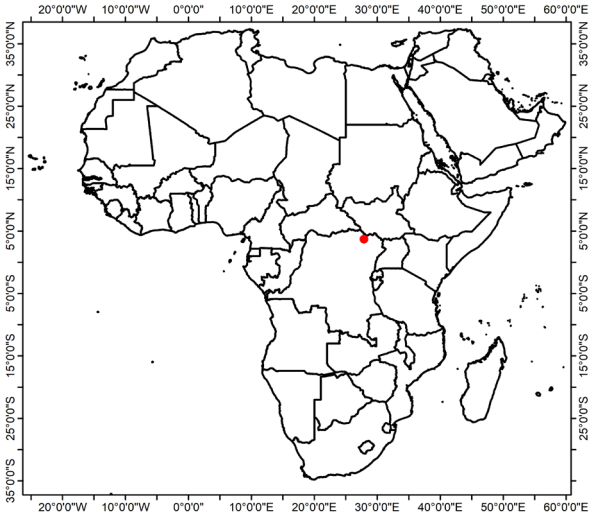


Figure 178. Distribution of *Mops* (*Mops*) *niangarae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the).

Mops (Mops) niveiventer Cabrera and Ruxton, 1926

*1926. *Mops angolensis niveiventer* Cabrera and Ruxton, Ann. Mag. nat. Hist., ser. 9, 17 (103): 594. Publication date: 1 May 1926. Type locality: Congo (Democratic Republic of the): Kasai Occidental province: St. Joseph de Luluabourg [=Kananga] [ca. 05 53 S 22 26 E, 610 m] [Goto Description]. Holotype: BMNH 1926.7.6.109: ♀, skin and skull. Collection date: 16 April 1924; original number: 409.
1937. *Mops chitauensis* J.Eric Hill, Am. Mus. Novit., 916: 2, 3, text-fig. 1. Publication date: 17 April 1937. Type locality: Angola: Malange district: Chitau [11 15 S 17 01 E, 4 930 ft] [Goto Description]. Holotype: AMNH 88116: ad ♂, skin and skull. Collected by: Lee S. Bradley and the Phipps-Bradley Expedition; collection date: 10 February 1933; original number: 676.
1975. *Tadarida nivieventer:* Fenton, Life Sci. Occ. Pap., R. Ont. Mus., 104: 23. (Lapsus)
? *Mops (Mops) niveiventer:* (Name Combination, Current Combination)
? *Mops niveiventer:* (Name Combination)
? *Tadarida (Mops) niveiventer:* (Name Combination)
? *Tadarida niveiventer:* (Name Combination)

TAXONOMY:
Koopman (1993a) suggested that *niveiventer* is possibly a subspecies of *demonstrator*. Here considered a distinct species following Simmons (2005).

COMMON NAMES:
Czech: morous sněhobílý. English: White-bellied Mops Bat, White-bellied Free-tailed Bat. French: Tadaride à ventre blanc. German: Weißbauch-Bulldoggfledermaus. Portuguese: Morcego de cauda livre de ventre branco.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Cotterill, 2008f; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida niveiventer*] (Cotterill, 2008f; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Cotterill, 2004f; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is locally threatened in parts of its range, often through general deforestation and the conversion of suitable habitat by shifting agricultural practices (Cotterill, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Cotterill (2008f) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species. It is not known if the species is present within any protected areas. Further studies are needed into the distribution and systematics of this species.

GENERAL DISTRIBUTION:
Mops niveiventer is present in Central Africa and parts of Southern Africa. It has been recorded from eastern Angola, southern Democratic Republic of the Congo, northern Zambia, Rwanda, northern Mozambique and possibly from Malawi.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 722,774 km^2.

Records from Botswana and Madagascar are definitely *condylurus* (see Hayman and Hill, 1971: 61; Meester *et al.*, 1986: 74; Simmons, 2005).

Native: Angola (Monadjem *et al.*, 2010d: 544); Burundi; Cameroon (Bol A Anong *et al.*, 2011: 48; Bakwo Fils *et al.*, 2014: 4); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 544); Mozambique (Monadjem *et al.*, 2010d: 544); Rwanda; Tanzania; Zambia (Ansell, 1973; Monadjem *et al.*, 2010d: 544).
Presence uncertain: Malawi.

The record from Cameroon is probably doubtful (Jakob Fahr, pers. comm.).

DENTAL FORMULA:
Dorst (1957b: 134) indicated the milk dentition of *Mops angolensis niveiventer* shows some differences with the dentition of *Mops angolensis* he described previously (Dorst, 1949), a fact he attributed to it being a different geographic race. However, the latter form is currently considered to belong to a separate species: *Mops (Mops) condylurus*. The upper milk toothrow of *niveiventer* consists of three functional teeth wich are reduced to pegs, and two additional, vestigial teeth. In the lower toothrow there are three incisors of different shape and a remarkably developed canine. There is also one premolar, which is clearly developed, but not functional as it doesn't erupt through the gum. This tooth is resorbed in the young.

ECHOLOCATION:
From Maroua, Cameroon, Manga Mongombe (2012: 79) and Bakwo Fils *et al.* (2018: 4) reported a FM call type for 10 calls and the following parameters: F_{max}: 37.7 ± 2.9 (32.2 - 40.8) kHz, F_{min}: 34.1 ± 2.6 (29.9 - 37.6) kHz, F_{mean}: 35.9 ± 2.8 (31.1 - 39.3) kHz, F_{knee}: 37.6 ± 2.7 (32.1 - 40.8) kHZ, F_{char}: 34.1 ± 2.6 (30.1 - 37.6) kHz, and duration: 0.74 ± 0.10 (0.65 - 0.95) msec.

DIET:
In fecal pellets from Maroua (Cameroon), Bol A Anong (2013: 32) found Coleoptera (64.75%), Hemiptera (25.00%), Diptera (9.53%) and Lepidoptera (0.23%).

POPULATION:
Structure and Density - This is a locally common species that can be found in large colonies of up to hundreds of individuals within buildings, but is more often present in smaller numbers (Cotterill, 2008f; IUCN, 2009).
Trend - 2008 - Unknown (Cotterill, 2008f; IUCN, 2009).

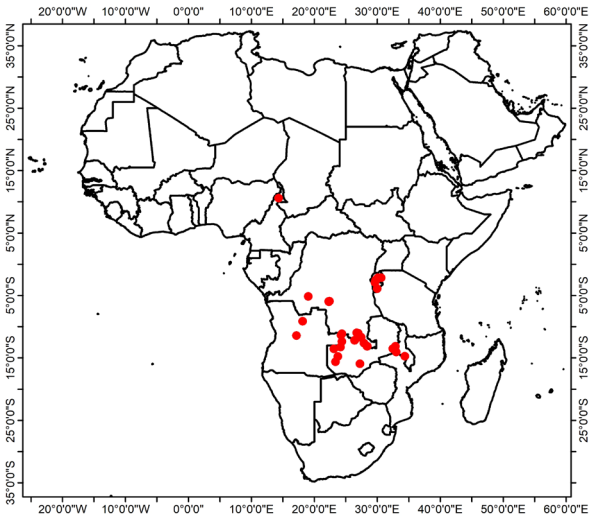


Figure 179. Distribution of *Mops* (*Mops*) *niveiventer*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Burundi, Cameroon, Congo (Democratic Republic of the), Mozambique, Rwanda, Zambia, Zimbabwe.

Mops (Mops) trevori J.A. Allen, 1917

*1917. *Mops trevori* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 469, pl. 48, fig. 2. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Faradje [03 44 N 29 43 E] [Goto Description]. Holotype: AMNH 49250: ad ♀, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 29 September 1912; original number: 1954. - Etymology: In honour of John B. Trevor, a Trustee of the American

Museum of Natural History and Chairman of the Committee on African Exploration, whose enthousiasm and generosity in support of the Congo Expedition contributed to its success (see Allen, 1917: 469).

1996. *Mops trevoli:* Kityo and Kerbis, J. East Afr. Nat. Hist., 85: 63. (Lapsus)

? *Mops (Mops) trevori:* (Name Combination, Current Combination)

? *Tadarida trevori:* (Name Combination)

TAXONOMY:
Formerly included in *niangarae*; see Freeman (1981b: 111, 159).

COMMON NAMES:
Czech: morous Trevorův. English: Trevor's Mops Bat, Trevor's Free-tailed Bat, Trevor´s Bat. French: Tadaride d'Allen, Tadaride de Trevor. German: Trevors Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since, although it has been recorded over a very wide area, there are only very few records, and very little is known about its status, threats and habitat requirements (Mickleburgh *et al.*, 2008bv; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) [assessed as *Tadarida trevori*] (Mickleburgh *et al.*, 2008bv; IUCN, 2009). 2004 - VU A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2004aw; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is generally threatened by habitat loss, resulting from the conversion of land to agricultural use, and the extraction of firewood and timber (Mickleburgh *et al.*, 2008bv; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bv) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, however, it has been recorded from some protected areas. Further studies are needed into the distribution, natural history and threats to this little-known bat.

GENERAL DISTRIBUTION:
Mops trevori has been patchily recorded in parts of West and Central Africa. In West Africa It has been recorded from Guinea, Côte d'Ivoire, Comoe in Ghana, and Agege in Nigeria. In Central Africa it has been recorded from the Central African Republic, parts of eastern Democratic Republic of the Congo and western Uganda.

Native: Central African Republic; Congo (The Democratic Republic of the); Côte d'Ivoire; Ghana; Guinea; Nigeria; Sierra Leone (Weber *et al.*, 2019: 28 - first record); Sudan; Uganda (Kityo and Kerbis, 1996: 63).

POPULATION:
Structure and Density - Little is known about the abundance of this apparently rare species, but it is presumed that colony size is likely to be small (Mickleburgh *et al.*, 2008bv; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bv; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
One of two females reported from Sierra Leone by Weber *et al.* (2019: 28) was pregnant on 25 March.

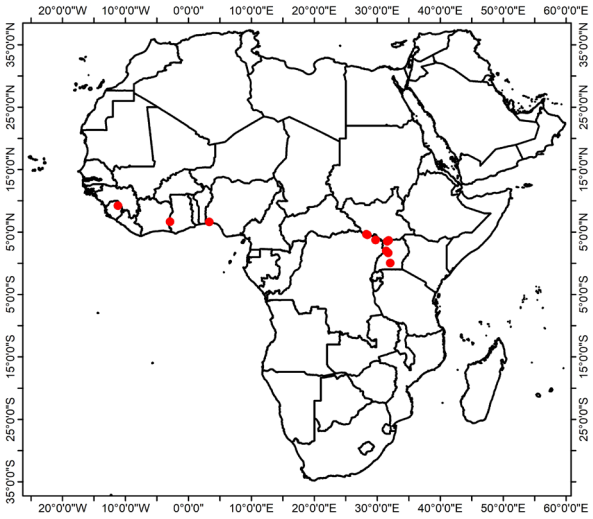


Figure 180. Distribution of *Mops* (*Mops*) *trevori*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Nigeria, Sierra Leone, South Sudan, Uganda.

Subgenus *Mops (Xiphonycteris)* Dollman, 1911

*1911. *Xiphonycteris* Dollman, Ann. Mag. nat. Hist., ser. 8, 7 (38): 210. Publication date: 1 February 1911 [Goto Description]. - Comments: Type species: *Xiphonycteris spurrelli* Dollman, 1911.

? *Mops (Xiphonycteris):* (Name Combination, Current Combination)

? *Tadarida (Xiphonycteris):* (Name Combination)

Mops (Xiphonycteris) bakarii Stanley, 2009

*2008. *Mops bakarii* Stanley, Acta Chiropt., 10(2): 184, Figs 2 -6. Publication date: December 2008. Type locality: Tanzania: Pemba Island, Kipangani Village: in attic of hospital [4.96487 S 39.71456 E, 12m]. Holotype: FMNH 192895: ad ♂, skin and skull. Collected by: William ("Bill") T. Stanley; collection date: 5 August 2006; original number: WTS 7307. Paratype: FMNH 192824: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7312. Paratype: FMNH 192825: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7313. Paratype: FMNH 192826: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7327. Paratype: FMNH 192827: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7328. Paratype: FMNH 192828: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7329. Paratype: FMNH 192829: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7335. Paratype: FMNH 192830: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7336. Paratype: FMNH 192831: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7337. Paratype: FMNH 192832: ad ♀. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7338. Paratype: FMNH 192833: ad ♀. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7339. Paratype: FMNH 192834: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7345. Paratype: FMNH 192835: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7347. Paratype: FMNH 192836: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7348. Paratype: FMNH 192894: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7306. Paratype: FMNH 192896: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7308. Paratype: FMNH 192897: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7322. Paratype: FMNH 192898: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7331. Paratype: FMNH 192899: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7332. Paratype: FMNH 192900: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7333. Paratype: FMNH 192901: ad ♂. Collected by: William ("Bill") T. Stanley; collection date: 5 - 6 August 2006; original number: WTS 7334. - Etymology: In honour of Dr. Bakari Asseid, director of the Department of Commercial Crops, Fruits and Forestry, Zanzibar, to recognize his significant contributions to the conservation of natural habitats and biota of Zanzibar (including both Pemba and Unguja Islands) (see Stanley, 2008: 185).

? *Mops (Xiphonycteris) bakarii:* (Name Combination, Current Combination)

COMMON NAMES:
Czech: morous Stanleyův. German: Bakaris Bulldoggfledermaus, Pemba-Bulldoggfledermaus.

GENERAL DISTRIBUTION:
O'Brien (2011: 288) reports it from Pemba.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Tanzania.

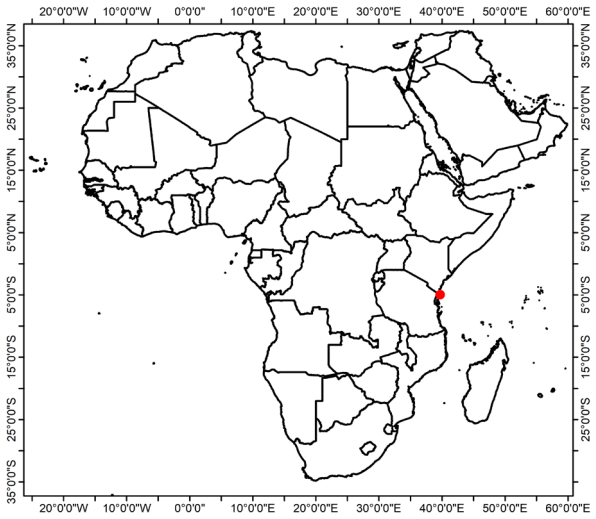


Figure 181. Distribution of *Mops* (*Xiphonycteris*) *bakarii*

Mops (Xiphonycteris) brachypterus (Peters, 1852)

*1852. *Dysopes brachypterus* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 59, pl. 15, fig. 1. Publication date: 1852. Type locality: Mozambique: Mozambique Island [15 03 S 40 46 E] [Goto Description]. Holotype: ZMB 536/85537: ad ♂, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008) [skin: ZMB 536 + skull: ZMB 85537 (=An 16356)]. Neotype: ROM 46721: ad ♂, skin and skull. Collected by: Terence Michael Shortt and A.E. Williams; collection date: 24 June 1968; original number: SG301. Presented/Donated by: ?: Collector Unknown. - Etymology: From the Greek adjective "*βρᾰχύς*" (brakhìs), meaning "short" and the Greek neuter substantive "*πτερόν*" (pteròn), meaning "wing"; but actually the species' wings are not particularly short (see Lanza *et al.*, 2015: 295).

1877. *Nyctinomus [(Nyctinomus)] brachypterus:* Dobson, Proc. zool. Soc. Lond., 1876, IV: 722. Publication date: April 1877. (Name Combination)

1908. *Nyctinomus leonis* Thomas, Ann. Mag. nat. Hist., ser. 8, 2 (10): 373. Publication date: 1 October 1908. Type locality: Sierra Leone: "Sierra Leone" [Goto Description]. Holotype: BMNH 1862.12.23.3: ad ♂, skin and skull. Presented/Donated by: J. Brown Esq. (Specimen "c" of Dobson's catalogue).

1917. *Nyctinomus ochraceus* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 455. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Medje [02 25 N 27 18 E, 800 m] [Goto Description]. Holotype: AMNH 48821: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 16 March 1910; original number: 745.

1980. *Tadarida (Mops) brachyptera:* El-Rayah, Systematics of African molossid bats of the subgenus *Xiphonycteris* of the genus *Tadarida* (Molossidae: Chiroptera) - PhD Thesis - University of Toronto:, 231.

? *Chaerephon leonis ochraeus:*

? *Mops (Xiphonycteris) brachypterus:* (Name Combination, Current Combination)

? *Mops brachypterus leonis:* (Name Combination)

? *Mops brachypterus ochraceus:* (Name Combination)

? *Mops brachypterus:* (Name Combination)

? *Tadarida brachyptera leonis:* (Name Combination)

? *Tadarida brachyptera:* (Name Combination)

? *Tadarida leonis leonis:*

? *Tadarida leonis ochraeus:*

? *Tadaride brachyptera:* (Name Combination)

? *Xiphonycteris leonis:*

TAXONOMY:
Includes *leonis*; see El-Rayah (1981: 6). Stanley (2008: 190) points out that *brachypterus* is in need of revision, since the dental features (e.g. size of upper canines and first upper premolar) differ between for the holotype and continental specimens attributed to it.

Monadjem *et al.* (2016y: 368) and Herkt *et al.* (2017: Appendix S9) found differences in the ecological niches and a clear geographic gap between the distribution areas of *brachypterus* and *leonis* sensu stricto, but as genetic tests evaluating the distinct species status are still lacking, they are still considered to represent the same species.

COMMON NAMES:
Chinese: 短翼犬吻蝠. Czech: morous krátkokřídlý. English: Sierra Leone Mops Bat, Short-winged Mops Bat, Sierra Leone Free-tailed Bat, White-fingered Free-tailed Bat. French: Tadaride de Peters, Tadaride à doigts blancs. German: Kurzflügel-Bulldoggfledermaus, Kurzflügeligen Doggengrämler. Italian: Carlìno brachìttero. Spanish (Castillian): Murciélago Guanero

CONSERVATION STATUS:
Global - Listed as Least Concern in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bo; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida brachyptera*] (Mickleburgh *et al.*, 2008bo; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessed as *Mops brachypterus*] (Mickleburgh *et al.*, 2004bo; IUCN, 2004).

MAJOR THREATS:
The species is threatened in parts of its range by deforestation, presumably mostly through logging and mining activities and the conversion of land to agricultural use (Mickleburgh *et al.*, 2008bo; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bo) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Further studies are needed into the taxonomy, distribution, natural history, and threats to this species.

GENERAL DISTRIBUTION:
Mops brachypterus ranges widely from West Africa to the East African coast. In West Africa, it is distributed from the Gambia and Sierra Leone in the west, through to Nigeria and Cameroon in the east. From Cameroon, it occurs patchily eastwards through the Congo Basin to Uganda, and to coastal parts of Kenya, Tanzania (including the islands of Unguja [=Zanzibar] [where its presence is questioned according to O'Brien (2011: 289)] and Mafia) and Mozambique in the south.

Native: Cameroon; Central African Republic; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 543); Côte d'Ivoire; Equatorial Guinea; Gabon; Ghana; Guinea (Simons *et al.*, 2014: 284); Kenya; Liberia; Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 543); Nigeria; Sierra Leone; Tanzania; Togo.

Presence uncertain: Zanzibar (Stanley, 2008: 191).

Bates *et al.* (2013: 339) reject the presence of this species in the Republic of Congo.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) described the karyotype as having a diploid number of 2*n* = 48, aFN = 54, BA = 8, and a presumably submetacentric X (one female studied).

HABITAT:
Monadjem *et al.* (2016y: 368) captured this bat flying over small forest streams in the Mount Nimba area, at altitudes between 450 and 550 m.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - This is a common species (Mickleburgh *et al.*, 2008bo; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bo; IUCN, 2009).

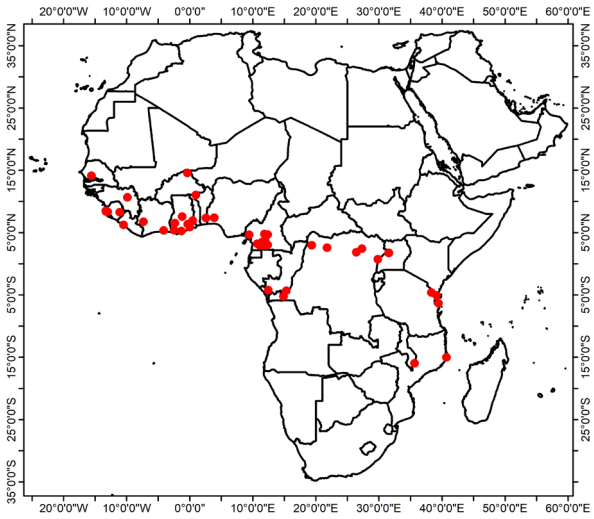


Figure 182. Distribution of *Mops* (*Xiphonycteris*) *brachypterus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Cameroon, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Guinea, Liberia, Malawi, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, Uganda.

Mops (Xiphonycteris) nanulus J.A. Allen, 1917

*1917. *Mops (Allomops) nanulus* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 477. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Niangara [03 24 N 27 52 E] [Goto Description]. Holotype: AMNH 48864: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 12 December 1910; original number: 1318. Topotype: AMNH 48860: ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 48861: ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 48862: ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 48863: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 48865: ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown.

1940. *Mops calabarensis* Hayman, in: Sanderson, Trans. Linn. Soc. Lond., 24 (7) 1: 677. Publication date: January 1940. Type locality: Nigeria: Eastern region, Calabar: Ikotmbo [05 03 N 18 19 E, 50 ft]. Holotype: BMNH 1939.318: ♂, skin and skull. Collected by: Ivan T. Sanderson; collection date: 18 September 1932; original number: 3.

1940. *Mops nannulus:* Sanderson, Trans. Linn. Soc. Lond., 24 (7) 1: 677. Publication date: January 1940. - Comments: Lapsus (see Grubb *et al.* (1998: 96). (Lapsus)

2015. *Mops annulus:* Gunnel, Butler, Greenwood and Simmons, Am. Mus. Novit., 3846: 34. Publication date: 16 December 2015. (Lapsus)

? *Mops (Xiphonycteris) nanulus:* (Name Combination, Current Combination)

? *Mops nanulus:* (Name Combination)

? *Tadarida nanula calabarensis:* (Name Combination)

? *Tadarida nanula:* (Name Combination)

TAXONOMY:
Distinction from *spurrelli* not certain; see Koopman (1989a).

COMMON NAMES:
Chinese: 侏犬吻蝠. Czech: morous trpasličí. English: Dwarf Mops Bat, Dwarf Free-tailed Bat. French: Tadaride naine. German: Zwerg-Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be

declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008w; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida nanula*] (Mickleburgh *et al.*, 2008w; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004o; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
In general, there are no threats to this widespread and somewhat adaptable species. In parts of its range it is locally threatened by habitat loss, primarily deforestation resulting from logging operations and the conversion of land to agricultural use (Mickleburgh *et al.*, 2008w; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008w) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Further studies are needed into the distribution, abundance, natural history, and threats to this species.

GENERAL DISTRIBUTION:
Mops nanulus is widely, but patchily, recorded in West, Central and East Africa. It ranges from Sierra Leone and Guinea in the west, through West Africa to Cameroon, and from here east to southern Sudan, Uganda, and western Kenya with an additional record from western Ethiopia and as far south as the southern portion of the Democratic Republic of the Congo. Start (1969: 222) suggests that the species' range might have been more continuous during the Pleistocene when there was a higher degree of rainfall, resulting in a continuous belt of lowland forest between Congo and Kenya.

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Cameroon; Congo (The Democratic Republic of the) (Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 544); Côte d'Ivoire; Ethiopia; Gambia (Emms and Barnett, 2005: 50; Simmons, 2005); Ghana; Guinea (Fahr *et al.*, 2006a: 73; Decher *et al.*, 2016: 276); Kenya (Start, 1969: 220); Liberia (Fahr, 2007a: 104); Nigeria; Sierra Leone; Sudan; Uganda.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Start (1969: 221) indicates that there appears to be a general cline from pale-winged red forms in the west to dark-winged brown ones in the east, although this is not absolute.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) reported 2*n* = 48, FN = 54, BA = 8, a submetacentric X chromosome and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - This is a common species (Mickleburgh *et al.*, 2008w; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008w; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Start (1969: 221) reports on six female specimens collected in West Pokot (Kenya) between 25 and 29 August 1967, of which five were carrying well developed embryos, whereas the sixth was lactating.

Weber *et al.* (2019: 28) reported one pregnant female from Sierra Leone on 26 March.

Krutzsch (2000: 127) indicates that "*Tadarida (Mops) nanulus*" is polyoestrous.

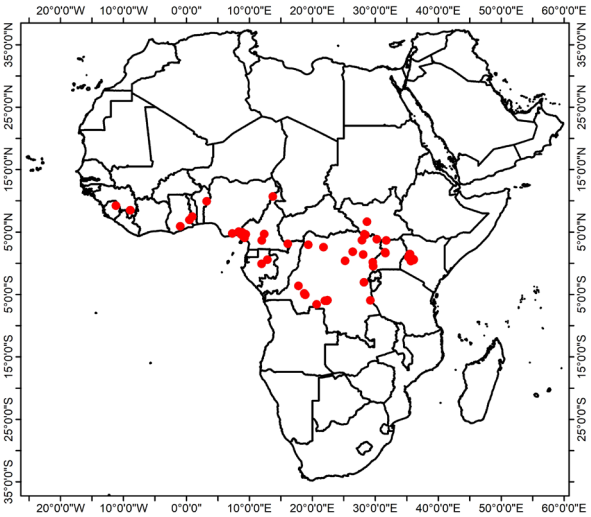


Figure 183. Distribution of *Mops* (*Xiphonycteris*) *nanulus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Gabon, Ghana, Guinea, Kenya, Nigeria, Sierra Leone, South Sudan, Togo, Uganda.

Mops (Xiphonycteris) petersoni (El Rayah, 1981)

*1981. *Tadarida [(Xiphonycteris)] petersoni* El Rayah, Life Sci. Occ. Pap., R. Ont. Mus., 36: 3, figs 1 - 2. Publication date: 11 December 1981. Type locality: Cameroon: Kumba, 15 km S

[04 39 N 09 26 E] [Goto Description]. Holotype: ROM 55813: ad ♂, skull and alcoholic. Collected by: Randolph L. Peterson; collection date: 27 January 1970; original number: 0364. See: 3). Paratype: AMNH 236332: ♂, skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. 6 km SE Eseka(03°35'N 10°44'E) (See El-Rayah, 1981: 3). Paratype: AMNH 236333: ♂, skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. 6 km SE Eseka(03°35'N 10°44'E) (see: El-Rayah, 1981: 3). Paratype: AMNH 241075: ♂, skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Near Okola (04°00'N 11°33'E) (see El-Rayah, 1981: 3). Paratype: AMNH 241076: ♂, skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. 30 km E Nanga Emboko (04°38'N 12°21'E) (see El-Rayah, 1981: 3). Paratype: AMNH 241078: ♀, skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. 30 km E Nanga Emboko (04°38'N 12°21'E) (see El-Rayah, 1981: 3). - Etymology: In honour of Randolph L. Peterson, collector of the type specimen.

? *Mops (Xiphonycteris) petersoni:* (Name Combination, Current Combination)

? *Mops petersoni:* (Name Combination)

? *Tadarida petersoni:* (Name Combination)

TAXONOMY:
Described in *Tadarida (Xiphonycteris)*, but see comments under *Tadarida* and *Mops*.

COMMON NAMES:
Czech: morous kamerunský. English: Peterson's Mops Bat, Peterson's Free-tailed Bat. French: Tadaride de Peterson. German: Petersons Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU A4c ver 3.1 (2001)) because it is suspected that a population decline, estimated to be more than 30% would be met over a ten-year period which is ongoing from the recent past to the near future, inferred from the loss of its primary forest habitat (Mickleburgh *et al.*, 2008bt; IUCN, 2009).

Assessment History -
2008 - VU A4c ver 3.1 (2001) [assessed as *Tadarida petersoni*] (Mickleburgh *et al.*, 2008bt; IUCN, 2009). 2004 - VU A4c ver 3.1 (2001) (Mickleburgh *et al.*, 2004av; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is considered to be threatened by loss and degradation of forest habitats within its known range, largely through the conversion of land to agricultural use and the extraction of firewood and timber (Mickleburgh *et al.*, 2008bt; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bt) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species. It is not known if the species is present within any protected areas. There is a need to maintain areas of suitable forest within the range of this species. Further studies are needed into the distribution, abundance, breeding biology and general ecology of this species.

GENERAL DISTRIBUTION:
Mops petersoni has only been recorded from Ghana and Cameroon (with type locality at '15 km S Kumba'), with no records from the intervening countries of Togo, Benin and Nigeria. Koopman (1993a) included "perhaps Sierra Leone" as part of the distribution, however, J. Fahr (*pers. comm.*, 2004 in Mickleburgh *et al.*, 2008bt; IUCN, 2009) indicates that there is no evidence of the species' presence.

Native: Cameroon; Ghana.
Presence uncertain: Sierra Leone (Koopman, 1993a).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) reported $2n = 48$, FN = 54, BA = 8, a submetacentric X chromosome and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - It is considered to be a very rare species (Mickleburgh *et al.*, 2008bt; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bt; IUCN, 2009).

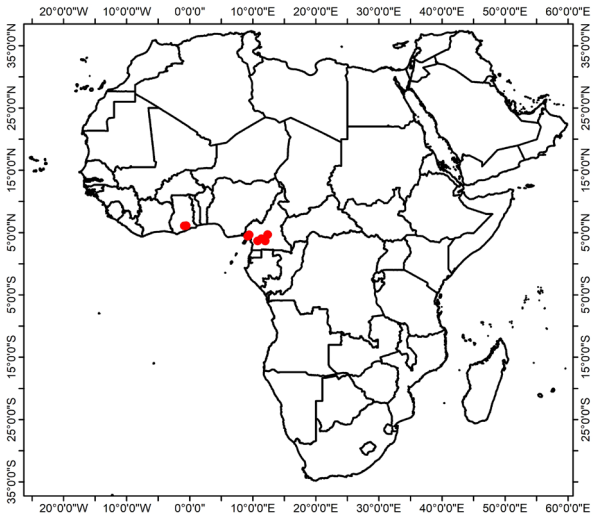


Figure 184. Distribution of *Mops* (*Xiphonycteris*) *petersoni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Cameroon, Ghana.

Mops (Xiphonycteris) spurrelli (Dollman, 1911)

*1911. *Xiphonycteris spurrelli* Dollman, Ann. Mag. nat. Hist., ser. 8, 7 (38): 211. Publication date: 1 February 1911. Type locality: Ghana: Western province: 60 mi (90 km) W Kumasi: Bibianaha [=Bibiani] [06 28 N 02 20 W, 720 ft] [Goto Description]. Holotype: BMNH 1911.1.11.1: ad ♂. Collected by: Dr. H.G.F. Spurrell; collection date: 8 December 1910; original number: 34. - Etymology: In honour of dr. H.G.F. Spurrell, who collected the type specimen, and provided many rare and unique West-African mammals to National Collection (see Dollman, 1911: 211).
1973. *Xiphonycteris spurelli:* Eisentraut, Bonn. zool. Monogr., 3: 47. (Lapsus)
? *Mops (Xiphonycteris) spurelli:* (Lapsus)
? *Mops (Xiphonycteris) spurrelli:* (Name Combination, Current Combination)
? *Mops spurrelli:* (Name Combination)
? *Tadarida spurelli:* (Lapsus)
? *Tadarida spurrelli:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: morous sahelský. English: Spurrell's Mops Bat, Spurrell's Free-tailed Bat. French: Tadaride de Spurell. German: Spurrells Bulldoggfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008dm; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida spurrelli*] (Mickleburgh *et al.*, 2008dm; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cm; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is locally threatened by deforestation, often through conversion of land to agricultural use or by extraction of timber and firewood (Mickleburgh *et al.*, 2008dm; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dm) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species, and it is not known if the species is present within any protected areas. There is a need to maintain areas of suitable forest habitat for this species. Additional studies are needed into the distribution of this species.

GENERAL DISTRIBUTION:
Mops spurrelli ranges through parts of West and Central Africa. It occurs from Sierra Leone in the

west, through Liberia, Guinea, Côte d'Ivoire and Togo, to Cameroon, Equatorial Guinea (Bioko and Rio Muni), the Central African Republic with a record from the eastern part of The Democratic Republic of the Congo. It is possibly present in other countries, such as Benin, Nigeria and Congo, however, this needs to be confirmed.

Native: Cameroon; Central African Republic; Congo (The Democratic Republic of the); Côte d'Ivoire; Equatorial Guinea (Bioko); Ghana; Guinea (Fahr and Ebigbo, 2003: 128); Liberia; Sierra Leone; Togo.

Presence uncertain: Benin; Congo; Nigeria.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Smith *et al.* (1986) reported 2*n* = 48, FN = 64, BA = 18, a submetacentric X chromosome for a female.
Protein / allozyme - Unknown.

HABITAT:
At Mount Nimba, Monadjem *et al.* (2016y: 368) recorded this species over small streams and swamps at altitudes between 450 and 600 m.

POPULATION:
Structure and Density - Within Central Africa this is a very common species and is believed to have quite large colonies (Mickleburgh *et al.*, 2008dm; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008dm; IUCN, 2009).

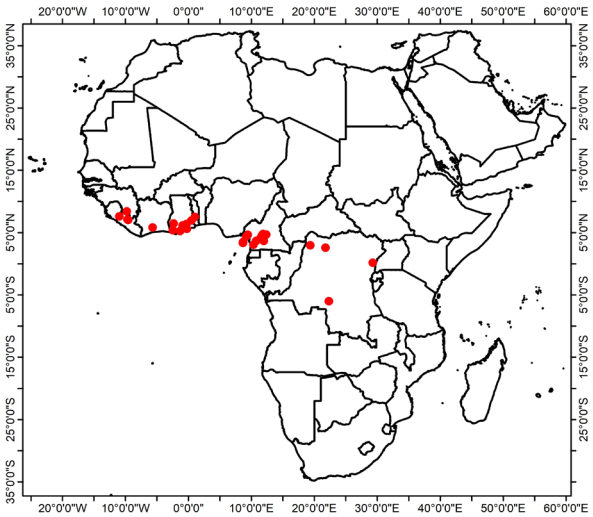


Figure 185. Distribution of *Mops* (*Xiphonycteris*) *spurrelli*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ghana, Liberia, Sierra Leone, Togo.

Mops (Xiphonycteris) thersites (Thomas, 1903)

*1903. *Nyctinomus thersites* Thomas, Ann. Mag. nat. Hist., ser. 7, 12 (72): 634. Publication date: 1 December 1903. Type locality: Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. Holotype: BMNH 1904.2.8.4: ad ♂. Collected by: George Latimer Bates Esq. 3 specimens: see Thomas (1903e: 635). - Etymology: Thersites was one of the members of the Greek army against Troy. He tried to stir up the army against its leaders, for which he got beaten by Odysseus. His name is a scorn: naughty boy. He was an excessive thwaddler, with deformed legs, feet, and bent over shoulders, a pointed head and thin flaky hair.
1917. *Mops (Allomops) occipitalis* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 474, text-fig. 15. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Avakubi [01 18 N 27 32 E] [Goto Description]. Holotype: AMNH 48851: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 13 February 1914; original number: 2487.
1973. *Tatarida theresites:* Eisentraut, Bonn. zool. Monogr., 3: 113. (Lapsus)
? *Mops (Xiphonycteris) thersites:* (Name Combination, Current Combination)
? *Mops (Xyphonycteris) thersites:* (Lapsus)
? *Mops thersites:* (Name Combination)
? *Tadarida (Mops) thersites:* (Name Combination)
? *Tadarida thersites thersites:* (Name Combination)
? *Tadarida thersites:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Chinese: 无畏犬吻蝠. Czech: morous spílavý. English: Railer Mops Bat, Railer Bat. French: Tadaride de Railer. German: Thersites'

Bulldoggfledermaus. Portuguese: Morcego de railer.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Gunnell *et al.* (2015a: 22) report on a number of humeri from a Pleistocene deposit at Olduvai Gorge (Tanzania), which they assigned to *Mops* cf. *M. thersites*.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008dn; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Tadarida thersites*] (Mickleburgh *et al.*, 2008dn; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cl; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
It is locally threatened by habitat destruction, often through conversion of land to agricultural use or timber extraction (Mickleburgh *et al.*, 2008dn; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dn) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species. It is not known if the species is present within any protected areas. Additional studies are needed into the distribution of this species.

GENERAL DISTRIBUTION:
Mops thersites has been recorded from much of Western and Central Africa. It ranges from Sierra Leone in the west, through West Africa (where it has been recorded from most countries) to Cameroon, and from here south into southern parts of the Democratic Republic of the Congo, and east into Uganda, Rwanda and western Kenya. It is present on Bioko Island, Equatorial Guinea.

Native: Cameroon; Central African Republic; Congo (The Democratic Republic of the) (Schouteden, 1944; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 544); Côte d'Ivoire; Equatorial Guinea [Bioko]; Gabon; Ghana; Guinea (Fahr *et al.*, 2006b: 245; Denys *et al.*, 2013: 284); Kenya; Liberia (Fahr, 2007a: 104); Nigeria; Rwanda; Sierra Leone; Uganda.

Presence uncertain: Mozambique and Zanzibar.

Bates *et al.* (2013: 339) reject the presence of this species in the Republic of Congo as Malbrant and Maclatchy (1949) only suggested it might occur in that country and subsequent authors did not provide supporting records.

MOLECULAR BIOLOGY:
Denys *et al.* (2013: 284) report the karyotype for a single female specimen from the Guinean Mount Nimba area attributed to this species as: 2*n* = 48, NFa = 70, including four pairs of metacentric, eight pairs of subtelocentric, 11 pairs of acrocentric autosomes and a middle-sized submetacentric X chromosome.

HABITAT:
This species was captured by Monadjem *et al.* (2016y: 368) in the Mount Nimba area above water in forested and open habitats between 450 and 880 m.

POPULATION:
Structure and Density - It appears to be quite abundant in parts of its range (Mickleburgh *et al.*, 2008dn; IUCN, 2009).
Trend - Stable (Mickleburgh *et al.*, 2008dn; IUCN, 2009).

PARASITES:
Polyctenidae: *Hypoctenes clarus* Jordan, 1922, from near Kribi, Cameroon (Haeselbarth *et al.*, 1966: 18).

SIPHONAPTERA
Ischnopsyllidae: *Lagaropsylla oblique* Smit, 1957 from Sierra Leone, Cameroon and the Congo (Haeselbarth *et al.*, 1966: 191).

VIRUSES:
Filoviridae - File viruses
Marburgvirus
Weiß (2013: 58, 66) found antibodies against MARV in one *M. thersites* from the Taï National Park (Côte d'Ivoire).

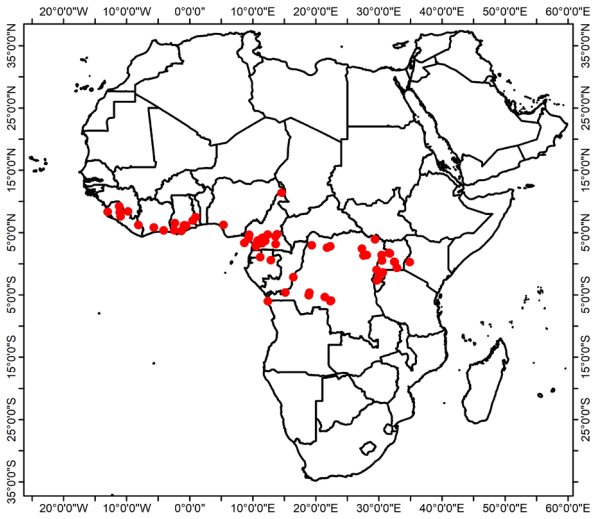


Figure 186. Distribution of *Mops* (*Xiphonycteris*) *thersites*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Cameroon, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Kenya, Liberia, Nigeria, Rwanda, Sierra Leone, Togo, Uganda.

Genus ***Mormopterus*** Peters, 1865

*1865. *Mormopterus* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 258. - Comments: Type species: *Nyctinomus (Mormopterus) jugularis* Peters, 1865. - Etymology: From the Greek "*mormopterus*" meaning phantom- or ghost-winged or winged goblin (Flannery, 1990: 367; 1995a: 408). (Current Combination)

? *Tadarida (Mormopterus):* (Name Combination)

TAXONOMY:

Meester *et al.* (1986) state that this treatment of *Mormopterus* is provisional; it has been regarded as a subgenus of *Tadarida* (Hayman and Hill, 1971) or as a vaild genus that includes *Platymops* and *Sauromys* as subgenera (Freeman, 1981b; Legendre, 1984), and the extralimital *Micronomus* as either a subgenus (Legendre loc. cit.) or a synonym (Freeman, 1981b; Peterson, 1985).

Bronner *et al.* (2003) mention that the status of *Sauromys*, described as a monotypic subgenus of the extralimital (to southern Africa) *Platymops* for the South African flat-headed free-tailed bat, remains unclear. Peterson (1965) raised it to generic rank, a treatment endorsed by many subsequent authors, and corroborated by a limited multivariate analysis of wing bone and cranial characteristics (Peterson, 1985). However, morphometric studies by Freeman (1981b) and Legendre (1984) concluded that it is a subgenus of *Mormopterus*, a position followed by Koopman (1993a, 1994). Simmons (2005) retains *Sauromys* as a valid genus in the 3rd Edition of Mammal Species of the World, a treatment we favour because of the unique ecology and morphology of *S. petrophilus*. The separation between *Mormopterus* and *Sauromys* is also supported by the analysis of the Rag2 data by Ammerman *et al.* (2013: 309).

Meester *et al.* (1986) furthermore state that it was originally described as a subgenus, but this genus was regarded as a synonym of *Platymops* by Shortridge (1942), Roberts (1951) and Ellerman *et al.* (1953). Harrison (1962) retains it as a subgenus, while Peterson (1965) raises it to generic rank, in which he is followed by Hayman and Hill (1971), Smithers (1971), Corbet and Hill (1980) and Rautenbach (1982). However, Freeman (1981b), followed by Koopman (1982) and Legendre (1984), conclude that both *Sauromys* and *Platymops* are subgenera of *Mormopterus*. We take the view that both *Platymops* and *Sauromys* are valid genera.

From their molecular study, Lamb *et al.* (2010: 203; 2011: 10) found that *M. jugularis* and *M. francoismoutoui* form a monophyletic clade (dated about 31.2 MYR), whereas a third member of the genus (the New World *M. kalinowskii*) seems more related to the South American *Nyctinomops laticaudatus* and *Nyctinomops aurispinosus*.

The analysis of the recombination activating gene 2 (Rag2) sequence data led Ammerman *et al.* (2013: 307) to conclude that the genus *Cheiromeles* is the most basal lineage within the Molossinae, and that *Mormopterus* is a sistergroup of the rest of the Molossinae.

Key in Jacobs and Fenton (2002, Mammalian Species, 703).

Known species within the genus *Mormopterus*: ***acetabulous*** (Hermann, 1804); *beccarii* Peters, 1881 – Molucca Isls, New Guinea, adjacent small islands, northern Australia (Simmons, 2005: 444); *doriae* K. Andersen, 1907 – Sumatra (Indonesia) (Simmons, 2005: 445); ***francoismoutoui*** Goodman, Jansen Van Vuuren, Ratrimomanarivo, Probst and Bowie, 2008; ***jugularis*** (Peters, 1865); *kalinowskii* (Thomas, 1893) – Peru, northern Chile (Simmons, 2005: 445); *loriae* Thomas, 1897 – northern Australia; New Guinea (Simmons, 2005: 445); *mimutus* (Miller, 1899) – Cuba (Simmons, 2005: 445); *norfolkensis* (Gray, 1840) – Norfolk Isl, southeastern Queensland, eastern New South Wales (Australia) (Simmons, 2005: 445); *phrudus* (Handley, 1956) – Peru (Simmons, 2005: 4435); *planiceps* (Peters, 1866) – southern and central Australia (Simmons, 2005: 446).

COMMON NAMES:
Czech: Petersovi morousi. English: Phantom-winged Bats, Little Bulldog Bats, Little Mastiff Bats, Little Goblin Bats, Flat-headed Bats, Flat-headed Bulldog Bats, Goblin bats. French: Tadarides. German: Mastino-Fledermäuse.

UTILISATION:
See Goodman *et al.* (2008d).

Mormopterus acetabulosus (Hermann, 1804)

*1804. *V[espertilio] acetabulosus* Hermann, Obs. Zool. , 19. Publication date: 31 August 1804. Type locality: Mauritius: Port Louis [Goto Description]. Holotype: MNHN ZM-MO-1984-368: ad? ♀. Collected by: M. Desjardins; collection date: 1829; original number: A488. Goodman *et al.* (2008c: 1324) incidcate that the specimen is labeled as type, but was collected 25 years after Hermann (1804) described it. Neotype: FMNH 187489: Collected by: Steven M. Goodman and V. Florens; collection date: 29 October 2006. Mauritius, Black River District, Palma, Palma Cave, 20 16'40.5"S 57 27'14.7"E. Goodman *et al.* (2008c: 1327) designated this as the neotype. Cheke (2009b) rejects the assignment of the neotype by Goodman *et al.* (2008c), based on article 73.1.4 and 75.8 (rules of Nomenclature - ICZN 1999). - Comments: Cheke (2009b: 1) rejects the assignment of the neotype, based on article 73.1.4 (rules of Nomenclature - ICZN 1999), which indicates that Paul Jossigny's drawings made of the specimen that Commerson once had before him in Mauritius should be considered the holotype of Hermann's *Vespertilio acetabulosus*, and that the designation of a neotype by Goodman *et al.* (2008c: 1324) is invalidated by article 75.8. The drawings on which Commerson based himself (and which were referred to by Hermann, 1804: 19) are to be found amongst the Commerson papers, in the folder of other similar drawings at MS 282(II), labelled No. 51 (Moutou, 1982, pers. obs. 2006) in the archives of the Bibiothèque du Muséum; the folder is described in paragraph 73 of Laissus's (1974) catalogue.
1820. *Nyctinomus acetabulosus:* Desmarest, Mammalogie, 117. (Name Combination)
1877. *Nyctinomus [(Mormopterus)] acetabulosus:* Dobson, Proc. zool. Soc. Lond., 1876, IV: 734. Publication date: April 1877. (Name Combination)
? *Molossus acetabulosus:* Commerson. - Comments: Dobson (1877: 734) refers for this combination to Peters (1869a: 402), and suggests it is only a manuscript name. (Name Combination)
? *Mormopterus acetabulosus:* (Name Combination, Current Combination)
? *Tadarida acetabulosus natalensis:* (Name Combination)

TAXONOMY:
See Simmons (2005: 444) and Goodman *et al.* (2008c).

Cheke (2009a: 115) indicates that Jossigny's drawing used by Hermann to describe the species in 1804 is to be considered as the lectotype of the species, which would overrule the need for a neotype as designated by Goodman *et al.* (2008c: 1324).

COMMON NAMES:
Afrikaans: Natalse losstertvlermuis. Czech: morous mauricijský. English: Natal Flat-headed Bat, Natal Wrinkle-lipped Bat, Natal Free-tailed Bat. French: Sauromys du Natal, Tadaride à lèvres ridées, Petit molosse de Port Louis. German: Mauritius Mastino-Fledermaus, Maurizische Doggengrämler.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU D2 ver 3.1 (2001)) because it is known from fewer than five locations, and it is plausible that it will decline as a result of disturbance to its cave roosting sites (Hutson and Bergmans, 2008; IUCN, 2009).

Assessment History -
2008 - VU D2 ver 3.1 (2001) (Hutson and Bergmans, 2008; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Hutson and Bergmans, 2004; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

Regional -
South Africa: 2004 -considered a vagrant not assessed, known from single locality (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
It is threatened by disturbance of roosting caves, and the removal of protective grills over the caves for landfill purposes Hutson and Bergmans, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Hutson and Bergmans (2008) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. There is a need to protect cave roosts of this species in Mauritius by re-grilling important sites.

GENERAL DISTRIBUTION:
Mormopterus acetabulosus is endemic to the Mascarene Islands (Mauritius) (see Goodman *et al.*, 2008c: 1316; O'Brien, 2011: 288). Records from Réunion should be assigned to *Mormopterus francoismoutoui*).

There is a single doubtful record for Madagascar (Peterson *et al.*, 1995: 150). Taylor (1998: 60) mentioned a specimen from South Africa (Durban) collected by Andrew Smith in 1833, but also states that no further specimens have been collected since. An old record from between the district of Shoa and Lake Rudolph in southern Ethiopia (Hayman and Hill, 1971: 59), most probably should be attributed to *M. francoismoutoui* (Goodman *et al.*, 2008c: 1325). Furthermore, it is now considered most likely that specimens taken outside of the Mascarene Islands were vagrants.

Monadjem *et al.* (2010d) did not retain this species for south Central Africa, but did mention the specimen from Durban, South Africa in the appendix (p. 545).

Native: Mauritius (Smith, 1833: 54; Meester *et al.*, 1986: 67; Simmons, 2005: 444; Goodman *et al.*, 2008c: 1316).

Presence uncertain: Madagascar (Dobson, 1878; Allen, 1939a; Hayman and Hill, 1971; Meester *et al.*, 1986: 67; Peterson *et al.*, 1995: 150; Simmons, 2005: 444); South Africa (Meester *et al.*, 1986: 67; Taylor, 1998: 60; Taylor, 2000: 75; Simmons, 2005: 444; Monadjem *et al.*, 2010d: 545); Sudan (Freeman, 1981b: 75).

Presence incorrectly assigned: Ethiopia (Hayman and Hill, 1971: 59; Simmons, 2005: 444; Kaipf *et al.*, 2015: 13); Réunion.

ROOST:
Middleton (1998: 91) mention large colonies occurring in two caves in the Plaine des Roches area (Mauritius), and indicate that elsewhere the colonies seldom reach 2,000 animals.

POPULATION:
Structure and Density - The largest known day roost colony on La Réunion (at Trois Bassins), with estimates from 25,000 to 10,000 individuals, is abandoned in austral winter, and it is not known where these bats spend the winter (Devaux, 2006; Issartel, 2004; Probst, 2003; Goodman *et al.*, 2008c: 1325).
Trend - 2008 - Unknown (Hutson and Bergmans, 2008; IUCN, 2009).

PARASITES:
Dietrich *et al.* (2018a: 3) reported the presence of sequences closely related to the bacterium *Leptospira borgpetersenii*.

Laudisoit *et al.* (2012: 739) indicate that the type host for *Araeopsylla martialis* (Rothschild, 1903) (Siphonaptera; Ischnopsyllidae) was originally mentioned as "*Nyctinomus acetabulosus*", but this should actually be *Mormopterus francoismoutoui*.

VIRUSES:
Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 55 individuals from the Mauritius using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 1 positive results for viral nucleic acids.

Rhabdoviridae
Of 31 specimens tested against *Lagos bat lyssavirus* and *Duvenhage lyssavirus* by Mélade *et al.* (2016a: 6), respectively five and six showed a seroreaction. This was also the case for one out of eight bats tested for *European bat lyssavirus 1*.

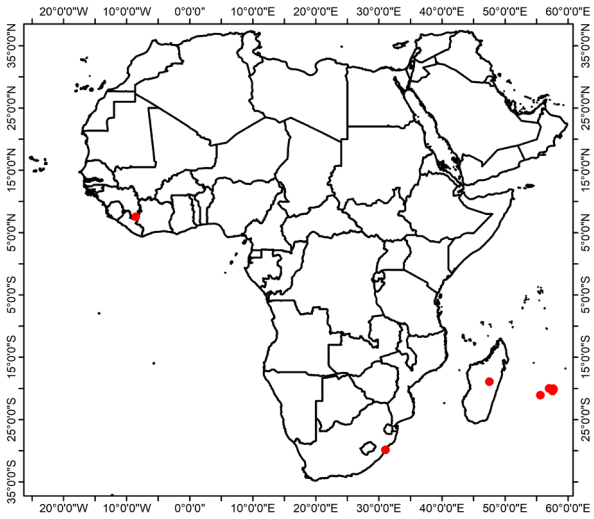


Figure 187. Distribution of *Mormopterus acetabulosus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Ethiopia, Liberia, Madagascar, Mauritius, South Africa.

Mormopterus acetabulosus acetabulosus (Hermann, 1804)

*1804. *V[espertilio] acetabulosus* Hermann, Obs. Zool. , 19. Publication date: 31 August 1804. Type locality: Mauritius: Port Louis [Goto Description]. Holotype: MNHN ZM-MO-1984-368: ad? ♀. Collected by: M. Desjardins; collection date: 1829; original number: A488. Goodman *et al.* (2008c: 1324) incidcate that the specimen is labeled as type, but was collected 25 years after Hermann (1804) described it. Neotype: FMNH 187489: Collected by: Steven M. Goodman and V. Florens; collection date: 29 October 2006. Mauritius, Black River District, Palma, Palma Cave, 20 16'40.5"S 57 27'14.7"E. Goodman *et al.* (2008c: 1327) designated this as the neotype. Cheke (2009b) rejects the assignment of the neotype by Goodman *et al.* (2008c), based on article 73.1.4 and 75.8 (rules of Nomenclature - ICZN 1999). - Comments: Cheke (2009b: 1) rejects the assignment of the neotype, based on article 73.1.4 (rules of Nomenclature - ICZN 1999), which indicates that Paul Jossigny's drawings made of the specimen that Commerson once had before him in Mauritius should be considered the holotype of Hermann's *Vespertilio acetabulosus*, and that the designation of a neotype by Goodman *et al.* (2008c: 1324) is invalidated by article 75.8. The drawings on which Commerson based himself (and which were referred to by Hermann, 1804: 19) are to be found amongst the Commerson papers, in the folder of other similar drawings at MS 282(II), labelled No. 51 (Moutou, 1982, pers. obs. 2006) in the archives of the Bibiothèque du Muséum; the folder is described in paragraph 73 of Laissus's (1974) catalogue.

1823-1824. *Nyctinomus mauritianus* Horsfield, Zoological Research in Java, Part 5, 9th page of text in account of *N. tenuis*. Publication date: 1823 - 1824. Type locality: Mauritius: Port Louis.

? *Mormopterus acetabulosus acetabulosus:* (Name Combination, Current Combination)

ROOST:
On Mauritius, these bats use caves as typical roosting sites (see Wilkinson *et al.*, 2012: 160).

VIRUSES:
Wilkinson *et al.* (2012: 160) found one specimen out of 55 examined on Mauritius, that tested positive for Respirovirus / Morbillivirus / Henipahvirus (RMH) and Paramyxovirinae (PMV)

Mormopterus acetabulosus natalensis (A. Smith, 1847)

1833. *Nyctinomus dubius* A. Smith, S. Afr. Quart. J., ser. 2, 1 (2): 54. Publication date: November 1833. Type locality: South Africa: Cape Province and Natal, between [Goto Description].

*1847. *Dysopes natalensis* A. Smith, Illustrated Zoology of South African Mammals, pl. 49 and text. Publication date: December 1847. Type locality: South Africa: KwaZulu-Natal: Port Natal [=Durban], near [ca. 29 52 S 31 00 E]. - Comments: Dobson (1877: 734) mentions that the original name used by Smith (1847: pl. 49) was *Nyctinomus natalensis*, but this could not be checked yet. If this isn't the case, then this combination should probably be attributed to Dobson (1877). - Etymology: The name reflects the two specimens collected in KwaZulu-Natal.

? *Mormopterus acetabulosus natalensis:* (Name Combination, Current Combination)

TAXONOMY:
Allen (1939a) tentatively treats *dubius* as a species of *Nyctinomus* (= *Tadarida*), remarking that its status is uncertain; Roberts (1951), without giving reasons, regards it as a prior name for *natalensis*. Ellerman *et al.* (1953) are doubtful whether or not the two names are synonymous, and although they list *dubius* in the synonymy of *natalensis* they suggest that it may be necessary to discard the name as not being certainly identifiable. Hayman and Hill (1971: 65) list *dubius* as *incertae sedis*.

Mormopterus francoismoutoui Goodman, Jansen Van Vuuren, Ratrimomanarivo, Probst, Bowie, 2008

*2008. *Mormopterus francoismoutoui* Goodman, Jansen Van Vuuren, Ratrimomanarivo, Probst and Bowie, J. Mamm., 89 (5): 1318, figs. 2 - 6. Type locality: Réunion: Commune de La Possession: Pont de Balthazar [2056.732S 5519.848E, 40m] [Goto Description]. Holotype: FMNH 193986: ad ♂, skull and alcoholic. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006; original number: SMG 15310. Paratype: FMNH 193982: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193983: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193984: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193985: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193987: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193988: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193989: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193990: ♀, alcoholic (skull not removed). Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193991: ♀, alcoholic (skull not removed). Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 25 September 2006. Paratype: FMNH 193992: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 193993: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 193994: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 193995: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 193996: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 193997: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 193998: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 193999: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194000: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194001: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194002: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194003: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194004: ♀, skull only. Collected by: Steven M. Goodman and Jean-

Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194005: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194006: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194007: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194008: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194009: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194010: ♂, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194011: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194012: ♀, skull only. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194013: complete skeleton. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194014: complete skeleton. Collected by: Steven M. Goodman and Jean-Michel Probst; collection date: 26 September 2006. Paratype: FMNH 194015: ♂, complete skeleton. Collected by: Steven M. Goodman. Paratype: FMNH 194016: ♀, complete skeleton. Collected by: Steven M. Goodman. Paratype: FMNH 74208: ♂, alcoholic (skull not removed). Collected by: G. Morel. Paratype: FMNH 74209: ♀, alcoholic (skull not removed). Collected by: G. Morel. Paratype: MNHN ZM-MO-1862-362: Collected by: M. Millard. Paratype: MNHN ZM-MO-1865-24: Collected by: M. Lantz. Paratype: MNHN ZM-MO-1865-25: Collected by: M. Lantz. Paratype: MNHN ZM-MO-1865-26: Collected by: M. Lantz. Paratype: MNHN ZM-MO-1981-301: Collected by: Dr. Véto and F. Moutou; collection date: 23 March 1979. Paratype: MNHN ZM-MO-1981-302: Collected by: Dr. Véto and F. Moutou; collection date: 1 August 1980. Paratype: MNHN ZM-MO-1981-303: Collected by: Dr. Véto and F. Moutou; collection date: 1 August 1980. Paratype: MNHN ZM-MO-1981-304: Collected by: Dr. Véto and F. Moutou; collection date: 1 August 1980. Paratype: MNHN ZM-MO-1981-305: Collected by: Dr. Véto and F. Moutou; collection date: 1 August 1980. Paratype: MNHN ZM-MO-1981-306: Collected by: Dr. Véto and F. Moutou; collection date: 1 August 1980. Paratype: MNHN ZM-MO-1981-307: Collected by: Dr. Véto and F. Moutou; collection date: 1 August 1980. Paratype: UMMZ 115813: Collected by: Frank B. Gill; collection date: 2 June 1967. Paratype: UMMZ 115814: Collected by: Frank B. Gill; collection date: 2 June 1967. Paratype: UMMZ 115815: Collected by: Frank B. Gill; collection date: 2 June 1967. Paratype: UMMZ 115816: Collected by: Frank B. Gill; collection date: 2 June 1967. Paratype: UMMZ 115817: Collected by: Frank B. Gill; collection date: 2 June 1967. Paratype: UMMZ 115818: Collected by: Frank B. Gill; collection date: 2 June 1967. Paratype: UMMZ 115819: Collected by: Frank B. Gill; collection date: 2 June 1967. - Etymology: The name *francoismoutoui* is a patronym in honour of Dr. François Moutou of the Unité d'Epidémiologie, Agence Française de Sécurité Sanitaire des Aliments, Maison Alfort, France. Dr. Moutou has made important contributions to the vertebrate fauna of the Mascarene Islands, particularly La Réunion (Goodman *et al.*, 2008c: 1319). (Current Combination)

TAXONOMY:
Formerly identified as *M. acetabulosus* see Goodman *et al.* (2008c: 1316).

COMMON NAMES:
Czech: morous réunionský. English: Reunion Free-tailed bat. French: Petit molosse, Tadaride de La Réunion. German: Reunion Mastino-Fledermaus.

CONSERVATION STATUS:
Global - Goodman *et al.* (2008c: 1325) state it is under no serious threat of population decline in the near future. Augros *et al.* (2016: 372) refer to IUCN (2010) and mention "LC" as status.

CONSERVATION ACTIONS:
On the basis of territorial legislation, all bats on La Réunion are protected by law (Arrêté of 17 April 1981 and of 17 February 1989) (Goodman *et al.*, 2008c: 1325).

GENERAL DISTRIBUTION:
Mormopterus francoismoutoui has been recorded from a variety of localities on La Réunion from sea level to about 2,000 m (Moutou, 1982; Goodman *et al.*, 2008c).

Native: Réunion (Goodman *et al.*, 2008c: 1316).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Mormopterus francoismoutoui is a relatively large member of the genus *Mormopterus*. Its dorsal body fur is short and dense with a rich dark brown color and its ventrum is slightly paler. Wing membrane and uropatagium are brownish black and show no noticeble change in pigmentation across their surface area. In adult males, there is a large glandular sac on the ventral portion of the lower neck; this gland is absent in females (Goodman *et al.* (2008c).

An albino specimen was reported by Ramasindrazana *et al.* (2014: 103) and Lucati and López-Baucells (2016: Suppl.).

DENTAL FORMULA:
I $^{1}/_{3}$, C $^{1}/_{1}$, P $^{1}/_{2}$, M $^{3}/_{3}$ = 30

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Goodman *et al.* (2008c): The skull of *M. francoismoutoui*, as with most other members of this genus, is not noticebly flattened and has a long rostrum and well-developed lachrymal tubercles. The postorbital processes are well developed and distinctly shaped. The palatal emargination is well developed, similar to character state 4 for variable C65 of Freeman (1981b). Basisphenoid pits are present, but are not prominent, and there is a pronounced extension of the palatal spine descending onto the palatine bone.

ECHOLOCATION:
Barataud and Giosa (2013: 150) analyzed 63 sequences from *M. francoismoutoui* specimens on Réunion and found QFC = 77 kHz and FM = 176 kHz

HABITS:
The holotype and associated specimens roosting in the expansion joint of a bridge were observed to roost in a vertical position (head down) in very narrow crevices (Goodman *et al.*, 2008c: 1319).

ROOST:
Found in a variety of different roost sites, ranging from natural caves to synanthropic situations (Goodman *et al.*, 2008c). The holotype and associated specimens were extracted by hand from the expansion fissures in the lower portion of a concrete bridge (Goodman *et al.*, 2008c). Moutou (1982) found the species to roost in the crevices found in the rock faces around the island. It is also associated with a variety of human structures, including open roofs, roof slats, and window shutters (Goodman *et al.*, 2008c).

Augros *et al.* (2016: 374) provide an overview of 112 roosts, of which 74 (66 %) were artificial.

MIGRATION:
The bats abandon Trois Bassins (with estimates of 10,000 to 25,000 individuals) during the austral winter, and it is not known where these bats spend the winter (Probst, 2003; Issartel, 2004; Devaux, 2006; Goodman *et al.*, 2008c).

POPULATION:
Structure and Density - The largest known day roost colony on La Réunion (at Trois Bassins), with estimates from 10,000 to 25,000 individuals, is abandoned in austral winter, and it is not known where these bats spend the winter (Devaux, 2006; Issartel, 2004; Probst, 2003; Goodman *et al.*, 2008c: 1325) [as *M. acetabulosus*].

Trend - 2008 - Unknown (Hutson and Bergmans, 2008; IUCN, 2009).

PARASITES:
Laudisoit *et al.* (2012: 739) indicate that *M. francoismoutoui* is actually the type host for *Araeopsylla martialis* (Rothschild, 1903) (Syphonaptera; Ischnopsyllidae) and not "*Nyctinomus acetabulosus*".

Dietrich *et al.* (2015b: 4280) found similar infection dynamics for *Leptospira* bacteria and paramyxoviruses, which showed peak infections during late pregnancy and two months after the initial birth period. Both pathogens, however, did not seem to interact with one another.

Guernier *et al.* (2016: 1) found *M. francoismoutoui* on Réunion to be infected by *Leptospira borgpetersenii* bacteria, which also infect humans. However, these bacteria had different haplotypes, indicating that the bats do not have any role in human infections. Dietrich *et al.* (2018a: 2) mention the bacterium to be closely related to *L. borgpetersenii*.

VIRUSES:
Rhabdoviridae
A large amount of bats from La Réunion were tested for lyssaviruses by Mélade *et al.* (2016a: 6), which resulted in the following numbers: *Lagos bat lyssavirus*: 3 seroreactions for 121 bats; *Duvenhage lyssavirus*: 14/117, and *European bat lyssavirus 1*: 9/82.

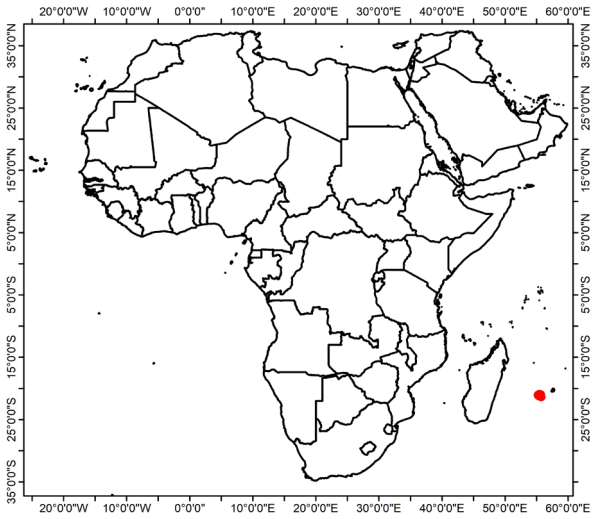


Figure 188. Distribution of *Mormopterus francoismoutoui*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Réunion.

Mormopterus jugularis (Peters, 1865)

*1865. *Nyctinomus (Mormopterus) jugularis* Peters, in: Sclater, Proc. zool. Soc. Lond., 1865, II: 468. Publication date: October 1865. Type locality: Madagascar: Antananarivo (formerly Tananarive) [18 55 S 47 31 E]. Holotype: ZMB 2977: ad ♂, skull and alcoholic. Collected by: H.R. Caldwell. Presented/Donated by: William Lutley Sclater. See Turni and Kock (2008: 70).

1877. *Nyctinomus [(Mormopterus)] albiventer* Dobson, Proc. zool. Soc. Lond., 1876, IV: 733. Publication date: April 1877. Type locality: Madagascar: "Madagascar" [Goto Description]. Holotype: BMNH 1863.12.26.1: ♀. Presented/Donated by: ?: Collector Unknown. - Comments: Type: BMNH ???, ad ♀, alcoholic, purchased.

? *Mormopterus albiventer:*

? *Mormopterus jugularis:* (Name Combination, Current Combination)

TAXONOMY:
See Simmons (2005: 445).

COMMON NAMES:
Czech: morous Petersův. English: Peters's Goblin bat, Peters's Wrinkle-lipped Bat, Peters' Wrinkle-lipped Bat. French: Sauromys à jugulaire, Sauromys de Peters, Tadaride de Madagascar. German: Madagaskar Mastino-Fledermaus. Japanese: Pita-ohiki-koumori.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Muldoon *et al.* (2009: 1114) report on subfossil remains from the Ankilitelo fauna (late Holocene, appr. 500 years ago).
Gunnell *et al.* (2014: 3) refer to fossil material from Tsimanampetsotsa (one tooth and a few pieces of a forelimb according to Sabatier and Legendre (1985: 23)), Ankilitelo, and Andrahomana on Madagascar.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its widespread distribution across Madagascar and because it is not thought to be facing any major threats across its range (Andriafidison *et al.*, 2008g; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Andriafidison *et al.*, 2008g; IUCN, 2009). 1996 - VU A2c ver 2.3 (1994) (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is not threatened by loss of native forests because it forages in open areas associated with agriculture. It is locally persecuted when roosting in buildings although this is not yet a major threat. Some colonies are subject to hunting and although this is though to have resulted in abandonment in at least two cases (Goodman *et al.*, 2008d), harvest levels do not appear a major threat (Andriafidison *et al.*, 2008g; IUCN, 2009).

Fernández-Llamazares *et al.* (2018: 273) indicate that *M. jugularis* is often hunted in sacred caves in and around the Tsimanampetsotsa National Park,

although in the park, it is generally restricted to periods of famine, e.g. in 2007, when the bats fed 200 people for two months.

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008g) [in IUCN (2009)] report that as this species is more commonly found roosting in buildings than natural settings it is not found in many of the protected areas in Madagascar (Goodman *et al.*, 2005a). However, there is no need for any conservation measures at present as this species appears to be widely distributed and is locally abundant.

GENERAL DISTRIBUTION:
Mormopterus jugularis is endemic to Madagascar (Peterson *et al.*, 1995) and very widespread across the island with a known distribution extending from the coast up to the high plateau at 1,400 m in Anjozorobe (J. Ranivo *pers. comm.,* in Andriafidison *et al.*, 2008g) in IUCN, 2009).

Native: Madagascar (Peterson *et al.*, 1995; Simmons, 2005: 445)

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 62) describe the baculum of this species as proportionately broad at the proximal, rounded base and tapering to a rounded distal tip. In lateral view, the structure has a slight curve to the main shaft; length: 0.69 ± 0.015 (0.68 - 0.71) mm, width: 0.24 ± 0.016 (0.22 - 0.26) mm.

MOLECULAR BIOLOGY:
DNA - Unknown
Karyotype - Richards *et al.* (2010) reported one male with a 2*n*=48 and a Fna=54. They found one large metacentric, three medium-sized metacentric and 19 acrocentric autosomal pairs. The X chromosome is submetacentric and the Y chromosome is metacentric. FISH using *Myotis* probes was also applied.

HABITAT:
Dammhahn and Goodman (2013: 108) indicate that this species' foraging habitat consists of open areas and the area above the forest canopy.

ROOST:
Synantropic structures are the typical roosting sites for this species on Madagascar (see Wilkinson *et al.*, 2012: 160).

MIGRATION:
Reher *et al.* (2019: 121) found that *M. jugularis* was only present in a southwestern Madagascan cave during the rainy season, whereas other species such as *Triaenops menamena* and *Miniopterus mahafaliensis* were present in both the dry and wet season.

DIET:
Kemp *et al.* (2018: Suppl.) used DNA metacarcoding to detect insect pest species in the diet of these bats and found the following prey orders (in descending order): Coleoptera (*Xyleborus ferrugineus* (Fabricius, 1801)), Ephemeroptera, Diptera (*Simulium lineatum* (Meigen, 1804), *Culex annulioris* Theobald, 1901, *Culex* MBI-27, *Anopheles squamosus* Theobald, 1901), Lepidoptera (*Meyrickiella homosema* (Meyrick, 1887), *Herpetogramma licarsisalis* (Walker, 1859)), Blattodea, Dermaptera, Hemiptera, Neuroptera, Orthoptera, Sarcoptiformes, Astigmata, Hymenoptera

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of three individuals in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

POPULATION:
Structure and Density - There are no quantitative data available on populations of this species; however, it is assumed to have a high population size because it is widespread and roosts in large colonies in buildings (Andriafidison *et al.*, 2008g; IUCN, 2009).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008g; IUCN, 2009).

PARASITES:
Lagadec *et al.* (2012: 1696) and Gomard *et al.* (2016: 5) report the presence of *Leptospira* sp bacteria in this species, which, according to Dietrich *et al.* (2018a: 3), were having sequences closely related to *L. borgpetersernii*

Laudisoit *et al.* (2012: 739) refer to Lumaret (1962), who reported the present of *Araeopsylla martialis* (Rothschild, 1903) (Siphonaptera; Ischnopsyllidae) on "*Tadarida albiventer*" [= *M. jugularis*]. This flea was also reported by Hastriter (2016: 15).

Durette-Desset and Chabaud (1975: 10) described the Nematode *Molinostrongylus richardae* from a "*Mormopterus albiventer*" from Anjiro, Madagascar.

VIRUSES:
Flaviviridae
Flavivirus
Reynes *et al.* (2011: 3) reported the isolation of Dakar bat virus from *M. jugularis*.

Paramyxoviridae

Wilkinson *et al.* (2012: 160) tested 13 individuals from the Mauritius using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids. Wilkinson *et al.* (2014) tested 19 individuals in Madagascar with an RT-PCR specific for the Respiro-, Morbilli- and Henipavirus genera, two of the 19 individuals tested positive for paramyxovirus RNA.
12 out of 152 Madagascan specimens tested by Mélade *et al.* (2016b: 4) were positive for paramyxoviruses.

Rhabdoviridae
58 specimens were tested by Mélade *et al.* (2016a: 6), which laid to three seroreactive results for *Lagos bat lyssavirus* and 17 for *Duvenhage lyssavirus*.

UTILISATION:
See Goodman *et al.* (2008d).

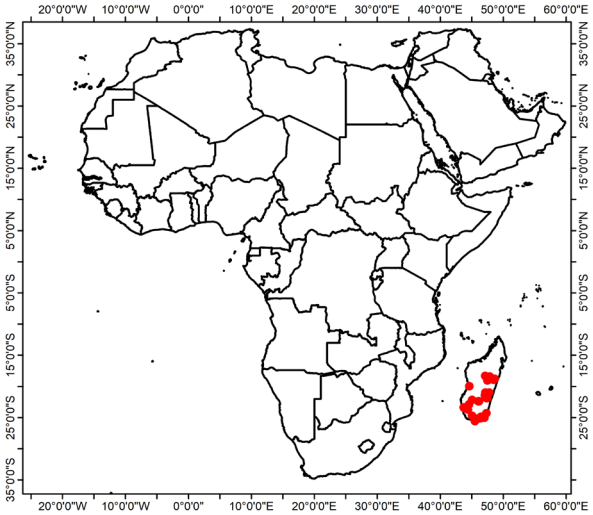


Figure 189. Distribution of *Mormopterus jugularis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar.

Genus ***Myopterus*** E. Geoffroy St.-Hilaire, 1818

*1818. *Myopterus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 113. Publication date: 1818 [Goto Description]. - Comments: Type species: *Myopterus senegalensis* Oken, 1816 (not available) (=*Myopteris daubentonii* Desmarest, 1820). - Etymology: From the Greek "*μύξ*" or é*μυόξ*", meaning mouse and "*πτέρυξ*", meaning wing (see Palmer, 1904: 440). (Current Combination)
1820. *Myopteris* Desmarest, Encyclopédie Méthodique, (Zoologie, Mammalogie), 1: 131. Publication date: 1820. - Comments: Type: *Myopteris daubentonii* Desmarest, 1820.
1837. *Myoptera* de Blainville, C. R. séances Acad. Sci., Paris, 5: 815. Publication date: 1837.
1905. *Eomops* Thomas, Ann. Mag. nat. Hist., ser. 7, 16 (95): 572. Publication date: 1 November 1905 [Goto Description]. - Comments: Type species: *Mormopterus whitleyi* Scharff, 1900.

TAXONOMY:
Includes *Eomops*; see Hayman and Hill (1971: 56). Grubb *et al.* (1998: 97) indicate that *Myopterus* Oken, 1816, Lehrbuch Naturgesch. Pt 3, Zool. Sect. 2: 952, type species *Myopterus senegalensis* Oken (=*Myopteris daubentonii* Desmarest, 1820), is not available according to Opinion 417 of the ICZN.

Grubb *et al.* (1998: 97) indicate that Mahoney and Walton (1988a: 116) considered the date of Geoffroy's publication to be 1813. Gardner and Hayssen (2004: 12) mention that the correct date should be 1818, not 1813 as mentioned on the publication itself.

Known species within the genus *Myopterus*: ***daubentonii*** Desmarest, 1820; ***whitleyi*** (Scharff, 1900).

COMMON NAMES:
Czech: krysoví morousi, spaky. English: Winged-mouse Bats, African Free-tailed Bats, Winged-rat Free-tailed Bats. French: Myoptères. German: Pergamentflügel-Fledermäuse.

Myopterus daubentonii Desmarest, 1820

1816. *Myopterus senegalensis* Oken, Lehrbuch Naturgeschichte, Jena, 3 (2): 952. Type locality: Senegal. - Comments: Not available (Opinion 417 of the ICZN) see Grubb *et al.* (1998: 97).
*1820. *Myopterus daubentonii* Desmarest, Encyclopédie Méthodique, (Zoologie, Mammalogie), 1: 132. Publication date: 1820. Type locality: Senegal: "Senegal". Holotype: [Unknown] lost:. See Koopman (1993a: 238). - Comments: Type specimen lost (see Koopman, 1993a: 238). - Etymology: In honour of the French naturalist Louis-Jean-Marie d'Aubenton

[=Daubenton] (1716 - 1799/1800) (see Bogdanowicz, 1994: 5; Kozhurina, 2002: 15). (Current Combination)

1915. *Myopterus albatus* Thomas, Ann. Mag. nat. Hist., ser. 8, 16 (96): 469. Publication date: 1 December 1915. Type locality: Congo (Democratic Republic of the): Uele River [04 09 N 22 26 E] [Goto Description]. Holotype: BMNH 1919.5.9.1: Collected by: M. Hutereau; original number: 17. Congo Museum o. 2911.

? *Myopterus daubentonii albatus:* (Name Combination)

TAXONOMY:
Koopman (1989a) and Simmons (2005) recognise *albatus* Thomas, 1915 as a subspecies. Allen (1939a: 110) used *Myopterus senegalensis* Oken, 1816 for this species.

COMMON NAMES:
Czech: morous krysový, spaka krysová. English: Daubenton's Winged-mouse Bat, Daubenton's Free-tailed Bat, Senegal Mastiff Bat. French: Myoptère de Daubenton, Myoptère du Sénégal. German: Daubentons Pergamentflügel-Fledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since, although it has been recorded over a very wide area, there are only very few records, and very little is known with certainty about its distribution, threats and habitat requirements (Mickleburgh *et al.*, 2008bc; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008bc; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004ca; IUCN, 2004). 1996 - DD (Baillie and Groombridge, 1996).

MAJOR THREATS:
The species is generally threatened by habitat loss, especially the removal of potential roost trees (Mickleburgh *et al.*, 2008bc; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bc) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, and it is not known if the species is present within any protected areas. Further studies are needed into the distribution, natural history and threats to this bat.

GENERAL DISTRIBUTION:
Myopterus daubentonii is patchily recorded from eight localities in West and Central Africa. It has been reported from Côte d'Ivoire, Central African Republic and northern Democratic Republic of the Congo. It is generally a lowland species, but has been found up to 1,250 m asl.

Native: Central African Republic; Congo (The Democratic Republic of the); Côte d'Ivoire; Senegal.

ROOST:
Brosset and Vuattoux (1968: 85) reported five specimens from Côte d'Ivoire (as *M. senegalensis*), that were captured in a hollow trunk of a Borassus palm (*Borassus aethiopum*). The tree was standing in a savanna area, but only a few hundred meters from a galery forest. The bats were roosting at an altitude of about 12 meters.

POPULATION:
Structure and Density - This appears to be a rare species, known from very few specimens (Mickleburgh *et al.*, 2008bc; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008bc; IUCN, 2009).

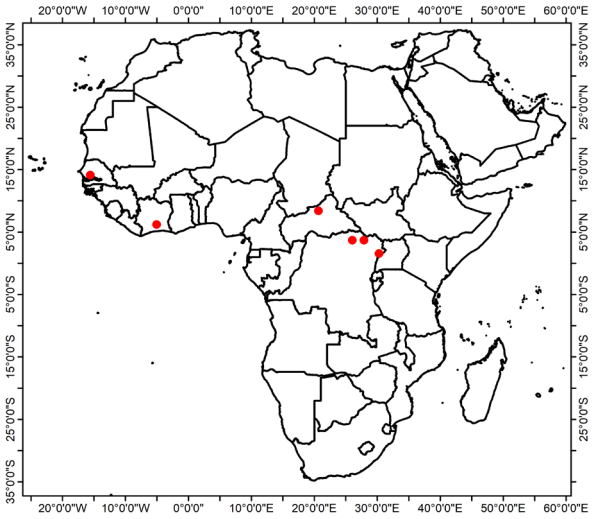


Figure 190. Distribution of *Myopterus daubentonii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Senegal.

Myopterus whitleyi (Scharff, 1900)

*1900. *Mormopterus Whitleyi* Scharff, Ann. Mag. nat. Hist., ser. 7, 6 (36): 569. Publication date: 1 December 1900. Type locality: Nigeria: Mid-Western Region, Nikrowa Forest Reserve,

Sapoba: Benin City [06 19 N 05 41 E] [Goto Description]. Holotype: BMNH 1900.10.26.1: ad ♂, skull and alcoholic. Presented/Donated by: ?: Collector Unknown.

? *Myopterus whitleyi:* (Name Combination, Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: morous západoafrický. English: Bini Winged-mouse Bat, Whitley's Winged-mouse Bat, Bini Free-tailed Bat. French: Myoptère de Whitley, Myoptère de Bini. German: Whitleys Pergamentflügel-Fledermaus, Bini Pergamentflügel-Fledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008bd; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008bd; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004cf; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is presumably threatened by general conversion of forest to agricultural land and logging activities (Mickleburgh *et al.*, 2008bd; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008bd) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed into the species distribution, natural history, and adaptability to habitat degradation.

GENERAL DISTRIBUTION:
Myopterus whitleyi is distributed in West and Central Africa. It has been recorded from Ghana in the west, through parts of Nigeria, Cameroon, Gabon, and the Democratic Republic of the Congo to western Uganda in the east.

Native: Cameroon; Central African Republic (Barrière *et al.*, 2002: 234); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 545); Gabon; Ghana; Nigeria; Uganda.

POPULATION:
Structure and Density - It is generally considered to be a rare species. It is found roosting singly or in small numbers (Mickleburgh *et al.*, 2008bd; IUCN, 2009).
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008bd; IUCN, 2009).

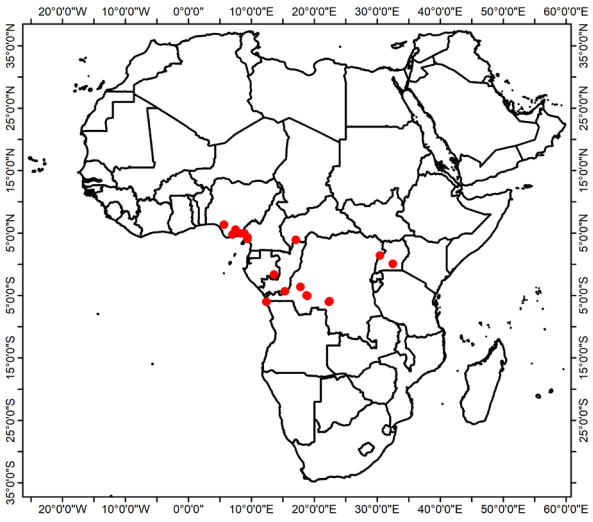


Figure 191. Distribution of *Myopterus whitleyi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Central African Republic, Congo (Democratic Republic of the), Gabon, Ghana, Nigeria, Uganda.

Genus ***Otomops*** Thomas, 1913

*1913. *Otomops* Thomas, J. Bomb. nat. Hist. Soc., 22: 91. Publication date: April 1913. - Comments: Type species: *Nyctinomus wroughtoni* Thomas, 1913. - Etymology: From the Greek substantive "*oὖς*" (genitive "*ὠτός*", "*ûs*", "*ōtós*"), meaning "ear" and the masculine German substantive *Mops*, as the genus has outstandingly large ears (see Lanza *et al.*, 2015: 309). (Current Combination)

TAXONOMY:
Richards *et al.* (2012: 910) suggest that three distinct taxa might be recognized in Africa: *Otomops madagascariensis* from Madagascar; *O. martiensseni* s.s. from southern, eastern, central, and western Africa; and an "undescribed taxon"

(now identified as *O. harrisoni*) from north-east Africa and the Arabian Peninsula.

Known species within the genus *Otomops*: *formosus* Chasen, 1939 – Java (Simmons, 2005: 447); ***harrisoni*** Ralph et al., 2015; *johnstonei* Kitchener, How and Maryanto, 1992 – Alor Isl (Indonesia) (Simmons, 2005: 447); ***madagascariensis*** Dorst, 1953; ***martiensseni*** (Matschie, 1897); *papuensis* Lawrence, 1948 – southeastern New Guinea (Simmons, 2005: 448); *secundus* Hayman, 1952 – northeastern New Guinea (Simmons, 2005: 448); *wroughtoni* (Thomas, 1913) – southern and northeastern India, Cambodia (Simmons, 2005: 448).

COMMON NAMES:
Czech: velkouší morousi. English: Big-eared Bulldog Bats, Big-eared Free-tailed Bats, Mastiff Bats. French: Molosses à grandes oreilles. German: Riesen-Bulldoggfledermäuse. Italian: Otocarlìno.

ETYMOLOGY OF COMMON NAME:
So named because they have outstanding large round-pointed ears that are attached along the nose and lie in the plane of the face (see Taylor, 2005).

BIOGEOGRAPHY:
Lamb *et al.* (2008) suggests that African and Oriental *Otomops* lineages diverged around 4.2 Myr, while Malagasy and African lineages split around 1.5 Mya.

MOLECULAR BIOLOGY:
Patterson *et al.* (2018: 7) found the average interspecific genetic distance (uncorrected cyt-*b* p-distance) between *O. harrisoni* and *O. martiensseni* to be 2.5 %.

Otomops harrisoni Ralph, Richards, Taylor, Napier and Lamb, 2015

*2015. *Otomops harrisoni* Ralph, Richards, Taylor, Napier and Lamb, Zootaxa, 4057 (1): 1, 18, figs 8 - 10. Publication date: 9 December 2015. Type locality: Ethiopia: Bale district: Sof Omar Cave [06 54 N 40 48E, 1340 m] [Goto Description]. Holotype: HZM 60.36217: ad ♂, skull and alcoholic. Collected by: Paul J.J. Bates, Malcolm J. Pearch and O. Nurhussein; collection date: 19 July 1998; original number: A51. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 40.31315: ad ♂. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 41.31316: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 42.31317: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 43.31318: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 44.31328: ad ♂. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 56.36213: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 57.36214: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 july 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 58.36215: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 59.36216: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 61.36218: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 62.36219: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Ralph *et al.* (2015: 19) mention "(also DM 14750)". Paratype: HZM 63.36220: ad ♀. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. Paratype: HZM 64.36221: ad ♂. Collected by: ?: Collector Unknown; collection date: 19 July 1998. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of Dr. David L. Harrison (1926 - 2015), who's numerous publications on Afro-Arabian Chiroptera, in particular the Molossidae, have significantly improved our knowledge of this poorly known family (Ralph *et al.* (2015: 20).

COMMON NAMES:
Chinese: 哈氏巨犬吻蝠. English: Harrison's large-eared giant mastiff bat. German: Harrison-Riesen-Bulldoggfledermaus

SIMILAR SPECIES:
Ralph *et al.* (2015: 25) report that *O. harrisoni* is in general larger than other *Otomops* species.

CONSERVATION STATUS:
Patterson *et al.* (2018: 11) report the status of *O. harrisoni* as Vulnerable.

GENERAL DISTRIBUTION:
Native: Djibouti; Eritrea (Kock and Zinner, 2004: 3 as *O. martiensseni*); Ethiopia (in a disused railway tunnel 8 km east of Asmara) for the first time (Kock and Zinner, 2004: 3 as *O. martiensseni*); Kenya (Patterson *et al.*, 2018: 1), Rwanda (Patterson *et al.*, 2018: 1) and Yemen (Hud Sawa cave, Ar-Rayadi Al-Gharbi Mountains) on the Arabian Peninsula (Al-Jumaily, 1999; Hutson *et al.*, 2001 as *O. martiensseni*).

Ralph *et al.* (2015: 27) suggest that the range might include additional localities in Uganda, northern areas of Tanzania and southern areas of Somalia.

Patterson *et al.* (2018: 1) found both O. martiensseni and *O. harrisoni* in a cave in the Musanze district, Rwanda. As they found both species in Kenya, they also caution the identifications of *Otomops* specimens from that country, especially those from Kwale, Lake Baringo, Nairobi, Naivasha, and
Wei-Wei River (p. 11).

DENTAL FORMULA:
The dental formula of *O. harrisoni* is I 1/2, C 1/1, P 2/2, M 3/3, characteristic of molossid bats (see Ralph *et al.*, 2015: 26).

ECHOLOCATION:
Ralph *et al.* (2015: 26) indicate that Taylor *et al.* (2005) reported the following values for *O. martiensseni* specimens from Bungule, Kenya: F_{peak}: 12.00 kHz, F_{min}: 10.50 kHz, F_{max}: 50 kHz, and duration of 9.00 msec. However, since this locality is equidistant from localities were either *O. martiensseni* or *O. harrisoni* was found, the taxonomic assignment of the specimens involved remains uncertain.

Patterson *et al.* (2018: Suppl.) recorded the following parameters for 10 Kenyan specimens identified as "*O.* cf. *harrisoni*: F_{max}: 13.99 ± 2.93 (9.52 - 17.95) kHz, F_{start}: 19.35 ± 3.50 (10.72 - 21.90) kHz, F_{end}: 11.58 ± 1.17 (9.63 - 13.13) kHz, duration: 10.13 ± 2.46 (7.04 - 15.16) msec. However, they also found (p. 7) differences between *O. harrisoni* populations from two localities in Kenya: Chyulu Hills: F_{peak}: 17.18 ± 0.42 (16.40 - 17.95) kHz, F_{max}: 21.67 ± 0.10 (21.48 - 21.90) kHz, F_{min}: 12.53 ± 0.29 (11.80 - 13.13) kHz and call duration: 10.72 ± 1.10 (7.57 - 12.67) msec; and Mount Suswa: F_{peak}: 11.86 ± 0.72 (9.52 - 13.80) kHz, F_{max}: 17.81 ± 1.70 (10.72 - 21.62) kHz, F_{min}: 110.94 ± 0.47 (9.63 - 12.80) kHz and call duration: 9.74 ± 1.21 (7.04 - 15.16) msec.

MOLECULAR BIOLOGY:
Karyotype:
Warner *et al.* (1974) reported 2*n* = 48, FN = 58, BA = 12, a submetacentric X chromosome and a submetacentric Y chromosome for one male *O. martiensseni* specimen from Kenya, which differed from previously reported karyotypes. It is therefore possible that this male might have been a representative of *O. harrisoni*.

HABITAT:
Ralph *et al.* (2015: 27) mention that these bats are found at high altitudes (above 1,000 m) characterised by relatively drier climates (< 500 mm annual precipitation), including warm semi-arid, tropical savanna, warm desert and temperate oceanic climates (e.g. the Ethiopian highlands).

ROOST:
Ralph *et al.* (2015: 27) indicate that individuals roost predominantly in mountain-associated cave systems and lava caves.

DIET:
Feacal data from Ethiopia indicate that medium (size range: 1 - 5 cm) to large (wing span size range: 2.5 - 30 cm) Lepidoptera (Noctuidae, Geometridae and Saturniidae) form 97 % by volume of this bat's diet (see Ralph *et al.*, 2015: 26).

PARASITES:
At Mount Suswa (Kenya), Patterson *et al.* (2018: 10, Suppl.) found the following ectoparasites: *Brachytarsina alluaudi* (Falcoz, 1923) [Diptera, Hippoboscidae], *Hypoctenes clarus* (Jordan, 1922) [Hemiptera, Polyctenidae], *Lagaropsylla* sp. [Siphonaptera, Ischnopsyllidae], and some unidentified Argasidae and Macronyssidae.

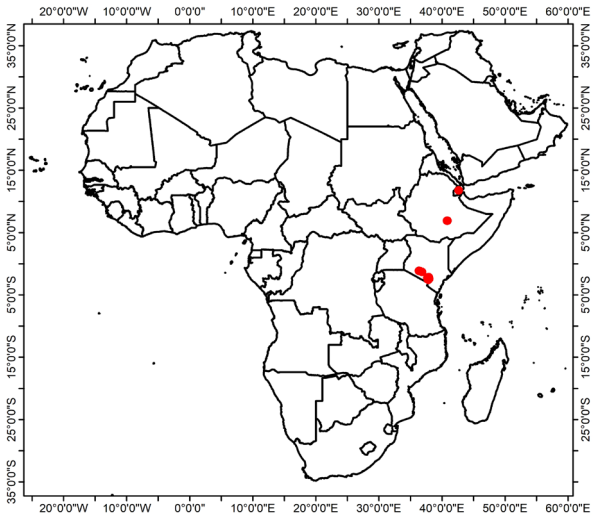


Figure 192. Distribution of *Otomops harrisoni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Djibouti, Ethiopia, Kenya.

Otomops madagascariensis Dorst, 1953

*1953. *Otomops madagascariensis* Dorst, Mém. Inst. Scient. Madagascar, (A) 8: 236. Type locality: Madagascar: S of Soalala: Namoroka, Réserve Naturelle: Cave P. Saboureau, No. 8 [16 23 S 45 28 E]. Holotype: MNHN ZM-MO-1953-1590: ad ♀, skull and alcoholic. Collected by: Renaud Paulian; collection date: September 1952. See Peterson *et al.* (1995: 181), Richards *et al.* (2012: 912). - Etymology: Referring to the island where this taxon occurs. (Current Combination)

2000. *Otomops martiensseni madagascarensis:* Horácek, Hanák and Gaisler, Bats of the Palearctic region. (Lapsus)

? *Otomops madagascariensis madagascariensis:* (Name Combination)

? *Otomops martiensseni madagascariensis:* (Name Combination)

TAXONOMY:
Previously recognised as a subspecies or synonym of *Otomops martiensseni* (Koopman, 1993a: 239). Valdivieso *et al.* (1979) listed it as a distinct species, as did Peterson *et al.* (1995: 183) and Russ *et al.* (2001). We are (yet) unable to confirm whether the original spelling is *madagascariensis* (see Koopman, 1993a: 239, Peterson *et al.*, 1995, Russ *et al.*, 2001, Simmons, 2005: 447) or *madagascarensis* (see Horácek *et al.*, 2000: 137; Fenton *et al.*, 2002: 1584).

COMMON NAMES:
Czech: morous madagaskarský. English: Madagascar Free-tailed Bat, Madagascar Mastiff Bat. French: Molosse à grandes oreilles de Madagascar. German: Madagassische Riesen-Bulldoggfledermaus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Muldoon *et al.* (2009: 1114) report on subfossil remains from the Ankilitelo fauna (late Holocene, appr. 500 years ago).

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its widespread but patchy distribution in Madagascar. It is not well known in Madagascar, but it is likely distributed more widely than current records suggest and it is unlikely that it is declining at a rate that would warrant listing in a higher category of threat (Andriafidison *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Andriafidison *et al.*, 2008l; IUCN, 2009).

MAJOR THREATS:
The threats to this species are unclear, but more research is needed into possible disturbance at its roost sites (Andriafidison *et al.*, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008l) [in IUCN (2009)] report that this species roosts in one cave that is locally protected by 'fady' or taboo (Andriafidison *et al.*, 2007). It has been recorded from five protected areas: Parc National du Tsingy de Bemaraha, Parc National de Namoroka, Parc National d'Isalo, Réserve Spéciale d'Ankarana and Réserve Spéciale d'Analamerana (Goodman *et al.*, 2005a). A total of nine roosting colonies are currently known: six in Réserve Spéciale d'Ankarana (Cardiff, 2006), two in Parc National du Tsingy de

Bemaraha (Andriafidison *et al.*, 2007) and one in Sarodrano (Goodman *et al.*, 2005a; Andriafidison *et al.*, 2007), and all receive some form of protection. More research is needed on its roosting ecology and surveys are required in areas where this species is expected to occur.

GENERAL DISTRIBUTION:
Otomops madagascariensis is endemic to the island of Madagascar where it has a disjunct distribution from the north to the south-west of the island. It has an elevation range of 5 m to 800 m above sea level (Goodman *et al.*, 2005a).

O'Brien (2011: 289) reports it from the Tanzanian island of Mafia.

Native: Madagascar (Valdivieso *et al.*, 1979; Peterson *et al.*, 1995: 183; Russ *et al.*, 2001; Simmons, 2005: 447).

DETAILED MORPHOLOGY:
Baculum:
The baculum of *O. madagascariensis* is an elongated rod with a notable twist to the mid-shaft. In lateral view, its proximal portion is distinctly wider than the proximal end (Rakotondramanana and Goodman, 2017: 62); length: 0.74 ± 0.057 (0.65 - 0.80) mm, width: 0.13 ± 0.028 (0.09 - 0.18) mm.

MOLECULAR BIOLOGY:
DNA - See Lamb *et al.* (2008).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
Dammhahn and Goodman (2013: 108) report that this species' foraging habitat includes open areas and the area above the forest canopy.

ROOST:
Cave roosts in limestone or sandstone (Goodman *et al.*, 2005a; Andriafidison *et al.*, 2007).

POPULATION:
Structure and Density - The colony of *O. madagascariensis* in a cave in the south of Parc National du Tsingy de Bemaraha consisted of between 90 and 100 individuals in 2003 (Andriafidison *et al.*, 2007). The Sarodrano roost in the south of Madagascar contained at least 67 animals in November 2003 (Andriafidison *et al.*, 2007). The maximum colony size at Réserve Spéciale d'Ankarana was 97 individuals (S. G. Cardiff *pers. comm.* [in Andriafidison *et al.* (2008l) in IUCN (2009)]).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008l; IUCN, 2009).

PARASITES:
Lagadec *et al.* (2012: 1696), Lei and Olival (2014: Suppl.) and Gomard *et al.* (2016: 5) report the presence of *Leptospira* sp. bacteria in this species, which were identified as having sequences closely related to *L. borgpetersenii* by Dietrich *et al.* (2018a: 3).

Laudisoit *et al.* (2012) describe a new species *Lagaropsylla makay* (Siphonaptera; Ischnopsyllidae), and they also mention a new parasite-host association between *Araeopsylla martialis* (Rothschild, 1903) (Siphonaptera; Ischnopsyllidae) and *O. madagascariensis*.

Ramasindrazana *et al.* (2016: 6) report the presence of an unnamed filariod in this bat species.

VIRUSES:
Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 8 individuals from the Madagascar using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids. Wilkinson *et al.* (2014) tested 18 individuals from Anjohikinakina in Madagascar with an RT-PCR specific for the *Respiro-*, *Morbilli-* and *Henipavirus* genera, five of the 18 individuals tested positive for paramyxovirus RNA.
Seven out of 39 Madagascan specimens tested by Mélade *et al.* (2016b: 4) were positive for paramyxoviruses.

Rhabdoviridae
Mélade *et al.* (2016a: 6) examined 20 specimens for *Lagos bat lyssavirus* and got three positive results. Four out of 18 animals had a positive outcome for *Duvenhage lyssavirus*.

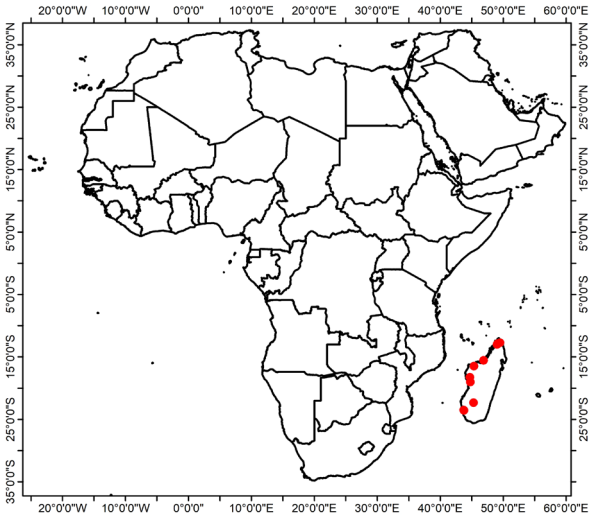


Figure 193. Distribution of *Otomops madagascariensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Otomops martiensseni (Matschie, 1897)

*1897. *Nyctinomus martiensseni* Matschie, Arch. Naturgesch. Berlin, 63 (1): 84. Publication date: October 1897. Type locality: Tanzania: 25 mi W of Tanga, SE portion of W Usambara Mts: Magrotto Plantation [05 07 S 38 45 E] [Goto Description]. Holotype: ZMB 97523: ♂, skin and skeleton and skull. Collected by: Martienssen; collection date: August 1897. See Turni and Kock (2008: 71). - Comments: Horácek *et al.* (2000: 137) mention the type locality as "Usanbara Mts., W of Tanga, NE Tanzania". Grubb *et al.* (1998: 98) indicate that the locality has been defined by Swynnerton, 1945, Proc. Zool. Soc. Lond., 115: 63). - Etymology: In honour of "Herr Martienssen of the Königlich Museum für Naturkunde" who found the type specimen (see Long, 1995: 4).
1966. *Otomops maertiensseni:* Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: pl. XX. Publication date: December 1966. (Lapsus)
2017. *O[tomops] martiensenni:* Waruhiu, Ommeh, Obanda, Agwanda, Gakuya, Ge, Yang, Wu, Zohaib, Hu and Shi, Virol. Sin., 32 (2): 10. Publication date: 6 April 2017. (Lapsus)
2017. *Otomops martiensenii:* Waruhiu, Ommeh, Obanda, Agwanda, Gakuya, Ge, Yang, Wu, Zohaib, Hu and Shi, Virol. Sin., 32 (2): 7. Publication date: 6 April 2017. (Lapsus)
2017. *Otomops martienssi:* Tao, Shi, Chommanard, Queen, Zhang, Markotter, Kuzmin, Holmes and Tong, J. Virol., 91 (5) e01953-16: Suppl. Publication date: 11 January 2017. (Lapsus)
? *Otomops martiensseni:* (Name Combination, Current Combination)

TAXONOMY:
Koopman (1993a: 239) included *madagascariensis*, but see Peterson *et al.* (1995: 183), Long (1995) and Simmons (2005: 447). Lamb *et al.* (2008: 30) indicate that there are two clades in *martiensseni*, of which "clade 1" (north-east Africa + Yemen) would constitute an undescribed taxon. Additionally, Lamb *et al.* (2008: 31) indicate that the population from Côte d'Ivoire may represent a distinct lineage.

Ralph *et al.* (2015) proved that the specimens from Ethiopia, Eritrea, Somalia, Djibouti and Yemen represent a different species: *O. harrisoni*, which is larger and more robust than any other *Otomops*.

Ammerman *et al.* (2012: 23) indicate that the separation between *martiensseni* and *madagascariensis* took place less than 2 million years ago.

Simmons (2005: 447) recognises one subspecies *icarus* Chubb, 1917.

COMMON NAMES:
Afrikaans: Bakoor-losstertvlermuis. Chinese: 大耳犬吻蝠. Czech: morous Martienssenův. English: Martienssen's Big-eared Bulldog Bat, Large-eared Free-tailed Bat, Giant Mastiff Bat, Martiensen's Free-tailed Bat, Martienssen bat, Large-eared Giant Mastiff Bat. French: Grand molosse à grandes oreilles, Chauve-souris bouledogue géante. German: Großohrige Riesen-Bulldoggfledermaus. Italian: Otocarlìno di Martienssèn. Kinande (DRC): Mulima.

CONSERVATION STATUS:
Global - Listed as Near Threatened (NT ver 3.1 (2001)) because this species is probably still in significant decline globally (but probably at a rate of less than 30 % over ten years), owing to the probable continued loss of the known major East African populations. Smaller populations from southern Africa may be increasing. The status of populations in Central and West Africa, where the species is still known from very few specimens, remains unclear. Almost qualifies as threatened under criterion A2c (Mickleburgh *et al.*, 2008dd; IUCN, 2009).
Ralph *et al.* (2015: 27) indicate that the assignment of this species must be re-evaluated due to the split off of *O. harrisoni* in the northern part of the original distribution area.

Assessment History -
2008 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2008dd; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004cq; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Richards *et al.*, 2016e). 2004- VU D2 ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
The leading threat to this species appears to be roost disturbance. Major colonies in East Africa, such as the population at Mount Suswa (Kenya),

seem to have disappeared through disturbance of their cave habitats (Hutson *et al.*, 2001) [see Kock *et al.*, 2005: 3, who refutes this]. Threats to these caves include guano mining (with associated changes to the cave microclimate), blocking of entrances, recreational caving and general tourism activities (Anonymus, 2004f: 57). It is possible that the collection of 4,954 bats by Mutere (1973a) as part of a reproductive study may have contributed to a decline of the Kenyan populations [see Kock *et al.*, 2005 who refute this too]. Populations in Durban (South Africa) have been found to use old buildings with attics as roosts, and it appears that the main threat to these populations is indirect poisoning through the application of toxic timber treatments (Fenton *et al.*, 2002).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dd) [in IUCN (2009)] report that there is a need to reassess the status of all known roosts (and to locate additional localities) to ascertain numbers and status of colonies, so that key sites can be identified. There is a need to collect better information on the current status of populations in both Central and West Africa. Disturbance of key localities should be restricted or managed to reduce the impact on colonies. The species has been recorded from Comoe National Park, Côte d'Ivoire, it has been recorded from within a national park in Rwanda, and the former large colony at Mount Suswa, Kenya, is believed to be protected (Hutson *et al.*, 2001). *O. martiensseni* is protected by provincial ordinance in KwaZulu Natal, South Africa. An IUCN Species Action Plan has been developed for this species (Hutson *et al.*, 2001).

GENERAL DISTRIBUTION:
Otomops martiensseni has been widely, but patchily, recorded from much of sub-Saharan Africa. In Africa, it has been reported from Côte d'Ivoire and Ghana in West Africa, through Central Africa (recorded from Central African Republic, the Democratic Republic of the Congo, Rwanda and western Uganda) to East Africa (Kenya and Tanzania) to southern Africa (Malawi, central Angola [Chitau], Zimbabwe, Zambia and eastern South Africa). It is found at elevations from sea level to 2,900 m asl, although the highest elevations might need to be referred to *O. harrisoni*.

Records from Madagascar are now refered to *O. madagascariensis* (see Taxonomy section above). Lamb *et al.* (2008: 30, 39) mention it from Côte d'Ivoire, Ghana, and Burundi, but also see Taxonomy paragraph. Records from Djobuti, Eritrea, Ethiopia, Somalia, Yemen are now referred to *O. harrisoni*, as might be the case for some of the records from Kenya, Tanzania and Uganda (see Taxonomy section above).

Patterson *et al.* (2018: 1) found both *O. martiensseni* and *O. harrisoni* in a cave in the Musanze district of Rwanda.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 545; Taylor *et al.*, 2018b: 63); Botswana (Adams *et al.*, 2015: 711); Central African Republic; Congo (The Democratic Republic of the) (Ansell, 1974; Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 545); Côte d'Ivoire; Ghana; Kenya (Patterson *et al.*, 2018: 5); Malawi (Monadjem *et al.*, 2010d:454); Rwanda (Patterson *et al.*, 2018: 1); South Africa (Monadjem *et al.*, 2010d:545;Adams *et al.*, 2015: 710-711); Tanzania; Uganda; Zambia Monadjem *et al.*, 2010d: 545); Zimbabwe (Lamb *et al.*, 2008; Monadjem *et al.*, 2010d: 545).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Large species, with narrowest wings of any bat for fast flying in open areas (Anonymus, 2004f: 57).

FUNCTIONAL MORPHOLOGY:
Based on the analysis of wing dimensions, Thollesson and Norberg (1991: 34) suggest that the longer hand wings and more pointed wing tips of *O. martiensseni* indicate that this is a species primarily flying in open areas at a high altitude.

ECHOLOCATION:
From Bungule in Kenya Taylor *et al.* (2005) reported a maximum frequency of 16.5 kHz. However, due to the split off of *O. harrisoni*, the taxonomic status of the specimens involved is uncertain (see Ralph *et al.*, 2015: 26).

At Sengwa in Zimbabwe, Jacobs (1996) and Fenton and Bell (1981) recorded a highest frequency of 17 kHz. Taylor (1999b) recorded maximum frequencies of 29.5 (2.4) kHz (open flight) and 14.7 (1.5) (emergence) from two localities in the Durban area in South Africa. Whereas, Fenton *et al.* (2004) reported a highest frequency of 14.7 (1.68) kHz from the Durban area in South Africa. From the same area, Schoeman and Waddington (2011: 291) mention a peak frequency of 10.7 ± 0.4 kHz and a duration of 27 ± 1.5 msec.
Fenton (2004b: 4) states that there is evidence that, in this species, calls originally associated with echolocation may actually serve more for communication.

Adams *et al.* (2015: 709) report the following values from South Africa: F_{char}: 11.70 ± 3.61 (10.51 - 13.54) kHz; F_{high}: 13.19 ± 1.08 (11.01 - 15.67) kHz; F_{low}: 10.82 ± 0.65 (9.11 - 12.23) kHz; Band

width: 2.40 ± 0.90 (0.65 - 5.64) kHz; F_{max}: 12.41 ± 0.90 (10.76 - 14.55) kHz; Duration: 21.18 ± 3.61 (11.79 - 27.81) msec. Also from the RSA (Mapungubwe National Park), Parker and Bernard (2018: 57) reported on 20 calls: F_{char}: 10.74 ± 0.63 kHz, F_{max}: 11.52 ± 0.60 kHz, F_{min}: 10.28 ± 0.50 kHz, F_{knee}: 10.81 ± 0.64 kHz, duration: 22.68 ± 13.89 msec, with 3.98 ± 2.40 calls/sec.

For seven calls from the Aberdares Range in Kenya, Eisenring *et al.* (2016: SI 2) reported: PF: 14.8 ± 2.8 (9.9 - 17.4), HF: 22.0 ± 4.2 (14.5 - 26.4), LF: 9.9 ± 2.5 (5.2 - 13.2), DT: 0.1 ± 0.0 (0.1 - 0.2), DF: 12.1 ± 2.4 (9.3 - 16.0), IPI: 3.3 ± 2.0 (1.5 - 5.5).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003), Lamb *et al.* (2006) and Lamb *et al.* (2008).
Karyotype - Đulic and Mutere (1973a) reported 2*n* = 48, FN = 56, BA = 10, a submetacentric X chromosome, and an acrocentric Y chromosome. However, Warner *et al.* (1974) reported 2*n* = 48, FN = 58, BA = 12, a submetacentric X chromosome and a submetacentric Y chromosome for one male specimen from Kenya. In view of the split off of *O. harrisoni* the Kenyan karyotype might represent the latter species rather than *O. martiensseni*.

Protein / allozyme - Unknown.

HABITS:
O. martiensseni is probably a long-range forager, which hunts over a wide diversity of habitats, e.g. semi-arid areas and montane forests up to 2,000 m (Anonymus, 2004f: 57). Adams *et al.* (2015), referring to Fenton and Griffin (1997), indicate that foraging occurs at altitudes exceeding 600 m above ground. Actually, Fenton and Griffin (1997: 248) reported one call in the 10 - 13 kHz range (used by *O. martiensseni*) at an altitude between 500 and 550 m.

Foord *et al.* (2018: 5) indicate that open-air feeders (e.g. *O. martiensseni*) may commute over 10 km between roosts and feeding areas, but do prefer smaller feeding areas.

ROOST:
In the Durban area, Taylor *et al.* (1999: 67) found roosts on the brick surface of the inner gable apex wall within the roof space, with entrances height between 3 and 12 m. The colony size varied between one and 30.

Anonymus (2004f: 57) indicates that *O. martiensseni* is generally colonial with larger colonies in underground sites (e.g. caves and lava tubes), whereas in South Africa small colonies occur in houses.

POPULATION:
Structure and Density - Although *O. martiensseni* was once considered to be rare, with gaps in distribution, additional collecting has demonstrated local abundance in several areas (Long, 1995; Taylor, 1998; Fenton *et al.*, 2002; Skinner and Chimimba, 2005). For example, it is common around Durban in KwaZulu Natal Province of South Africa (Fenton *et al.*, 2002), and is fairly common in Comoe National Park, Côte d'Ivoire. Hutson *et al.* (2001) reported that major colonies of this species (consisting of hundreds of bats) from caves in East Africa have declined severely and now have few or no bats (no date of observation given). However, Kock *et al.* (2005: 3) refute this as a visit to Mt. Suswa 15 February 2004 where they reported a collony of 10-15 thousand individuals to be present.
Trend - 2008 - Decreasing (Mickleburgh *et al.*, 2008dd; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Martin and Bernard (2000: 32) indicate that the corpus luteum undergoes luteolysis in late pregnancy. Krutzsch (2000: 126) further mentions that the species exhibits classical mammalian male-female synchrony of reproductive cycles.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] indicated that juveniles have been recorded from October through May.

MATING:
Ober *et al.* (2016: 375) mention that *O. martiensseni* forms single male/mulitple female groups.

PARASITES:
SIPHONAPTERA
Ischnopsyllidae: Beaucournu and Kock (1996) reported *Araeopsylla scitula* Rothschild, 1909 from a bat from Kenya. However, in view of the split off of *O. harrisoni*, this latter species might have been the host for this ectoparasite.

ACARI
Trombiculidae: Stekolnikov (2018a: 189) mentioned *Willmannium suswaensis* (Vercammen-Grandjean & Langston, 1976) from a bat collected at Mount Suswa (Kenya).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Otomops martiensseni*: Adenoviruses and Polyomaviruses.

Adenoviridae:

Adenovirus - Two of the 19 specimens from the Suswa Cave (Kenya) by Conrardy *et al.* (2014: 259) tested positive for this virus.

Coronaviridae - Coronaviruses
SARS-CoV - Tong *et al.* (2009) tested two bats collected in Kenya during 2006 positive for the presence of coronavirus RNA in fecal samples.
28.6 % (10 out of 35) of the Kenyan *O. martiensseni* specimens were positive for CoV (Tao *et al.*, 2017: 3).

Flaviviridae
Hepacivirus (BHV) - Quan *et al.* (2013: Table S5) report that 3 of 15 Kenyan specimens were infected with clade C *Hepacivirus* (20.0 %).
Pegivirus (BPgV) - 2 of the 15 specimens examined by Quan *et al.* (2013: Table S5) were also infected with clade K *Pegivirus* (13.3 %).

Paramyxoviridae:
Paramyxovirus - Five of the 19 specimens from the Suswa Cave by Conrardy *et al.* (2014: 259) tested positive for this virus, and this was also the case for nine out of 40 specimens from Kenya, which were tested by Mortlock *et al.* (2015: 1481).

Polyomaviridae:
Orthopolyomavirus - Initially, three novel orthopolyomaviruses were detected in 2006 from Kenya by Tao *et al.* (2012). Additional surveillance detected 6 of the 19 specimens from the Suswa Cave to be positive tested by Conrardy *et al.* (2014: 259).

Rhabdoviridae
Lyssavirus - Rabies related viruses
Horton *et al.* (2014: Table S1) tested 16 Kenyan *O. martiensseni* specimens but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).

Remark: as most of these viruses were found on "*O. martiensseni*" specimens from Kenya, the actual host species might be *O. harrisoni*.

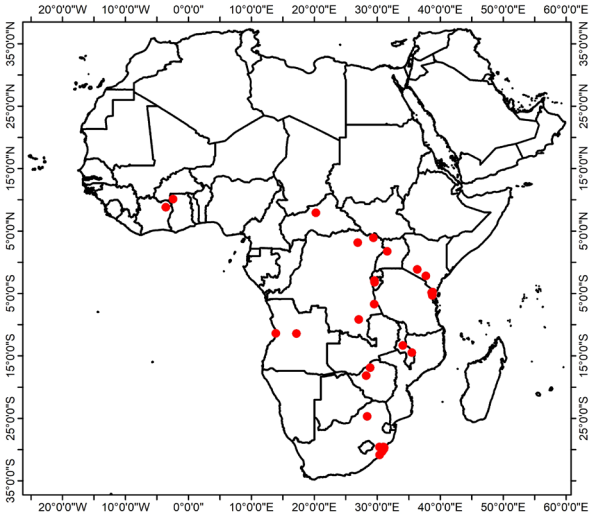


Figure 194. Distribution of *Otomops martiensseni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Burundi, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Rwanda, South Africa, Tanzania, Zimbabwe.

Otomops martiensseni icarus Chubb, 1917

*1917. *Otomops icarus* Chubb, Ann. Durban Mus., 1: 433, pl. 21. Publication date: 21 May 1917. Type locality: South Africa: KwaZulu-Natal: Durban [29 52 S 31 00 E] [Goto Description]. Holotype: BMNH 1916.10.9.1: ♂. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. - Etymology: Named after Icarus, son of Daidalos, who fled from their prison with wings made of wax and feathers.
? *Otomops martiensseni icarus:* (Name Combination, Current Combination)

GENERAL DISTRIBUTION:
From Angola to KwaZulu-Natal, Malawi (Horácek *et al.*, 2000: 137).

Otomops martiensseni martiensseni (Matschie, 1897)

*1897. *Nyctinomus martiensseni* Matschie, Arch. Naturgesch. Berlin, 63 (1): 84. Publication date: October 1897. Type locality: Tanzania: 25 mi W of Tanga, SE portion of W Usambara Mts: Magrotto Plantation [05 07 S 38 45 E] [Goto Description]. Holotype: ZMB 97523: ♂, skin and skeleton and skull. Collected by: Martienssen; collection date: August 1897. See Turni and Kock (2008: 71). - Comments: Horácek *et al.* (2000: 137) mention the type locality as "Usanbara Mts., W of Tanga, NE Tanzania". Grubb *et al.* (1998: 98) indicate that the locality has been defined by Swynnerton, 1945, Proc. Zool. Soc. Lond., 115: 63).

- Etymology: In honour of "Herr Martienssen of the Königlich Museum für Naturkunde" who found the type specimen (see Long, 1995: 4).

.

? *Otomops martiensseni martiensseni:* (Name Combination, Current Combination)

GENERAL DISTRIBUTION:
Central African Republic to Yemen and south to Zimbabwe (Horácek *et al.*, 2000: 137).

Genus ***Platymops*** Thomas, 1906

*1906. *Platymops* Thomas, Ann. Mag. nat. Hist., ser. 7, 17 (101): 499. Publication date: 1 May 1906 [Goto Description]. - Comments: Type species: *Platymops Macmillani* Thomas, 1906 (=*Mormopterus setiger* Peters, 1878). - Etymology: From the Greek adjective "*πλατύς*" (platýs), meaning "flat" and the masculine German substantive *Mops*, referring to the extremely flattened skull of the genus (see Lanza *et al.*, 2015: 315). (Current Combination)

? *Mormopterus (Platymops):* (Name Combination)

TAXONOMY:
Considered a subgenus of *Mormopterus* by Koopman (1993a: 238), Czaplewski *et al.* (2003: 68), but a valid genus by Kock (1969a: 155), Simmons (2005).
Included in *Mormopterus* by Jacobs and Fenton (2002: 1).

Known species within the genus *Platymops*: ***setiger*** (Peters, 1878).

COMMON NAMES:
Czech: ploší morousi. English: East African Flat-headed Bats, Peters's flat-headed Bats. French: Tadarides à tête plate. German: Flachkopf-Bulldoggfledermäuse. Italian: Platicarlìni.

Platymops setiger (Peters, 1878)

*1878. *Mormopterus setiger* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 196, pl. 1, fig. 2. Type locality: Kenya: Taita district: Ndi [03 14 S 38 30 E, 2 000 m] [Goto Description]. Syntype: ZMB 5265a: ♀, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt; collection date: July 1877. See Turni and Kock (2008). Syntype: ZMB 5265b: ♀, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt; collection date: July 1877. See Turni and Kock (2008). - Comments: Allen (1939a: 109) mentioned 1881; Monatsb. K. Preuss. Akad. Wiss., Berlin, p. 483, pl., fig. 3. - Etymology: From the masculine Latin adjective *sètiger*, meaning "covered with coarse hair, bristly", referring to the coarse fur of the species Lanza *et al.*, 2015: 316).

1960. *Platymops setiger:* Harrison and Fleetwood, Durban Mus. Novit., 5 (20): 269. (Name Combination, Current Combination)

TAXONOMY:
See Freeman (1981b: 133, 161). Included in *Platymops* by Harrison and Fleetwood (1960: 277 - 278).

COMMON NAMES:
Chinese: 彼德犬吻蝠. Czech: morous plochý. English: East African Flat-headed Bat, Peters's Flat-headed Bat, Flat-headed free-tailed bat. French: Sauromys à tête plate, Tadaride à tête plate de Peters. German: Peters' Flachkopf-Bulldoggfledermaus. Italian: Carlìno setolóso.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008al; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008al; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2004ay; IUCN, 2004). 1996 - LR/lc [assessed as *Mormopterus setiger*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
There are presumably no major threats to this species (Mickleburgh *et al.*, 2008al; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008al) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. In view of the species' East African range, it seems likely that it is present within some protected areas, although this needs to be confirmed. Further studies are needed into the distribution, natural history and potential threats to this species.

GENERAL DISTRIBUTION:
Platymops setiger is an East African species present in Kenya, southwestern Ethiopia (Glass, 1965: 179), southeastern Sudan and is possibly present in adjacent Uganda, although this needs to be confirmed. It has been recorded at elevations of up to 2,000 m asl.

Native: Ethiopia; Kenya; Sudan.
Presence uncertain: Uganda.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Warner *et al.*, 1974) reported 2*n* = 48, FN = 54, BA = 8 and submetacentric X and acrocentric Y chromosomes.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Mickleburgh *et al.*, 2008al; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008al; IUCN, 2009).

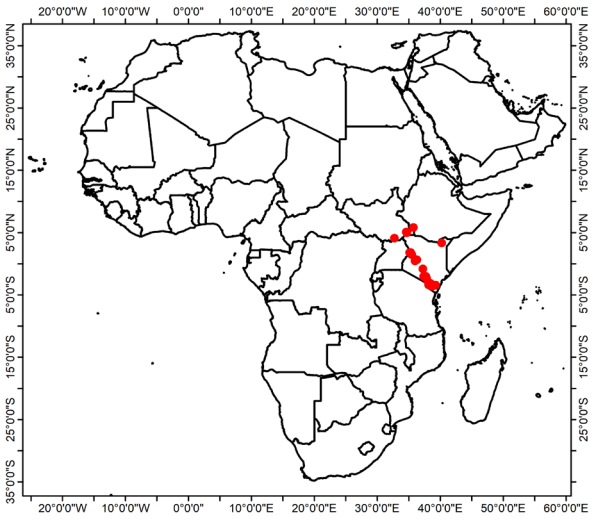


Figure 195. Distribution of *Platymops setiger*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Kenya.

Platymops setiger macmillani Thomas, 1906

*1906. *Platymops Macmillani* Thomas, Ann. Mag. nat. Hist., ser. 7, 17 (101): 500. Publication date: 1 May 1906. Type locality: Ethiopia: Between Addis Ababa and Lake Rudolf [Goto Description]. Holotype: BMNH 1906.11.1.10: ad ♂, skull and alcoholic. Collected by: Ph.C. Zaphiro. Presented/Donated by: W.N. McMillan Esq. 7 specimens. - Etymology: In honour of Mr. W.N. McMillan, to whose liberality science is indebted for the exploration of which it is part of the outcome (see Thomas, 1906b: 501).

1956. *Platymops barbatogularis* Harrison, Ann. Mag. nat. Hist., ser. 12, 9 (104): 549. Publication date: 18 December 1956. Type locality: Sudan: SE Sudan, Ilemi triangle: Lokomarinyang Marsh [05 02 N 35 33 E] [Goto Description]. Holotype: BMNH 1967.1232: ad ♂, skin and skull. Collected by: John George Williams; collection date: 10 June 1953. Formerly HZM 2.1897 (see Harrison (1956e: 549). Paratype: BMNH 1957.258:. - Comments: Evenhuis (2003: 54) indicates that ser. 12, 9 (104) is the "August 1956" issue which was published on "18 December 1956".

1960. *Platymops barbatogularis parkeri* Harrison and Fleetwood, Durban Mus. Novit., 5 (20): 270, figs 1 - 6. Publication date: 30 April 1960. Type locality: Kenya: Lualeni borehole: Maktau [03 24 S 38 08 E] [Goto Description]. Holotype: BMNH 1959.524: ad ♀, skin and skull. Collected by: Ian Parker; collection date: 12 February 1958; original number: 2.

? *Mormopterus setiger macmillani:* (Name Combination)

? *Platymops setiger macmillani:* (Name Combination, Current Combination)

TAXONOMY:
Kock (1969a: 155) considers *barbatogularis* to be a synonym of *macmillani*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia, Kenya, South Sudan.

Platymops setiger setiger (Peters, 1878)

*1878. *Mormopterus setiger* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 196, pl. 1, fig. 2. Type locality: Kenya: Taita district: Ndi [03 14 S 38 30 E, 2 000 m] [Goto Description]. Syntype: ZMB 5265a: ♀, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt; collection date: July 1877. See Turni and Kock (2008). Syntype: ZMB 5265b: ♀, skull and alcoholic. Collected by: Dr. Johann Maria Hildebrandt; collection date: July 1877. See Turni and Kock (2008). - Comments: Allen (1939a: 109) mentioned 1881; Monatsb. K. Preuss. Akad. Wiss., Berlin, p. 483, pl., fig. 3. - Etymology: From the masculine Latin adjective *sètiger*, meaning "covered with coarse hair, bristly", referring to the coarse fur of the species Lanza *et al.*, 2015: 316).
? *Mormopterus setiger setiger:* (Name Combination)
? *Platymops setiger setiger:* (Name Combination, Current Combination)

Genus ***Sauromys*** Roberts, 1917

1917. *Platymops* Roberts, Ann. Transv. Mus., 6(1): 5. Publication date: 28 June 1917. - Comments: Type species: *Platymops (Sauromys) petrophylus* Roberts, 1917. Not of Thomas, 1906.
*1917. *Platymops (Sauromys)* Roberts, Ann. Transv. Mus., 6(1): 5. Publication date: 28 June 1917. - Comments: Type species: *Platymops (Sauromys) haagneri* Roberts, 1917 (=*Platymops petrophilus* Roberts, 1917). As a subgenus of *Platymops* Thomas, 1906. - Etymology: From Greek "*sauros*" meaning lizard and "mys" meaning mouse (see Jacobs and Fenton, 2002: 1).
? *Mormopterus (Sauromys):* (Name Combination)
? *Sauromys:* (Current Combination)
? *Tadarida (Sauromys):* (Name Combination)

TAXONOMY:
Bronner *et al.* (2003) state that the status of *Sauromys*, described as a monotypic subgenus of the extralimital *Platymops* for the South African flat-headed free-tailed bat, remains unclear. Peterson (1965) raised it to generic rank, a treatment endorsed by many subsequent authors, and corroborated by a limited multivariate analysis of wing bone and cranial characteristics (Peterson, 1985). However, morphometric studies by Freeman (1981b) and Legendre (1984) concluded that it is a subgenus of *Mormopterus*, a position followed by Koopman (1993a, 1994), and Jacobs and Fenton (2002: 1). Simmons (2005) retains *Sauromys* as a valid genus in the 3rd Edition of Mammal Species of the World, a treatment we favour because of the unique ecology and morphology of *S. petrophilus*. Analysis of the Rag2 data confirmed the split between *Mormopterus* and *Sauromys* (see Ammerman *et al.*, 2013: 309).

Meester *et al.* (1986) also state that originally described as a subgenus, this genus was regarded as a synonym of *Platymops* by Shortridge (1942), Roberts (1951) and Ellerman *et al.* (1953). Harrison (1962) retains it as a subgenus, while Peterson (1965) raises it to generic rank, in which he is followed by Hayman and Hill (1971), Smithers (1971), Corbet and Hill (1980) and Rautenbach (1982). However, Freeman (1981b), followed by Koopman (1982) and Legendre (1984), conclude that both *Sauromys* and *Platymops* are subgenera of *Mormopterus*. We take the view that both *Platymops* and *Sauromys* are valid genera.

Generic and species classification of African flat-headed molossids is unclear. Roberts (1917c) originally described *Sauromys* as a subgenus of *Platymops*. Later Roberts (1951, 1954) dropped *Sauromys* as a subgenus, as Shortridge (1942) reported that a minute upper premolar was found on the type *Platymops macmillani* Thomas, 1906. Peterson (1965) indicates that the minute premolar on the type *P. macmillani* is probably a milk premolar and that normal adult dental formula should be considered as having only one upper premolar. For this reason and others (e.g. glands not on wings) Peterson (1965) raises *Sauromys* to generic status. Koopman (1975) indicates that *Sauromys* is a subgenus within *Tadarida*, however Freeman (1981b) found that all the so-called flat-headed bats; *Sauromys*, *Platymops*, and *Neoplatymops*, are phenotypically related to *Mormopterus*. While the phenogram in Freeman

(1981b) also indicates that *Tadarida aegyptiaca* (E. Geoffroy 1818) and *T. brasiliensis* (I. Geoffroy St.-Hilaire 1824) are phenetically similar to *Mormopterus*, this grouping is explained due to convergence of shape due to similar life styles (Freeman, 1981b). Meester *et al.* (1986) did not follow Freeman (1981b) and rather followed Peterson (1965) recognizing *Sauromys*, *Mormopterus* and *Platymops* as valid genera. While Koopman (1993a) followed Freeman (1981b) in classifying *Sauromys* and *Platymops* as subgenera in the genus *Mormopterus*, Simmons (2005) recognizes *Sauromys* as a distinct genus.

Peterson (1965) suggests that a detailed comparison between *Sauromys* and *Tadarida* needs to be performed, including an investigation into the specific status and geographic variation. Ammerman *et al.* (2012: 21) suggest that *Sauromys* is more appropriately recognized as a member of the genus *Tadarida*, which split off from *T. aegyptiaca* some 6.5 million years ago. However, based on their morphological data, Gregorin and Cirranello (2015: 10) still find it premature to transfer *Sauromys* into *Tadarida*.

Known species within the genus *Sauromys*: ***petrophilus*** (Roberts, 1917).

COMMON NAMES:
Czech: ještěří morousi. French: Sauromys. German: Flachkopf-Bulldoggfledermäuse.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery (2007: 619) reported on the presence of *Sauromys* sp. in Pleistocene deposits at Wonderwerk Cave, South Africa.

Sauromys petrophilus (Roberts, 1917)

*1917. *Platymops (Sauromys) petrophilus:* Roberts, Ann. Transv. Mus., 6(1): 5. Publication date: 28 June 1917.
1917. *Platymops petrophilus* Roberts, Ann. Transv. Mus., 6(1): 5. Publication date: 28 June 1917. Type locality: South Africa: Western Transvaal: near Rustenburg: Bleskop [Goto Description]. Holotype: TM X835: ♂. Collected by: G.P. Van Dam; collection date: 2 February 1917; original number: 16. Presented/Donated by: ?: Collector Unknown. - Etymology: From the Greek "*petros*" meaning rock and "*philos*" meaning loving. (Name Combination)
? *Mormopterus petrophilus petrophilus:* (Name Combination)
? *Mormopterus petrophilus:* (Name Combination)
? *Platymops haagneri haagneri:*
? *Sauromys petrophilus:* (Name Combination, Current Combination)

TAXONOMY:



Figure 196. *Sauromys petrophilus umbratus* from Kliphuis, Cederberg, Western Cape South Africa.

Roberts (1951, 1954) recognised two species and five subspecies of flat-headed bats in southern Africa: *Platymops haagneri* Roberts, 1917 (*haagneri*, *umbratus* Shortridge and Carter, 1938) and *Platymops petrophilus* Roberts, 1917 (*petrophilus*, *erongensis* Roberts, 1946, *fitsimonsi* Roberts, 1946). Ellerman *et al.* (1953) suggested that the two species are conspecific, and rather recognized five subspecies of *Platymops petrophilus* (*petrophilus*, *haagneri*, *umbratus*, *erongensis* and *fitzsimonsi*). Meester *et al.* (1986) also recognized the five subspecies suggested by Ellerman *et al.* (1953) for *petrophilus* but within the genus *Sauromys*, following Peterson (1965: 12). Freeman (1981b) indicates that *erongensis* (Roberts, 1946) may be a synonmy of *haagneri* (Roberts, 1917) and *fitzsimonsi* (Roberts, 1946) is possibly a synonym of *umbratus* (Shortridge and Carter, 1938). Included in *Mormopterus* by Jacobs and Fenton (2002: 1). Jacobs and Fenton (2002: 1) considered *M. petrophilus* to be monotypic.

COMMON NAMES:
Afrikaans: Platkop-losstertvlermuis. Czech: morous ještěří. English: Rock-loving Flat-headed Bat, Rock-dwelling Flat-headed Bat, Roberts' Flat-headed Bat, Roberts's Flat-headed Bat, Flat-headed Free-tailed Bat. French: Sauromys de Roberts. German: Roberts' Flachkopf-

Bulldoggfledermaus. Portuguese: Morcego de cabeca curta.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
No fossils are known (Jacobs and Fenton, 2002: 1).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008an; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008an; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004bc; IUCN, 2004). 1996 - LR/lc [assessed as *Mormopterus petrophilus*] (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Jacobs *et al.*, 2016e). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species. In parts of its range it is believed to be threatened by considerable habitat change resulting from deforestation (Mickleburgh *et al.*, 2008an; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008an) [in IUCN (2009)] report that this species is present in several protected areas in Namibia and Angola. In South Africa it has been reported from the protected Algeria forestry station. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Sauromys petrophilus is found in southern Africa, ranging along the west coast from the Angola and Namibia border area, south into southern South Africa, and from here into northeastern South Africa, Zimbabwe, and western Mozambique. It is found between 100 m and 2,000 m asl. In the RSA, its distribution is best predicted by geology (Babiker Salata, 2012: 50).

Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 915,652 km^2.

The Ghanaian specimen which should be in the USNM (see Meester *et al.*, 1986), could not be located in the collection (see Jacobs and Fenton, 2002: 2).

Native: Angola; Botswana (Monadjem *et al.*, 2010d: 545); Mozambique (Monadjem *et al.*, 2010d: 545; Monadjem *et al.*, 2010c: 382); Namibia (Monadjem *et al.*, 2010d: 545); South Africa (Seamark and Kearney, 2007; Monadjem *et al.*, 2010d: 545)); Zimbabwe (Monadjem *et al.*, 2010d: 545).
Presence uncertain: Ghana.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Jacobs and Fenton (2002).

Schoeman and Jacobs (2002: 157) mention the following wing parameters for 51 specimens from the Algeria Forestry Station (RSA): Fa: 39.0 ± 1.0 mm, Wing area: 93.1 ± 11 cm^2, Wing span: 26.3 ± 1.9 cm, Wing loading: 11.2 ± 1.1 N/m^2, and aspect ratio: 7.4 ± 0.6.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
As indicated by Rautenbach and Nel (1980: 112), the extremely flattened skull is an adaptation to roosting in the narrowest of rock crevices.
For further details, see Jacobs and Fenton (2002).

DETAILED MORPHOLOGY:
Baculum - Unknown
For a description of the crania, ears and tragus, and wingshape and aspect ratio, see Jacobs and Fenton (2002).

Curtis and Simmons (2018: 1390) found a relatively large, anteroposteriorly elongated, single, mineralized midline element positioned anterior to the dorsal margin of the nasal aperture in the cupular cartilages. Their CT-microscans showed a variation in the grayscale, suggesting porosity or trabeculae, which in turn might suggest a bony structure.

FUNCTIONAL MORPHOLOGY:
Toussaint and McKechnie (2012: 1138) found that the rapid increases in Evaporate Water Loss at high ambient temperatures in *S. petrophilus* may imply that, notwithstanding having a comparatively heat tolerance, this species may also be most vulnerable to lethal dehydration during future heat waves.

ECHOLOCATION:
See Jacobs and Fenton (2002).

From Algeria Forest Station (RSA), Schoeman and Jacobs (2002: 157) reported the type of calls to be low duty echolocation dominated by frequency modulated calls, with a F_{peak}: 29.2 ± 1.8 kHz.

Two calls by bats from the Kalahari Desert had the following characteristics: F_{char}: 24.0 ± 0.2 kHz, F_{max}: 30.3 ± 3.2 kHz, F_{min}: 23.7 ± 0.1 kHz, duration: 4.3 ± 0.7 msec (Adams and Kwiecinski, 2018: 4).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 48, FN = 62, BA = 16, a submetacentric X chromosome, and an acrocentric Y chromosome for specimens from Namibia and South Africa. However, this did not include specimens from the Western Cape that Rautenbach *et al.* (1993) included with *Chaerephon pumilus*, but have subsequently been reidentified as *S. petrophilus* (Jacobs and Fenton, 2001).
Protein / allozyme - Unknown.

HABITAT:
Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *S. petrophilus* activity was significantly and positively influenced by size of wetland, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body. *S. petrophilus* favoured open habitats surrounding wetlands (Sirami *et al.*, 2013: 35) .

HABITS:
See Jacobs and Fenton, 2002).

ROOST:
See Jacobs and Fenton (2002).

DIET:
See Jacobs and Fenton (2002).

From the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following prey groups based on 464 faecal pellets from 51 bats (in volume percent): Diptera (37.8 ± 31.2), Hemiptera (32.9 ± 23.7), Coleoptera (19.5 ± 23.1), Hymenoptera (7.9 ± 16.2), Neuroptera (0.6 ± 3.0), Trichoptera (0.4 ± 2.9), Lepidoptera (0.3 ± 2.2), and unknown (1.0 ± 3.3).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention *S. petrophilus* as possible prey of Lanner falcon (*Falco biarmicus* Temminck, 1825) and Peregrine falcon (*Falco peregrinus* Tunstall, 1771),

POPULATION:
Structure and Density - This is a locally common species. It is generally found in small numbers, with colonies thought to be tens of animals rather than hundreds (Jacobs and Fenton, 2002).
Trend - 2008 - Stable (Mickleburgh *et al.*, 2008an; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
See Jacobs and Fenton, 2002).

REPRODUCTION AND ONTOGENY:
See Jacobs and Fenton (2002).

VIRUSES:
Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested 12 individuals from Riemvasmaak, Northern Cape, South Africa using "Trousse Platelia Rage" ELISA kit (Diagnostic Pasteur), none tested positive for antibodies to rabies virus glycoprotein G. Oelofsen and Smith (1993) tested 12 individuals from Riemvasmaak, Northern Cape, South Africa by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

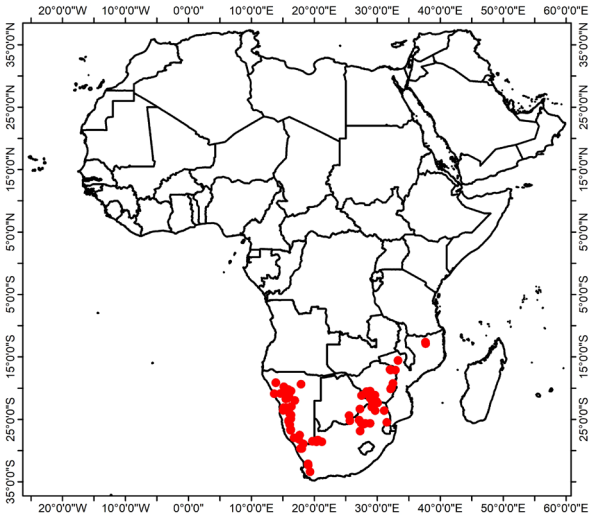


Figure 197. Distribution of *Sauromys petrophilus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Botswana, Mozambique, Namibia, South Africa, Zimbabwe.

Sauromys petrophilus erongensis (Roberts, 1946)

*1946. *Platymops petrophilus erongensis* Roberts, Ann. Transv. Mus., 20 (4): 308. Type locality: Namibia: Damaraland: Omaruru district: Eronga Mountains: Ombu Farm [21 35 S 15 43 E] [Goto Description]. Holotype: TM 9494: ♂. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 19 September 1941; original number: 112 (14). Presented/Donated by: ?: Collector Unknown. Holotype: TM 9570: ♂. Collected by: Austin Roberts; collection date: 22 September 1941; original number: 128. Presented/Donated

by: ?: Collector Unknown. Paratype: TM 9495: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 14 September 1941; original number: 77. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9496: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 17 September 1941; original number: 93. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9497: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 17 September 1941; original number: 95. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9497a: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 14 September 1941. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9498: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 18 September 1941; original number: 105. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9499: ♂. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 18 September 1941; original number: 106. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9500: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 18 September 1941; original number: 108. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9501: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 18 September 1941; original number: 107. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9502: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 19 September 1941; original number: 113. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9503: ♀. Collected by: The Barlow TM-Expedition and Austin Roberts; collection date: 19 September 1941; original number: 115. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9504: ♂. Collected by: Austin Roberts; collection date: 19 September 1941; original number: 116. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9505: ♂. Collected by: Austin Roberts; collection date: 19 September 1941; original number: 117. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9506: ♂. Collected by: Austin Roberts; collection date: 19 September 1941; original number: 118. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9507: ♀. Collected by: Austin Roberts; collection date: 20 September 1941; original number: 124. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9508: ♂. Collected by: Austin Roberts; collection date: 20 September 1941; original number: 125. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9511: ♂. Collected by: Austin Roberts; collection date: 22 September 1941; original number: 129. Presented/Donated by: ?: Collector Unknown. Paratype: TM 9512: ♀. Collected by: Austin Roberts; collection date: 22 September 1941; original number: 129. Presented/Donated by: ?: Collector Unknown. - Etymology: Referring to the Eronga mountains, where the type specimen was collected.

? *Mormopterus petrophilus erongensis:* (Name Combination)

? *Sauromys petrophilus erongensis:* (Name Combination, Current Combination)

Sauromys petrophilus haagneri (Roberts, 1917)

1917. *Platymops (Sauromys) haagneri:* Roberts, Ann. Transv. Mus., 6 (1): 5. Publication date: 28 June 1917. (Name Combination)

*1917. *Platymops haagneri* Roberts, Ann. Transv. Mus., 6 (1): 5. Publication date: 28 June 1917. Type locality: Namibia: Great Namaqualand: Keetmanshoop [26 35 00 S 18 08 00 E, 984 m] [Goto Description]. Holotype: TM X472: ad ♂. Collected by: Mr. Sigmund Haagner. Presented/Donated by: Mr. Sigmund Haagner.

? *Sauromys haagneri:* (Name Combination)

? *Sauromys petrophilus haagneri:* (Name Combination, Current Combination)

COMMON NAMES:
Afrikaans: Haagnerse Platkopvlermuis. English: Haagner's Flat-headed Bat.

Sauromys petrophilus petrophilus (Roberts, 1917)

*1917. *Platymops (Sauromys) petrophilus:* Roberts, Ann. Transv. Mus., 6(1): 5. Publication date: 28 June 1917.
? *Sauromys petrophilus petrophilus:* (Name Combination, Current Combination)

Sauromys petrophilus umbratus (Shortridge & Carter, 1938)

*1938. *Platymops haagneri umbratus* Shortridge and Carter, Ann. S. Afr. Mus., 32 (4): 282. Publication date: July 1938. Type locality: South Africa: Western Cape province: 11 mi [=18 km] NE Clanwilliam, Pakhuis Pass: Kliphuis [32 08 S 19 00 E] [Goto Description]. Holotype: KM 2827: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown.
1946. *Platymops petrophilus fitzsimonsi* Roberts, Ann. Transv. Mus., 20 (4): 308. Type locality: South Africa: SW Cape province: near Ceres: Mitchell's Pass [Goto Description]. Holotype: TM 8968: ♀. Collected by: Austin Roberts; collection date: 7 November 1940; original number: 63. Presented/Donated by: ?: Collector Unknown. Holotype: TM 8969: ♀. Collected by: Austin Roberts; collection date: 7 November 1940. Presented/Donated by: ?: Collector Unknown.
? *Sauromys petrophilus umbratus:* (Name Combination, Current Combination)

Genus ***Tadarida*** Rafinesque, 1814

*1814. *Tadarida* Rafinesque, Précis des découvertes et travaux somiologiques, 55. Publication date: 3 June 1814. - Comments: Type species: *Cephalotes teniotis* Rafinesque, 1814. - Etymology: Meaning unknown (Flannery, 1990: 366). Possibly from the Greek "data" or Latin "taeda" and "nukterida" (see Kozhurina, 2002: 18). Braun and Mares (1995: 182) refer to Gotsch (1979), who states this is a word created by C.S. Rafinesque. Lanza *et al.* (2015: 317 - 318) gives the following explanation: "From the feminine Greek substantive "*νυκτερίς*" (nykterís) [genitive "*νυκτερίδος*" (nikterídos)], meaning "bat"; by aphaeresis] and dialectal deformation, the above genitive turned into "tadarida" in southern Italy. Some examples of similar dialect deformations are according to Forsyth Major (1893): tagddariti (Naples); taddarita, taddarida and taddarito (Calabria), tardaritòla and tardarira (Sicily)". (Current Combination)
1818. *Nyctinomus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 114, pl. 2. Publication date: 1818 [Goto Description]. - Comments: Type species: *Nyctinomus aegyptiacus* E. Geoffroy St. Hillaire, 1818. - Etymology: From the Greek "*νύξ*" or "*νυκτός*", meaning night and "*νομός*", meaning habitation (see Palmer, 1904: 466).
1821. *Nyctimones* Gray, London Med. Repos., 15: 299. Publication date: 1 April 1821. - Comments: Generally, the name is reported as *Nyctinomes*, but Gray (1821: 299) actually mentioned *Nyctimones*, with one species *Vesp. acetabulosus*.
1821. *Nyctinoma* Bowdich, Analysis of the Natural Classification of Mammalia, p. 28.
1822. *Nyctinomia* Fleming, The Philosophy of Zoology, 2: 178 [Goto Description].
1825. *Dinops* Savi, Nuov. Giorn. Letter. Pisa, Sci., 10: 229. - Comments: Type species: *Dinops cestoni* Savi, 1824 (=*Cephalotes teniotis* Rafinesque, 1814). - Etymology: From the Greek "*δεινός*", meaning terrible and "*ώψ*", meaning face or aspect, probably referring to the deeply grooved or wrinkled face (see Palmer, 1904: 234).
1830-1831. *Dysopes* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 69. Publication date: 1830-1831. - Comments: Not of Illiger, 1811. The publication date of Cretzschmar's work is sometimes indicated as "1826" (as mentioned on the title page), but also as "1827", "1828", "1830-1831".
1934. *Austronomus* Iredale and Troughton, Mem. Aust. Mus., p. 100. - Comments: Type species: *Nyctinomus australis atratus* Thomas, 1924 (=*Molossus australis* Gray, 1839). (*Nomen Nudum*).

1941. *Austronomus* Troughton, Animals of Australia, 1st ed, 360. - Comments: Type species: *Nyctinomus australis atratus* Thomas, 1924 (=*Molossus australis* Gray, 1839). Validation of *Austronomus* Iredale and Troughton, 1934 (see Meester *et al.*, 1986: 68; Simmons (2005).
1973. *Tatarida:* Eisentraut, Bonn. zool. Monogr., 3: 113. (Lapsus)
1984. *Rhizomops* Legendre, Rev. suisse Zool., 91 (2): 427. Publication date: June 1984. - Comments: Type species: *Rhizomops brasiliensis* (I. Geoffroy Saint-Hilaire, 1824). - Etymology: From the Greek "*riza*" meaning root (see Legendre, 1984: 427).
1995. *Dynops:* Pavlinov, Borissenko, Kruskop and Jahonton, Arch. Zool. Mus., Moscow State Univ., 133: ???. (Lapsus)
? *Tadarida sp.:*

TAXONOMY:
Formerly included *Chaerephon*, *Mops*, *Mormopterus*, and *Nyctinomops*; see Freeman (1981b: 133). Includes *Rhizomops*, but see Legendre (1984); see also Owen *et al.* (1990). Mahoney and Walton (1988c) regarded *Nyctinomus* as the prior name for this genus.

Based on their analysis of molecular data, Lamb *et al.* (2011: 9) suggest that the genus *Tadarida* - as currently recognized - is not a natural group. *Tadarida teniotis* - the type species of the genus - forms a separate clade from *T. aegyptiaca* - the type species of *Nyctinomus* - and "*C. jobimena*". They suggest that the two latter species - together with other species - might be placed in a separate genus: *Nyctinomus*, but they await further taxonomic sampling and resolution of the phylogeny of other African taxa before making this formal.

Known species within the genus *Tadarida*: ***aegyptiaca*** (E. Geoffroy, 1818); *australis* (Gray, 1839) – south and central Australia (Simmons, 2005: 449); *brasiliensis* (I. Geoffroy, 1824) – southern Brazil, Bolivia, Argentina and Chile to Oregon, south Nebraska and Ohio (USA), Greater and Lesser Antilles (Simmons, 2005: 450); ***fulminans*** (Thomas, 1903); *insignis* Blyth, 1862 – Japan, Taiwan, Korea, southern China (Simmons, 2005: 450); *kuboriensis* McKean and Calaby, 1968 – New Guinea (Simmons, 2005: 450); *latouchei* Thomas, 1920 – northern China, Thailand, Laos, Japan (Simmons, 2005: 450); ***lobata*** (Thomas, 1891); ***teniotis*** (Rafinesque, 1814); ***ventralis*** (Heuglin, 1861).

COMMON NAMES:
Czech: širokouší morousi (hroznohledové, netopýři morousovití. English: Guano Bats, Free-tailed Bats, Tadarine Bats. French: Tadarides. German: Gewöhnliche Bulldoggfledermäuse. Italian: Tadarìde.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery (2007: 619) reported on the presence of *Tadarida* sp. in Pleistocene deposits at Wonderwerk Cave, South Africa.

PARASITES:
Barbosa *et al.* (2016: 215) reported *Trypanosoma erneyi* from a *Tadarida* sp. from Mozambique.

ACARI
Myobiidae: Fain (1994: 1280) reports one species of *Schizomyobia*, living on Old World *Tadarida*.

†*Tadarida engesseri* Rachl, 1983

*1983. *Tadarida engesseri* Rachl, Die Chiroptera (Mammalia) aus den mittelmiozänen Kalken des Nordlinger Rieses (Suddeutschland). Thesis Doct, Ludwig-Maximilians. Universität München.. Type locality: Germany: Steinberg (Ries).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Middle Miocene (Astaracanian).

GENERAL DISTRIBUTION:
Europe; Morocco Hugueney *et al.* (2015: 472).

Tadarida aegyptiaca (E. Geoffroy St.-Hilaire, 1818)

*1818. *Nyctinomus ægyptiacus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 128, pl. 2, No 2. Publication date: 1818. Type locality: Egypt: Giza province: Giza [30 01 N 31 13 E]. Lectotype: MNHN ZM-MO-1986-1084 (A.467): ad ♂, skin and skull. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector

Unknown. Number 228 in Rode (1941: 251). - Comments: Type locality restricted from "Egypt" to Giza by Koopman (1975: 422): see Qumsiyeh (1985: 73), Meester *et al.* (1986: 70). - Etymology: From the scientific Latin feminine adjective *aegyptiacus*, meaning "Egyptian", as the species was decribed from an Egyptian specimen (see Lanza *et al.*, 2015: 319).

1855. *D[ysopes] aegyptiacus:* Giebel, Die Säugethiere., 957. (Name Combination)

2012. *Nyctinomus aegyptiacus:* Benda, Faizolâhi, Andreas, Obuch, Reiter, Ševcík, Uhrin, Vallo, and Ashraf, Acta Soc. Zool. Bohem., 76: 163, 516. Publication date: 27 December 2012. (Alternate Spelling)

2018. *Tadarida aegyptica:* Lazzeroni, Burbrink and Simmons, Ecol. Evol., 8 (24): 12584. Publication date: 28 November 2018. (Lapsus)

? *Tadarida (Tadarida) aegyptiaca:* (Name Combination)

? *Tadarida aegyptiaca:* (Name Combination, Current Combination)

TAXONOMY:
Includes *tragata*; see Corbet (1978: 63) and Freeman (1981b: 165). However, see Benda *et al.* (2012a: 523) and Bendjeddou *et al.* (2016b:23) who consider *tragata* to be a separate species, extralimital to Africa.

Benda *et al.* (2012a: 516) place this taxon in the genus *Nyctinomus*, a view followed by a.o. Bendjeddou *et al.* (2016b: 23).

COMMON NAMES:
Afrikaans: Egiptiese losstertvlermuis. Bengali: Lomba-leji Chamchika. Chinese: 北非犬吻蝠. Czech: morous egyptský, přišerec egipecký, tadarida jižní, morous jižní. Dutch: Egyptischte bulvleermuis. English: Egyptian Free-tailed Bat, Egyptian Guano Bat, Egyptian Nyctinome. French: Tadaride d'Egypte, Molosse d'Egypte. German: Ägyptische Bulldoggfledermaus. Italian: Tadarìda egiziàna. Portuguese: Morcego de cauda livre do egipto. Tamil: எகிப்தி ய வாலற்ற வௌவால், Ekiptiya Vālarra Veḷavāl.

ETYMOLOGY OF COMMON NAME:
The original specimens were collected in Egypt during the Napoleonic wars by E. Geoffroy Saint-Hilaire, who at that time served under Napoleon (see Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery and Avery (2011: 18) report on Holocene and Pleistocene remains from Wonderwerk (Northern Cape province, South Africa).

CONSERVATION STATUS:
Global - Broadly distributed and locally common, hence is listed as Least Concern (LC ver 3.1 (2001)) (Mickleburgh *et al.*, 2008ar; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008ar; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2004bb; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (MacEwan *et al.*, 2016a). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
No serious threats other than roost disturbance from human interference is noted for this species (Molur *et al.*, 2002). Pesticides used against locusts are a threat as for all bat species found in the Saharan belt (Mickleburgh *et al.*, 2008ar; IUCN, 2009). Furthermore, Doty and Martin (2012: 75) report on fatalities due to wind turbines in the Eastern Cape, South Africa.

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008ar) [in IUCN (2009)] report that the species is protected by national legislation in some of the Mediterranean range states as well as in South Africa. It is likely to be found in protected areas. A survey using bat detectors should be undertaken to help clarify the distribution limits and population size of this species as it is probably more widespread than current records indicate. A study on the impacts of pesticides is required, especially ways in which the impact might be minimised.

GENERAL DISTRIBUTION:
Tadarida aegyptiaca is found throughout Africa, and in the Arabian Peninsula through to India, Sri Lanka and Bangladesh. In the Mediterranean region there are isolated records from southern Morocco and western Algeria, but it is more widely distributed in Egypt along the Nile River valley eastwards to the Red Sea coast and south to the Sudanese border. The species is thought to be more widely distributed than is currently known and may well occur elsewhere in the region. In South Asia, this widely distributed species is presently known from Afghanistan (Kabul Province) (Habibi, 2003), Bangladesh (no exact location) (Khan, 2001; Srinivasulu and Srinivasulu, 2005), India (Andhra Pradesh, Gujarat, Karnataka,

Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and West Bengal), Pakistan (Punjab and Sind) and Sri Lanka (Central and Uva Provinces) (Molur *et al.*, 2002). Elevation: sea level up to 2,100 m asl.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,214,127 km^2. In the RSA, the species' distribution is linked with land use/land cover (Babiker Salata, 2012: 50).

Native: Afghanistan; Algeria; Angola (Crawford-Cabral, 1989; Hayman, 1963; Monadjem *et al.*, 2010d: 545; Taylor *et al.*, 2018b: 63); Bangladesh; Botswana (Monadjem *et al.*, 2010d: 545); Congo (The Democratic Republic of the); Egypt; Ethiopia; Eritrea (Lavrenchenko *et al.*, 2004b: 132); India; Iran, Islamic Republic of; Kenya; Lesotho (Lynch, 1994: 197; Monadjem *et al.*, 2010d: 545); Mauritania; Morocco (Benda *et al.*, 2004d; El Ibrahimi and Rguibi Idrissi, 2015: 365); Mozambique (Monadjem *et al.*, 2010d: 545; Monadjem *et al.*, 2010c: 382); Namibia (Monadjem *et al.*, 2010d: 545); Nigeria; Oman; Pakistan; Saudi Arabia; South Africa (Seamark and Kearney, 2007; Monadjem *et al.*, 2010d: 546); Swaziland (Monadjem *et al.*, 2010d: 546); Sri Lanka; Sudan; Tanzania; Tunisia (Bendjeddou *et al.*, 2016b: 23); Uganda; Yemen (Benda *et al.*, 2011b: 45); Zambia (Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 546); Zimbabwe (Monadjem *et al.*, 2010d: 546).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Schoeman and Jacobs (2002: 157) reported the following parameters for 43 specimens from the Algeria Forestry Station (RSA): Fa: 45.1 ± 1.2 mm, Wing area: 115.2 ± 8.4 cm^2, Wing span: 30.8 ± 1.0 cm, Wing loading: 13.1 ± 1.6 N/m^2, and aspect ratio: 8.3 ± 0.6.

ECHOLOCATION:
See Taylor (1999b).

From Algeria Forest Station (RSA), Schoeman and Jacobs (2002: 157) reported the type of calls to be low duty echolocation dominated by frequency modulated calls, with a F_{peak}: 22.8 ± 1.9 kHz.

Schoeman and Waddington (2011: 291) mention a peak frequency of 21.8 ± 1.7 kHz and a duration of 12.8 ± 0.7 msec for specimens from Durban, South Africa.

From Waterberg, South Africa, Taylor *et al.* (2013b: 18) recorded the following parameters for 8 calls: F_{max}: 28.3 ± 3.36 (24.8 - 34.1) kHz, F_{min}: 21.6 ± 2.73 (17.2 - 24.0) kHz, F_{knee}: 24.2 ± 1.47 (21.9 - 26.1) kHz, F_{char}: 22.8 ± 1.39 (20.5 - 24.5) kHz, duration: 7.2 ± 3.10 (3.3 - 10.9) msec.

At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 24 (22 - 26) kHz.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg range (RSA): F_{min}:17 - 24 kHz, F_{char}: 20 - 24 kHz, F_{knee}: 22 - 26 kHz, Slope: 65 - 221 OPS, duration: 3 - 11 msec. In the Mapungubwe National Park (RSA), Parker and Bernard (2018: 57) recorded 20 calls with the following characteristics: F_{char}: 23.68 ± 1.51 kHz, F_{max}: 29.23 ± 5.77 kHz, F_{min}: 22.47 ± 1.74 kHz, F_{knee}: 25.72 ± 2.92 kHz, duration: 9.87 ± 3.93 msec, with 4.10 ± 2.72 calls/sec.

Moores and Brown (2017: 612) recorded the following parameters for 25 calls from southern Morocco: F_{start}: 26.0 ± 2.6 (22.2 - 30.4) kHz, F_{max}: 19.6 ± 1.6 (17.4 - 22.3) kHz, F_{end}: 18.4 ± 0.8 (17.2 - 19.5) kHz, duration: 9.4 ± 1.4 (8.1 - 12.2) msec, interpulse interval: 373 ± 153 (220 - 780) msec.

Adams and Kwiecinski (2018: 4) reported the following values for 5 calls from the Kalahari Desert: F_{char}: 21.6 ± 1.2 kHz, F_{max}: 25.2 ± 1.1 kHz, F_{min}: 21.2 ± 1.1 kHz, duration: 4.9 ± 0.6 msec.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Both Nagorsen *et al.* (1976) and Rautenbach *et al.* (1993) reported 2*n* = 48 and an actrocentric Y chromosome. However, while Nagorsen *et al.* (1976) reported FN = 54, BA = 8, and a submetacentric X chromosome, Rautenbach *et al.* (1993) reported FN = 68, BA = 22, and a metacentric X chromosome, for specimens from Namibia and South Africa.
Protein / allozyme - Unknown.

HABITAT:
Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *T. aegyptiaca* activity was significantly and positively influenced by wetland size, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body. *T. aegyptiaca* favoured open habitats surrounding wetlands (Sirami *et al.*, 2013: 35).

HABITS:
Rautenbach and Nel (1980: 112) indicate that this is fast flying bat which follows a relatively straight flight path.

Thomas and Jacobs (2013: 129) report that, at De Hoop Nature Reserve, South Africa, bats feeding on Diptera (such as *T. aegyptiaca*) emerged later than bats feeding on Lepidoptera (e.g. *Rhinolophus capensis* and *Nycteris thebaica*).

ROOST:
In the Durban area (RSA), Taylor *et al.* (1999: 68) found these bats roosting in high-rise buildings of the Central Business District, and the colony sizes varied between 30 and an estimated 300.

Toussaint *et al.* (2010) examined roost temperature in Pretoria, South Africa.

DIET:
In Zimbabwe, Fenton and Thomas (1980: 86) report that the diet of *T. aegyptiaca* consists of Lepidoptera and Coleoptera.

From the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following prey groups based on 314 faecal pellets from 43 bats (in volume percent): Diptera (34.6 ± 33.4), Coleoptera (25.5 ± 30.7), Hemiptera (19.2 ± 24.6), Hymenoptera (8.4 ± 22.2), Lepidoptera (5.4 ± 13.4), Ephemeroptera (2.7 ± 7.7), Neuroptera (1.5 ± 6.5), Orthoptera (0.6 ± 3.4), and unknown (1.4 ± 7.1).

For Saudi-Arabia, Benda *et al.* (2012a: 524) indicate that some diet samples were dominated by Lepidoptera, whereas others were dominated by Coleoptera and Hymenoptera or by Heteroptera and Brachycera. In Iran, three digestive tracts were analysed: One tract was empty, one contained Lepidoptera (30 % of volume), Coleoptera (Scarabaeidae) (30 %), Neuroptera (Myrmeleontidae) (10 %), and Orthoptera (Ensifera) (30 %), and the third tract contained Coleoptera (Elateridae, Carabidae) (60 %) and Orthoptera (Ensifera) (40 %).

PREDATORS:
Avery *et al.* (2005: 1054) found this species to be present in pellets from *Tyto alba* in South Africa.

Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - This species is widespread and common in its South Asian range, where its population seems to be stable (Molur *et al.*, 2002). Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008ar; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Toussaint *et al.* (2010) examined heterothermy in *T. aegyptiaca* in Pretoria, South Africa.

REPRODUCTION AND ONTOGENY:
In Pretoria (South Africa), Tsita (1993), Bernard and Tsita (1995: 18) and le Grange *et al.* (2011: 170 - 171) found spermatogenesis occurring in January, and spermatozoa were first found in the epididymis in May, where they were stored until the end of September. In females, follicular development was already taking place in January. Copulation, ovulation and fertilization took place in August to early September; and births took place in December. Their conclusion was that *T. aegyptiaca* is a monoestrous, monotocous seasonal breeder. le Grange *et al.* (2011: 173) also indicate that, at 33° S, spermatogenesis only started in February, and that follicular development only started in April, but copulation, ovulation, and fertilization also occurred at the end of August.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births in November or December.

PARASITES:
Copeland *et al.* (2011: 363) reported the rediscovery of the "terrible hairy fly" (*Mormotomyia hirsuta* (after 62 years) in guano produced by *C.* cf. *bivittatus* and *T. aegyptiaca* at Ukasi Hill, Kenya.

From Algeria, the following ectoparasites were reported by Bendjeddou *et al.* (2017: 15): Nycteribiidae: *Nycteribia (Nycteribia) pedicularia* Latreille, 1805 and *Phthiridium biarticulatum* Hermann, 1804; Streblidae: *Brachytarsina (Brachytarsina) flavipennis* Macquart, 1851: and Arachnida: *Spinturnix myoti* (Kolenati, 1856) and *Eyndhovenia euryalis* (G. Canestrini, 1885).

VIRUSES:
Bunyaviridae
Phlebovirus
Rift Valley Fever Virus (RVFV) - Oelofsen and Van der Ryst (1999) tested 24 individuals from two localities in the Free State Province, South Africa for RVFV antigen using an enzyme linked immunosorbet assay (ELISA), none tested positive.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested 55 individuals from four localities using "Trousse Platelia Rage" ELISA kit (Diagnostic Pasteur), none tested positive for antibodies to rabies virus glycoprotein G. Oelofsen and Smith (1993) tested 89 individual brains, from 9 localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

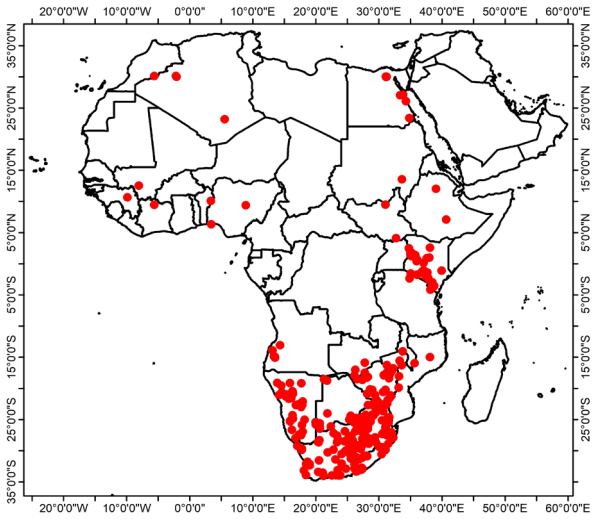


Figure 198. Distribution of *Tadarida aegyptiaca*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Angola, Botswana, Côte d'Ivoire, Egypt, Ethiopia, Guinea, Kenya, Lesotho, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

Tadarida aegyptiaca aegyptiaca (E. Geoffroy St.-Hilaire, 1818)

*1818. *Nyctinomus ægyptiacus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 128, pl. 2, No 2. Publication date: 1818. Type locality: Egypt: Giza province: Giza [30 01 N 31 13 E]. - Comments: Type locality restricted from "Egypt" to Giza by Koopman (1975: 422): see Qumsiyeh (1985: 73), Meester *et al.* (1986: 70). - Etymology: From the scientific Latin feminine adjective *aegyptiacus*, meaning "Egyptian", as the species was decribed from an Egyptian specimen (see Lanza *et al.*, 2015: 319).

1827. *Dysopes geoffroyi* Temminck, Monogr. Mamm, 1: 226, pls 19, 23. Publication date: 1827. - Comments: Allen (1939a: 110), Qumsiyeh (1985: 73) mentioned 1827 as year of publication. Kock (1969a: 137), Meester *et al.* (1986: 70) mention 1826. Substitute for *aegyptiacus* E. Geoffroy St. Hilaire (see Ellerman and Morrison-Scott, 1951: 135; Harrison, 1964a: 109; Kock, 1969a: 137; Qumsiyeh, 1985: 73; Meester *et al.*, 1986: 70).

1877. *Dysopes talpinus* Heuglin, Reise in Nordost Afrika, 2: 28. Publication date: 1877. Type locality: Sudan: Bahr-el-Ghazal province: Kidj district: Bahr el Jebel, West bank: "Kidj district" [ca. 07 06 N 30 46 E].

1916. *Nyctinomus (Nyctinomus) tongaënsis* Wettstein, Anz. kais. Akad. Wiss., Wien, 53: 192. Publication date: 1916. Type locality: Sudan: Upper White Nile: Tonga [09 30 N 31 03 E] [Goto Description]. Syntype: NMW 8406: ♂, alcoholic (skull not removed). Collected by: Prof. Dr. Franz Werner; collection date: 16 April 1916. Presented/Donated by: Otto Ritter von Westersheim Wettstein. See Benda *et al.* (2012a: 582). Syntype: NMW 8407: ♂, skull and alcoholic. Collected by: Prof. Dr. Franz Werner; collection date: 16 April 1916. Presented/Donated by: Otto Ritter von Westersheim Wettstein. See Benda *et al.* (2012a: 582). - Comments: Wettstein (1916: 189, 192) mentions two male type specimens, collected by Prof. Dr. Franz Werner on 16 April 1914.

1938. *[Nyctinomus] tongaënsis:* Frechkop, Exploration du Parc National Albert, 54. (Name Combination)

? *Tadarida aegyptiaca aegyptiaca:* (Name Combination, Current Combination)

? *tongaensis:* (Current Spelling)

GENERAL DISTRIBUTION:
Arabia, N Africa (Horácek *et al.*, 2000: 136).

PARASITES:
SIPHONAPTERA

Ischnopsyllidae: *Araeopsylla scitula* (Rothschild 1909) found in southern Africa from Cape, Natal, Transvaal Provinces of South Africa, Lesotho and Botswana (Haeselbarth *et al.*, 1966: 189).

Tadarida aegyptiaca bocagei (Seabra, 1900)

1900. *Nyctinomus Anchietæ* Seabra, J. Sci. mat. phys. nat., ser. 2, 6: 82. Publication date: August 1900. Type locality: Angola: W Angola: Quibula [Goto Description].

*1900. *Nyctinomus Bocagei* Seabra, J. Sci. mat. phys. nat., ser. 2, 6: 84. Publication date: August 1900. Type locality: Angola: Benguela district: East of Hanha: Galanga [12 04 S 15 09 E] [Goto Description].
1900. *Nyctinomus brunneus* Seabra, J. Sci. mat. phys. nat., ser. 2, 6: 83. Publication date: August 1900. Type locality: Angola: NE of Benguela: Quissange [12 30 S 14 05 E] [Goto Description].
1941. *Tadarida bocagei:* Hill and Carter, Bull. Am. Mus. Nat. Hist., 78 (1): 55. Publication date: 25 July 1941. (Name Combination)
? *Tadarida (Tadarida) aegyptiaca bocagei:* (Name Combination)
? *Tadarida aegyptiaca bocagei:* (Name Combination, Current Combination)

TAXONOMY:
If page precedence is to be taken into account, *anchietae* might be the senior synonym for this form.

COMMON NAMES:
Afrikaans: Bocagese Losstertvlermuis. English: Bocage's Free-tailed Bat.

GENERAL DISTRIBUTION:
Angola and Zambia to South Africa (Horácek *et al.*, 2000: 136).

PREDATORS:
Dean (1975: 218) reports on remains being found in barn owl (*Tyto alba*) pellets in South Africa.

PARASITES:
HEMIPTERA
Cimicidae: *Stricticimex transverses* Ferris and Usinger, 1957 from Kanye, Botswana (Haeselbarth *et al.*, 1966: 15).

SIPHONAPTERA
Ischnopsyllidae: *Araeopsylla scitula* (Rothschild, 1909) found in southern Africa from Cape, Natal, Transvaal Provinces of South Africa, Lesotho and Botswana (Haeselbarth *et al.*, 1966: 189).

ACARI
Trombiculidae: *Microtrombicula kanyei* Vercammen-Grandjean, 1965 was reported by Stekolnikov (2018a: 155) from bats from Kanye, Botswana.

Tadarida fulminans (Thomas, 1903)

*1903. *Nyctinomus fulminans* Thomas, Ann. Mag. nat. Hist., ser. 7, 12 (71): 501. Publication date: 1 November 1903. Type locality: Madagascar: Eastern Betsileo: Fianarantsoa [21 36 S 47 05 E, 1 130 m] [Goto Description]. Holotype: BMNH 1882.3.1.34: ♂, skull and alcoholic. Collected by: Rev. W. Deans Cowan; original number: 4. - Etymology: From the Latin "*fulminate*" meaning strike with lightning.
1946. *Nyctinomus mastersoni* Roberts, Ann. Transv. Mus., 20 (4): 306. Type locality: Zimbabwe: Bindura district: Masembura Nature Reserve: Chikupu caves [17 24 S 31 20 E] [Goto Description]. Holotype: TM 9976: ad ♂, skin and skull. Collected by: H.B. Masterson; collection date: 10 July 1945. Topotype: ROM 64580: ad ♂, skin and skull. Collected by: Randolph L. Peterson and G.E. Turner; collection date: 11 May 1972. Presented/Donated by: ?: Collector Unknown.
2004. *Tadarida fulmilans:* Goodman and Cardiff, Acta Chiropt., 6 (2): 227. (Lapsus)
? *Tadarida fulminans mastersoni:* (Name Combination)
? *Tadarida fulminans:* (Name Combination, Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Afrikaans: Madagaskarse grootlosstertvlermuis. Chinese: 岛犬吻蝠. Czech: morous východoafrický. English: Large Free-tailed Bat, Lightning Guano Bat, Large Guano Bat, Madagascan Large Guano Bat, Madagascan Large Free-tailed Bat, Madagascan Free-tailed Bat, Madagascar Large Free-tailed Bat, Malagasy Free-tailed Bat. French: Tadaride de Thomas, Grande Tadaride de Madagascar, Molosse de Madagascar. German: Madagassische Bulldoggfledermaus.

ETYMOLOGY OF COMMON NAME:
The colloquial name refers to the island where the species occurs.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide range across east and southern Africa. Although it is not a common species and can be patchily distributed, it is not thought to be facing any major threats (Cotterill *et al.*, 2008; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Cotterill *et al.*, 2008; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Cotterill, 2004b; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016z). 2004 - Considered a vagrant. Not assessed, due to known form a single locality (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species (Cotterill *et al.*, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Cotterill *et al.* (2008) [in IUCN (2009)] report that it has been recorded from one protected area in Madagascar and is presumed to exist in many protected areas within its range in eastern and southern Africa, however, there appear to be no active conservation measures in place. Further studies are needed into the distribution and taxonomic status of bats allocated to *Tadarida fulminans*.

GENERAL DISTRIBUTION:
Tadarida fulminans ranges through East Africa, southern Africa and a few localities on the island of Madagascar. Populations have been recorded through eastern and southeastern Africa, from around the border of Kenya and Uganda as far south as the border between Zimbabwe and South Africa. The most westerly record is from eastern Democratic Republic of the Congo. In Madagascar, it is only known from a few records, mostly from the central-south region near to Fianarantsoa and Isalo National Park, and from records at Tolagnaro near the southeast coast (Jenkins *et al.*, 2007a). Further surveys are needed within Madagascar (Goodman and Cardiff, 2004). It ranges from about sea level (at Fort Dauphin in Madagascar) to close to 2,000 m asl (Albertine Rift).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 541,523 km^2.

Native: Congo (The Democratic Republic of the); Kenya; Madagascar; Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 546); Mozambique (Monadjem *et al.*, 2010d: 546; Monadjem *et al.*, 2010c: 382); Rwanda; South Africa (Monadjem *et al.*, 2010d: 546); Tanzania; Zambia (Ansell, 1957; Ansell, 1967; Monadjem *et al.*, 2010d: 547); Zimbabwe (Monadjem *et al.*, 2010d: 547).

ECHOLOCATION:
See Taylor (1999b).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Peterson and Nagorsen (1975) reported 2*n* = 48, FN = 54, BA = 8, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from Zimbabwe. However, Rautenbach *et al.* (1993) reported 2*n* =48, FN =66, BA =20, a metacentric X chromosome and an acrocentric Y chromosome for specimens from South Africa.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - Locally common, but patchily distributed in Africa. On Madagascar this bat is an uncommon, patchily distributed species. Colonies of this species may consist of dozens of individuals (although always fewer than 100 animals) (Cotterill *et al.*, 2008; IUCN, 2009).
Trend - 2008 - Stable (Cotterill *et al.*, 2008; IUCN, 2009).

PARASITES:
Polyctenidae: *Hypoctenes fani* Benoit 1958, a single female collected from Rwanda (Haeselbarth *et al.*, 1966: 18).

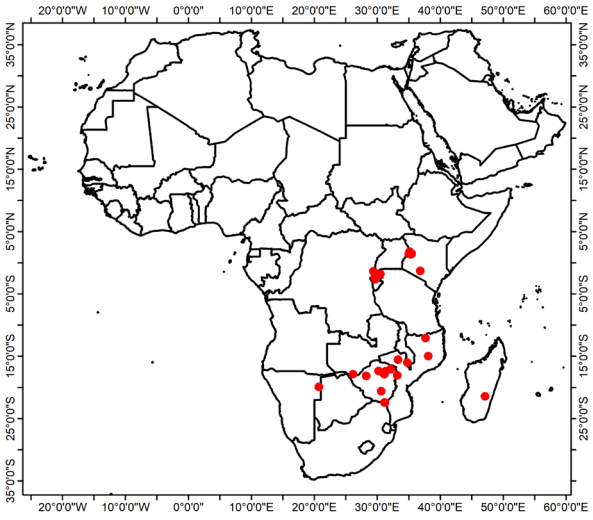


Figure 199. Distribution of *Tadarida fulminans*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Kenya, Madagascar, Malawi, Mozambique, Namibia, Rwanda, South Africa, Tanzania, Zimbabwe.

Tadarida lobata (Thomas, 1891)

*1891. *Nyctinomus lobatus* Thomas, Ann. Mag. nat. Hist., ser. 6, 7 (39): 303. Publication date: 1 March 1891. Type locality: Kenya: West Pokot: upper reaches of Turkwell: Turkwell Gorge, at or near [ca. 01 52 N 35 22 E] [Goto Description]. Holotype: BMNH 1893.2.3.7: ♂, skull and alcoholic. Collected by: Sir Frederic John Jackson. Peterson and Harrison (1970: 1) indicate that this specimen is probably a male, although they could not find any trace of scrotal development. - Etymology: From "*lobata*" meaning lobed.
? *Tadarida (Chaerephon) pumila limbata:*
? *Tadarida lobata:* (Name Combination, Current Combination, Current Spelling)
? *Tadarida pumila limbata:*

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Afrikaans: Grootoor-losstervlermuis. Chinese: 大耳犬吻蝠. Czech: morous širokouchý. English: Big-eared Guano Bat, Big-eared Kenyan Guano Bat, Kenyan Big-eared Free-tailed Bat, Big-eared Free-tailed Bat, Big-eared Kenya Free-tailed Bat, Eastern Africa Free-tailed Bat. French: Tadaride du Kenya, Tadaride de l'Afrique orientale, Molosse à grandes oreilles. German: Großohr-Bulldoggfledermaus.

ETYMOLOGY OF COMMON NAME:
The colloquial name perhaps refers to the country from which the species was originally described (see Taylor, 2005).

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) because it is associated with rocky areas in dry savanna habitat, and is unlikely to be declining fast enough to qualify for listing in a more threatened category (Cotterill, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Cotterill, 2008e; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Cotterill, 2004e; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no identifiable threats to this species (Cotterill, 2008e; IUCN, 2009).

CONSERVATION ACTIONS:
Cotterill (2008e) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further surveys are needed to better determine the range of this species, and to understand whether it is restricted to rocky areas or can persist in modified habitats.

GENERAL DISTRIBUTION:
Tadarida lobata has only been recorded from four localities in Kenya and four localities in Zimbabwe (Skinner and Chimimba, 2005). It is found between 600 and 2,000 m asl.

Native: Kenya; Zimbabwe (Monadjem *et al.*, 2010d: 547).

POPULATION:
Structure and Density - It appears to be a rare species found in small colonies (Cotterill, 2008e; IUCN, 2009). The apparent rarity might be attributed to their high-flying habits and inaccessible daylight roosts (Cotterill, 1996b).
Trend - 2008 - Unknown (Cotterill, 2008e; IUCN, 2009).

PARASITES:
Duszynski (2002: 20) indicates that *T. lobata* might be a host for *Eimeria dukei* Lavier, 1927, but as Pellérdy (1974) mentioned the bat as "*Tadarida limbata*" this might not be correct.

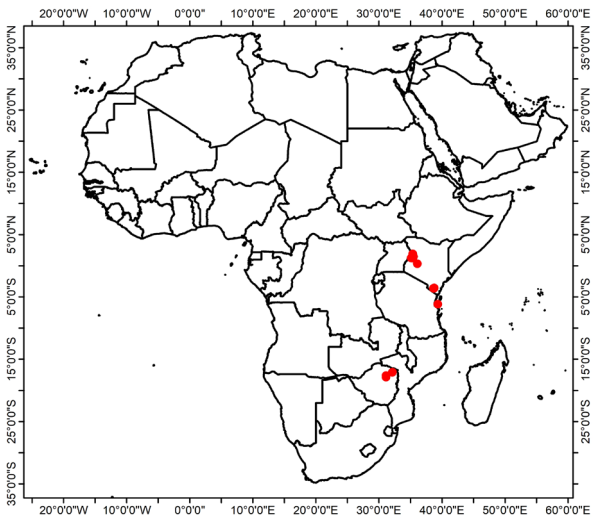


Figure 200. Distribution of *Tadarida lobata*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Kenya, Tanzania, Zimbabwe.

Tadarida teniotis (Rafinesque, 1814)

*1814. *Cephalotes teniotis* Rafinesque, Précis des découvertes et travaux somiologiques, 12, 55. Publication date: 3 June 1814. Type locality: Italy: Sicily [Goto Description]. - Etymology: From the Greek "*teniotis*" meaning striped, banded.

1825. *Dinops Cestonii* Savi, Nuov. Giorn. Letter. Pisa, Sci., 10: 230. Type locality: Italy: Tuscany: Pisa [43 43 N 10 24 E]. Syntype: ZFMK 1983.0173: ♂, alcoholic (skull not removed). Collected by: Prof. Paulo Savi; collection date: 1846. On label: "*Nyctinomus cestonii* (Savi) Dobson (In der Sammlg. Von Berthold als *Dysops Savii* angegeben) Toscana"; ex Göttingen Museun 1978: see Hutterer (1984: 32).

1827. *Dysopes rüpelii* Temminck, Monogr. Mamm, 1: 224, pl. 18. Publication date: 1827. Type locality: Egypt: Cairo [30 03 N 31 15 E]. Lectotype: SMF 12380: skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell. Presented/Donated by: ?: Collector Unknown. Locality: Egypt original number: II.K.1.b. Paralectotype: SMF 12379: skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell. Presented/Donated by: ?: Collector Unknown. Locality: Egypt old catalog number: II.K.1.a. - Comments: Type locality restricted from "Egypt" to Cairo by Qumsiyeh (1985: 71). Incorrect original spelling (*rüpelii*) corrected by Qumsiyeh (1985: 71) as *rueppellii*.

1840. *Dysopes Savii* Schinz, Europäische Fauna oder Verzeichniss der Wirbelthiere Europa's, 1: 138. - Comments: Substitute for *cestoni* (see Ellerman and Morrison-Scott, 1951: 134; Harrison, 1964a: 106). - Etymology: In honour of Gaetano Savi (1769 - 1844) (see Kozhurina, 2002: 17).

1855. *D[ysopes] Rüppelli:* Giebel, Die Säugethiere., 957. (Name Combination)

1855. *Dysopes cestonii:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur, mit Beschreibungen, Suppl. 5: 702.

1876. *Nyctinomus cestonii:* Dobson, Monogr. Asiatic Chiropt, 180.

1877. *Dysopes rüppellii:* Dobson, Proc. zool. Soc. Lond., 1876, IV: 719. Publication date: April 1877. - Comments: Correction of Temminck's *Dysopes rüpelii*.

1891. *Nyctinomus taeniotis:* Thomas, Proc. zool. Soc. Lond., 1891, II: 182. (Lapsus)

1897. *midas* Schulze, Helios, Berlin, 14: 95. - Comments: Preoccupied by *midas* Sundevall, 1843 (See Pavlinov *et al.*, 1995: 91).

1914. *Cephalotes tæniotis:* Cabrera, Fauna Ibérica, 145. (Lapsus)

1985. *rueppellii* Qumsiyeh, Spec. Publ. Mus. Texas Tech. Univ., 23: 71. - Comments: Emendation of *rüpelii* Temminck, 1827. (Emendation)

1988. *Tadarida taeniotis:* Estrada-Peña and Sánchez, Rev. Ibér. Parasitol., 48 (3): 310. (Lapsus)

2018. *Tadarida tenioti:* Lazzeroni, Burbrink and Simmons, Ecol. Evol., 8 (24): 12584. Publication date: 28 November 2018. (Lapsus)

? *Tadarida (Tadarida) teniotis rueppelli:* (Name Combination)

? *Tadarida (Tadarida) teniotis:* (Name Combination)

? *Tadarida teniotis rueppelli:* (Name Combination, Alternate Spelling)

? *Tadarida teniotis rueppellii:* (Name Combination)

? *Tadarida teniotis:* (Name Combination, Current Combination)

TAXONOMY:
Revised by Aellen (1966a) and Kock and Nader (1984).

Populations in Japan, Taiwan and Korea are now treated as a separate species, *T. insignis* (Simmons, 2005).

COMMON NAMES:
Albanian: Lakuriq nate bishtlirë, Lakuriq nate bisht-lire. Arabian: Khaffash. Armenian: Լայնականջ ծալքաշուրթ չղջիկ. Azerbaijani: Bükükdodaq enliqulaq. Basque: Saguzar buztanluze europar, Saguzar buztanluzea. Belarusian: Тадарыда еўрапейская. Bosnian: Golorepi šišmiš. Breton: Molos Cestoni. Bulgarian: Булдогов прилеп. Castilian: Murciélago rabudo. Catalan: Ratpenat cuallarg, Rat penat cuallarg. Croatian: Sredozemni slobodnorepac. Czech: Tadarida evropská, Morous evropský, Hroznohled pyskatý, Psohubec myšowý, Netopýr vrásopyskatý. Danish: Europæisk bulldogflagermus. Dutch: Zuideuropese bulvleermuis, Bulveermuis, Europese bulvleermuis. English: European Free-tailed Bat, European Guano Bat, Striped or Banded Guano Bat, Wrinkle-lipped Bat, Eurasian Free-tailed Bat. Estonian: Euroopa kurdmokk. Finnish: Doggilepakko. French: Molosse de Cestoni, Tadaride d'Europe, Molosse d'Europe, Tadaride de Cestoni. Frisian: Muskusbulflearmûs. Galician: Morcego rabudo. Georgian: ევროპული ჭადარიდა. German: Bulldoggfledermaus, Europäische Bulldoggfledermaus. Greek: Νυχτονόμος. Hebrew: Pashaf Matsui. Hungarian: Európai szabadfarkú-denevér, Nycteris i urophoros. Irish Gaelic: Ialtóg earrshaor Eorpach. Italian: Molosso del Cestoni. Latvian: Brivastes sikspā rnis. Lithuanian: Europinis raukš lė talŪ pis. Luxembourgish: Europäesch Bulldogfliedermaus. Macedonian: Опашест лилјак [= Opashest Liljak]. Maltese: Tadarida. Montenegrin: Dugorepi slijepi miš. Norwegian: Middelhavsfrihale. Polish: Molos europejski. Portuguese: Morcego-rabudo. Rhaeto-Romance: Moloss buldoc. Romanian: Lilacul cu coadă liberă europeană. Russian: Складчатогуб широкоухий. Serbian: Средоземни репаш [= Sredozemni repaš], Широкоухий складчатогуб Scottish Gaelic: Ialtag eàrr-shaor Eòrpach. Slovak: Tadarida buldogovitá. Slovenian: Dolgorepi netopir. Swedish: Veckläppad fladdermus. Turkish: Avrupa Serbest Kuyruklu Yarasası. Ukrainian: Тадарида європейська. Welsh: Ystlum cynffonog.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Amorim *et al.* (2013: 7) indicate that palaeodistribution models predict that during the Last Glacial Maximum (LGM: 23,000 - 18,000 YBP) the climatic conditions for *T. teniotis* were favorable in southern Europe and northern Africa.

CONSERVATION STATUS:
Global - The species is widely distributed over a large extent of occurrence. It occurs in urban areas and forages in other modified habitats. Population trends are not known but are not believed to approach the threshold for the population decline criterion of the IUCN Red List. Consequently, it is assessed as Least Concern (LC ver 3.1 (2001)) (Aulagnier *et al.*, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Aulagnier *et al.*, 2008e; IUCN, 2009). 1996 - LR: lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
It is negatively affected by disturbance and loss of roosts in buildings, and by use of pesticides. It is also potentially threatened by wind farms (GMA Europe Workshop, 2006), and deforestation affects the species in some parts of its range (Z. Amr *pers. comm.,* 2005 [in Aulagnier *et al.* (2008e in IUCN, 2009]). However, none of these are considered to be major threats at present (Aulagnier *et al.*, 2008e; IUCN, 2009).

Sherwin *et al.* (2012: 174) report aerial hawking and long-distance dispersal to be risk factors related with climatic change.

CONSERVATION ACTIONS:
Aulagnier *et al.* (2008e) [in IUCN (2009)] report that it is protected by national legislation in a number of range states and receives international legal protection through the Bonn Convention (Appendix II and Eurobats Agreement) and Bern Convention in parts of its range where these apply. It occurs in several protected areas across its range.

GENERAL DISTRIBUTION:
Tadarida teniotis is mainly a Palaearctic species, although the south-eastern edge of its range extends into the Indomalayan region. It is well known in the Mediterranean basin, occuring from Portugal, Spain eastwards through southern Europe to the Balkans, Turkey, Israel, Palestine and Jordan. In North Africa it has been recorded from Morocco, Algeria, Tunisa, Libya and Egypt. It is possibly present on Madeira (to Portugal) as there was a supposed old record, but it has not been recorded from there again. It occurs on all the Canary Islands (to Spain) except for

Fuerteventura and Lanzarote. It is also recorded from a number of Mediterranean islands (Hutson, 1999; Simmons, 2005). It occurs from sea level to 3,100 m.

Populations in Japan, Taiwan and Korea are now considered to be a separate species, *T. insignis* (Simmons, 2005).

Native: Afghanistan; Albania; Algeria (Horácek *et al.*, 2000: 136); Andorra; Armenia; Azerbaijan; Bangladesh; Bhutan; Bosnia and Herzegovina; Bulgaria; Croatia; Cyprus; Egypt; France [Corse]; Georgia; Gibraltar; Greece [Kriti]; Holy See (Vatican City State); India; Iran, Islamic Republic of; Iraq; Israel; Italy [Sardegna, Sicilia]; Jordan; Kazakhstan; Kyrgyzstan; Lebanon; Libyan Arab Jamahiriya (Horácek *et al.*, 2000: 136); Macedonia, the former Yugoslav Republic of; Malta; Monaco; Montenegro; Morocco (Benda *et al.*, 2010a: 161; El Ibrahimi and Rguibi Idrissi, 2015: 364); Myanmar; Nepal; Portugal; Russian Federation; San Marino; Saudi Arabia; Serbia; Spain [Baleares, Canary Is.]; Switzerland; Syrian Arab Republic; Tajikistan; Tunisia (Horácek *et al.*, 2000: 136; Dalhoumi *et al.*, 2014: 53; 2016b: 867); Turkey; Turkmenistan; Uzbekistan.
Presence uncertain: China.

FUNCTIONAL MORPHOLOGY:
Maniakas and Youlatos (2012: 574) studied the external and muscular forelimb features that could be associated with high-speed flight in open air. They found (p. 576) that the mass of the muscles responible for the downstroke represented 59.3 % of the total forelimb musculature, and that more than half of these muscles are formed by the M. pectoralis. The muscles responsible for the upstroke are comparatively small, which might indicate that the upstroke in this bat is less important than for other bat groups (p.580). All these features result in a fast, steady enduring flight with relatively limited maneuverability.

ECHOLOCATION:
For 10 Greek specimens, Papadatou *et al.* (2008b: 133) report a start frequency of 15.4 ± 3.28 kHz, a terminating frequency of 11.1 ± 1.34 kHz, a peak frequency of 13.2 ± 1.18 kHz, and a bandwidth of 5.3 ± 1.49 kHz. The duration of the call is 18.4 ± 4.74 msec, and the interpulse interval is 764.6 ± 259.37 msec. Walters *et al.* (2012: suppl.) report the following figures for 35 calls from bats from France, Greece, Italy and Switzerland: duration: 15.03 ± 3.47 msec, F_{max}: 14.61 ± 4.95 kHz, F_{min}: 10.64 ± 1.51 kHz, bandwidth: 3.97 ± 3.76 kHz, F_{peak}: 11.76 ± 2.28 kHz.

In Jordan, Benda *et al.* (2010b: 204) recorded the following parameters for seven calls: F_{start}: 15.7 ± 3.8 (12.4 - 22.6) kHz, F_{end}: 9.8 ± 0.4 (9.4 - 10.5) kHz, F_{peak}: 11.7 ± 0.4 (11.1 - 12.6) kHz, duration: 16.3 ± 2.2 (13.1 - 19.3) msec, and interpulse duration: 571.8 ± 254.6 (163.0 - 800.0) msec.

14 calls from Iranian specimens were reported by Benda *et al.* (2012a: 183): F_{start}:19.0 ± 2.6 (14.1 - 22.2) kHz, F_{end}: 11.8 ± 2.2 (8.9 - 14.2) kHz, F_{peak}: 14.5 ± 1.3 (10.6 - 15.9) kHz, duration: 10.6 ± 0.8 (9.5 - 11.8) msec, and interpulse interval: 368.7 ± 89.8 (266.0 - 484.0) msec.

Hackett *et al.* (2016: 223) recorded 44 calls in Israel with the following values: Pulse duration: 12.17 ± 3.34 msec, F_{start}: 22.73 ± 5.02 (17.5 - 29.2) kHz, F_{end}: 15.90 ± 1.44 (13.1 - 17.5) kHz, F_{peak}: 18.49 ± 1.57 (15.1 - 21.4) kHz.

Disca *et al.* (2014: 226) indicate that in Morocco the type of call is FM-QFC, with the following parameters: F_{start}: 22.3 ± 4.2 kHz, F_{end}: 13.3 ± 0.7 kHz, F_{peak}: 14.4 ± 0.8 kHz, bandwidth: 9.0 ± 3.9 kHz, duration: 18.7 ± 2.7 msec.

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotype - Đulic and Mrakovcic (1980) reported $2n$ = 48, FN = 76, BA = 30, a submetacentric X chromosome and a subtelocentric Y chromosome for one male from Kroatia. Arroyo Nombela *et al.* (1986), however, reported $2n$ = 48, FN = 78, BA = 32 , a submetacentric X and an acrocentric Y for specimens from Spain. Volleth and Eick (2012: 167) mention $2n$ = 48 and a segment number of 25. The autosomal complement consists of five meta- and submetacentrics, and 19 subtelocentric and acrocentric pairs, of which the smallest is dot-like (Arslan and Zima, 2014: 14). These authors also indicate that the X chromosome was found to be subtelocentric in some studies.

Combining mtDNA fragments, 14 microsatellites and ecological modelling tools, Amorim *et al.* (2017: 38) found three main haplogroups in Mediterranean *T. teniotis*: one restricted to the eastern Mediterranean and two that are widespread across the Iberian Peninsula and Morocco. The nuclear data indicated that the bats from the Canary Islands showed the lowest signs of gene flow with the continental populations. Furthermore, they found that gene flow between Morocco and the central Mediterranean area is higher than that between the Iberian Peninsula and the central Mediterranean.

Mata *et al.* (2017: 152) reported the mitogenome to be 16,869 bp long, containing 13 protein-coding genes, 2 ribosomal RNA genes, 22 transfer RNA genes, and 1 control region (d-loop). All protein-

coding genes start with the ATG start codon, except for ND2, ND3, and ND5 which begin with ATA or ATT. Eleven protein-coding genes terminated in a canonical stop codon, TAA or TAG, two contain incomplete stop codons, T or TA. Cytochrome b terminates in the mitochondria-specific stop codon AGA.

Protein / allozyme - Unknown.

HABITAT:
In her study on the summer foraging habitats of bats in the Mediterranean region of the Iberian Peninsula, Rainho (2007: 176) found that *T. teniotis* showed low activity over fresh-water habitats, and primarily seemed to use pine-tree woodlands and Mediterranean shrublands. For southern Portugal, Marques *et al.* (2004: 99) reported that *T. teniotis* foraged preferentially over forested areas, particularly pine and cork oak woodlands. They used both alluvial plains and the valleys of a mountainous area, but not its ridges.

HABITS:
In southern Portugal, Marques *et al.* (2004: 99) found that *T. teniotis* is a late emerger, leaving its roost about one hour after sunset. They also found that these bats have only one foraging bout, which lasted on average 6 hours and 39 minutes. Its flight speed can reach over 50 km/h, and flying can be maintained for over 10 hours.

Ancillotto and Russo (2014: 221) found that that *T. teniotis* is able to discriminate between familiar and stranger individuals. They also found that the animals show higher rates of aggressive behaviours towards the strangers. Females show less aggressiveness than males, especially towards other females, and both sexes behave less aggressive towards juveniles.

ROOST:
In Libya, Benda *et al.* (2014c: 119) found a roosting colony in a fissure in the ceiling in the portal of a large, but shallow cave

DIET:
Rydell and Arlettaz (1994: 175) suggest that the intense narrowband echolocation calls with low frequency (11 - 12 kHz) without strong harmonics emitted by *T. teniotis* seems to be a specialization for long-range detection of large, tympanate insects such as Lepidoptera and Neuroptera, which are less well represented in the diet of most other aerial-hawking bats. Based on faecal analyses, they found the following volume percents: southeastern France: Lepidoptera (68.3 %), Neuroptera (24.3 %), others (4.3 %), Acari (0.5 %), and unidentified (2.6 %); Kirghizstan: Lepidoptera (86.8 %), others (12.8 %), unidentified (0.4 %).

Benda *et al.* (2014c: 124) examined four sets of faecal pellets from Libya. Ten pellets from Wadi an Nazrat contained only large moths (Lepidoptera) as did one pellet from the quarry at Wadi al Kuf. Twenty pellets from another location at Wadi al Kuf contained 97 % by volume medium-sized moths and 3 % beetles (Coleoptera). Eight pellets from one animal from Wadi Darnah contained 56 % by volume medium-sized moths and 44 % lacewings (Neuroptera: Chrysopidae).

Benda *et al.* (2012a: 515) indicate that Orthoptera formed the largest contributing group in the diet of *T. teniotis* in Turkey and Jordan. On Rhodes, Coleoptera (especially Curculionidae) formed the most important group. In Iran, Lepidoptera were the most important diet item and Coleoptera, Orthoptera (Ensifera) and Heteroptera also contributed substantially to the diet. Neuroptera (Chrysopidae) and Auchenorrhyncha were almost negligible.

In northeastern Portugal, Mata *et al.* (2016: 1, 2) found significant dietary differences between males and females, where females ate more larger moths and more moths with migratory behaviour (* in below listing). In guano pellets of 69 females and 74 males, Lepidoptera were present in 98.6 % of the females pellets and in 100 % of the males pellets. Split over the various familes and species (which all occur in northern African too), they found (wingspan; % in females, % in males): Crambidae: *Nomophila noctuella** (Denis and Schiffermüller, 1775) (rush veneer) (26 - 32 mm; 7.2, 14.9), other Crambidae 6 5.8 9.5; Gelechiidae: *Mirificarma mulinella* (Zeller, 1839) (5.5 - 7.5 mm; 7.2, 14.9), other Gelechiidae (0.0, 2.7); Geometridae: *Aspitates ochrearia* (Rossi, 1794) (yellow belle) (25 - 34 mm; 4.3, 10.8), *Rhodometra sacraria** (Linnaeus, 1767) (vestal) (22 - 28 mm; 14.5, 36.5), other Geometridae (20.3, 13.5); Noctuidae: *Agrotis ipsilon** (Hufnagel, 1766) (dark sword-grass) (40 - 45 mm; 21.7, 4.1), *Agrotis puta* (Hübner, 1803) (shuttle-shaped dart) (30 - 32 mm; 13.0, 18.9), *Agrotis segetum* (Denis & Schiffermüller, 1775) / *Agrotis trux* (Hübner, [1824]) (turnip/crescent dart) (32 - 42 mm; 37.7, 36.5), *Autographa gamma** (Linnaeus, 1758) (silver y) (30 - 45 mm; 43.5, 23.0), *Hoplodrina ambigua* (Denis & Schiffermüller, 1775) (vine's rustic) (32 - 34 mm; 18.8, 35.1), *Mythimna albipuncta* (Denis & Schiffermüller, 1775) (white-point) (30 - 35 mm; 5.8, 9.5), *Mythimna vitellina* (Hübner, 1808) (delicate) (36 - 43 mm; 24.6, 28.4), *Noctua pronuba* (Linnaeus, 1758) / *Noctua janthe* Borkhausen, 1792 (large/lesser broad-bordered yellow underwing) (50 - 60 mm / 30 - 40 mm; 14.5,

13.5), *Peridroma saucia** (Hübner, 1808) (pearly underwing) (43 - 50 mm; 24.6, 12.2), *Phlogophora meticulosa** (Linnaeus, 1758) (angle shades) (45 - 52 mm; 18.8, 8.1), other Noctuidae (31.9, 36.5); Tortricidae: *Tortrix viridana* Linnaeus, 1758 (European oak leafroller) (18 - 23 mm; 5.8, 13.5), other Tortricidae (2.9 5.4); other Lepidoptera (17.4, 21.6); unidentifiedLepidoptera (13.0, 23.0). Other orders present in the pellets were: Coleoptera (1.4, 1.4); Diptera (10.1, 12.2), Hemiptera (2.9, 8.1), Neuroptera (7.2, 12.2), unidentified Insecta (1.4, 1.4), and also some unidentified Arthropoda (7.2, 5.4).

PREDATORS:
In Isreal, Reuven (1991: 79) observed *T. teniotis* being preyed upon by a Lanner Falcon (*Falco biarmicus* Temminck, 1825). Balmori (2012: 9) furthermore reports bats being taken by Peregrine Falcon (*Falco peregrinus* Tunstall, 1771) and Common Kestrel (*Falco tinnunculus* Linnaeus, 1758) as well as by Barn Owl (*Tyto alba* (Scopoli, 1769)) and Tawny Owl (*Strix aluco* Linnaeus, 1758), but also by a Garden Dormouse (*Eliomys quercinus* (Linnaeus, 1766)).
Mikula *et al.* (2016: Supplemental data) mention the following diurnal avian predators: Lanner falcon (*Falco biarmicus* Temminck, 1825), Peregrine falcon (*Falco peregrinus* Tunstall, 1771) and Eurasian hobby (*Falco subbuteo* Linnaeus, 1758),

POPULATION:
Structure and Density - It is a common species in suitable habitats. Summer and winter colonies typically number 5 - 100 individuals, although colonies of up to 300 - 400 animals have been recorded. It is probably sedentary, although seasonal in some areas (e.g., Malta). It is not abundant in the Caucasus, nor is it highly gregarious - large colonies are not known in this region (K. Tsytsulina *pers. comm.,* 2005 in Aulagnier *et al.*, 2008e [in IUCN, 2009)]). There are only six records for Iran, however, there have not been extensive survey efforts there (M. Sharifi *pers. comm.,* in Aulagnier *et al.*, 2008e [in IUCN, 2009]).
Trend - 2008 - Unknown (Aulagnier *et al.*, 2008e; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 13 years.

REPRODUCTION AND ONTOGENY:
In Spain, Balmori (2003: 37) reported births taking place from the end of June to the beginning of July.

In Portugal, Amorim *et al.* (2015: 228) found that drought had a severe negative influence on the reproduction of *T. teniotis*. This drought probably resulted in reduced food resources early in the pre-breeding season, which limited the ability to restore the bat's body condition after the winter and before the breeding season.

MATING:
In a colony in Valladolid, Spain, Balmori (2003: 37; 2017: 460) found that *T. teniotis* bats were organized in 'harems' made up by a dominant male together with a variable number of females, in which the male defends the refuge ("resource defence polygyny"). The males were emitting mating calls to attract passing-by females. These harems were formed between August and October. When competitors were present, the males reacted by noisy and fast chasing-flights and the releasing of a strong scent, probably used to mark their territory.

Balmori (2017: 465) found two peaks of sexual activity: one in spring (Apri - –June) and another in summer/autumn (August - October), but also indicated that each female might only enter heat once a year.

PARASITES:
In Italy, Voyron *et al.* (2011: 193) reported the following fungal entities from live *T. teniois* specimens: *Aspergillus fumigatus var. fumigatus* and *Trichosporon chiropterorum*.

Benda *et al.* (2010b: 315) only found the mite *Parasteatonyssus hoogstraali* Keegan, 1956 parasiting on *Tadarida teniotis* in Jordan. They do report on other ectoparasites found previously: the bat fly *Nycteribia pedicularia* Latreille, 1805 found in Palestine, bat fleas *Araeopsylla wassifi* Traub, 1954 in Turkey and Egypt, *A. gestroi* (Rotschild, 1906) in Lebanon, and a tick *Argas vespertilionis* (Latreille, 1802) in Egypt. Balmori (2012: 9) also mentioned *Steatonyssus periblepharus* Kolenati, 1858, *Ewingana baekelandae* Estrada-Peña, 1992, and unidentified Trombiculidae, as well als the bat bug *Cimex pipistrelli* Jenyns, 1839 and the flea *Araeopsylla gestroi* (Rothschild, 1906).

Parasteatonyssus hoogstraali Keegan, 1956 was already reported by Estrada-Peña and Sanchez (1988: 310) from *T. teniotis* on Frontera, Canary Islands.

The following enteroparasites were reported by Balmori (2012: 9): Trematodes *Plagiorchis vespertilionis* (Müller, 1784), *Prosthodendrium ascidia* (Van Beneden, 1873) and *Lecithodendrium linstowi* Dollfus, 1931; Nematodes: *Molinostrongylus alatus* (Ortlepp, 1932), *Pseudophysaloptera formosana* (Yokogawa, 1922), *Rictularia bovieri* Blanchard,

1886, *Litomosa aelleni* Tibayrenc, Bain & Ramachandran 1979, and further unidentified *Litomosa* sp.

Benda *et al.* (2014c: 124) reported the following ectoparasites from Libya:
Ischnopsyllidae: *Araeopsylla gestroi* (Rothschild, 1906),
Macronyssidae: *Parasteatonyssus hoogstraali* (Keegan, 1956) [1st record from Libya],
Spinturnicidae: *Spinturnix myoti* (Kolenati, 1856).

From Algeria, Bendjeddou *et al.* (2017: 15) reported one ectoparasite: Arachnida: *Ixodes ricinus* (Linnaeus, 1758).

VIRUSES:
Reoviridae
Orthoreovirus
This virus was reported by Kohl and Kurth (2014: 3113) from Italian bats.

Rhabdoviridae
Lyssavirus - Rabies related viruses
European bat lyssavirus 1 was reported by Luis *et al.* (2013: Suppl.), Willoughby *et al.* (2017: Suppl.).

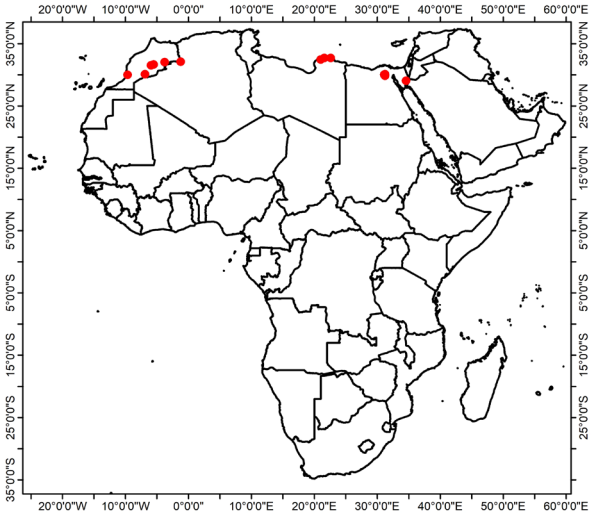


Figure 201. Distribution of *Tadarida teniotis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, Egypt, Libya, Morocco, Sudan.

Tadarida ventralis (Heuglin, 1861)

*1861. *Nyctinomus (Dysopes) ventralis* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 4, 11. Publication date: 1861. Type locality: Eritrea: Kérén [ca. 15 45 N 38 20 E] [Goto Description]. Lectotype: SMNS 982: ad ♀, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See Dieterlen *et al.* (2013: 294), who confirm that the Lectotype status of this specimen was designated by Kock (1975: 6). - Etymology: From the scientific Latin feminine adjective *ventràlis*, meaning "ventral", referring to the presence of a wide, median, prominent orange ventral stripe (see Lanza *et al.*, 2015: 324).
1862. *Nyctinomus ventralis:* Heuglin, Peterm. Geographische Mittheilungen, 8: 26. (Name Combination)
1876. *Nyctinomus africanus* Dobson, Ann. Mag. nat. Hist., ser. 4, 17 (101): 348. Publication date: 1 May 1876. Type locality: South Africa: Transvaal [Goto Description]. Holotype: BMNH 1875.11.19.1: ad ♂, skull and alcoholic. Presented/Donated by: Richard Browdler Sharp[e].
1877. *Dysopes ventralis:* Heuglin, Reise in Nordost Afrika, 2: 26. (Name Combination)
1877. *Nyctinomus [(Nyctinomus)] cestoni* Dobson, Proc. zool. Soc. Lond., 1876, IV: 719. Publication date: April 1877. - Comments: Not of Savi, 1825. In part (see Kock, 1975: 6).
1891. *N(yctinomus) taeniotis* Thomas, Proc. zool. Soc. Lond., 1891, II: 183. Publication date: August 1891. - Comments: Not of Rafinesque, 1814. See Kock (1975: 7).
1901. *N(yctinomus) midas* de Winton, Ann. Mag. nat. Hist., ser. 7, 7 (37): 42. Publication date: 1 January 1901. - Comments: Not of Sundeval. In part. See Kock (1975: 7).
1928. *Mops ventralis:* Thomas, Ann. Mag. nat. Hist., ser. 10, 1 (2): 302. Publication date: 2 February 1928. (Name Combination)
1939. *Mops rüppellii* Allen, Bull. Mus. comp. Zool., 83: 108. - Comments: Not of Temminck, 1827. In part. See Kock (1975: 7).
1951. *Tadarida africana:* Roberts, Mammals of Southern Africa, 101.
1953. *Tadarida (Tadarida) africana:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 66.
1974. *Tadarida (Tadarida) ventralis:* Largen, Kock and Yalden, Mon. Zool. ital., (N.S.) 16 (Suppl. 5): 253. (Name Combination)
2015. *Nyctinomus taeniatus:* Lanza, Funaioli and Riccucci, The bats of Somalia and neighbouring areas, 323. (Lapsus)
? *Tadarida ventralis africana:* (Name Combination)

? *Tadarida ventralis:* (Name Combination, Current Combination)

TAXONOMY:
For use of this name in place of *africana*, see Kock (1975).

COMMON NAMES:
Afrikaans: Transvaalse losstertvlermuis, Reuse losstertvlermuis. Chinese: 非洲大犬吻蝠. Czech: morous africký, tadarida africká. English: Giant Guano Bat, Giant African Guano Bat, African Giant Free-tailed Bat, Giant African Free-tailed Bat, Transvaal Free-tailed Bat, Giant Free-tailed Bat. French: Tadaride géante d'Afrique, Grande tadaride africaine, Molosse géant. German: Große Bulldoggfledermaus, rothbraune Doggengrämler. Italian: Tadarìda ventràle. Portuguese: Morcego gigante de cauda livre.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Mickleburgh *et al.*, 2008aj; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Mickleburgh *et al.*, 2008aj; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Mickleburgh *et al.*, 2004ao; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - VU D2 ver 3.1 (2001) (Taylor *et al.*, 2016d). 2004 - Considered a vagrant. Not assessed, known from a single locality (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
The threats to this species are poorly known. It may be threatened through the conversion of suitable habitat to agricultural land and the use of pesticides in these modified areas (Mickleburgh *et al.*, 2008aj; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008aj) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed into the distribution, natural history, and threats to this little-known species.

GENERAL DISTRIBUTION:
Tadarida ventralis is widely distributed in East and Southern Africa. It ranges from Eritrea in the north to Zimbabwe, and northern South Africa, in the south. The westernmost record is from the eastern Democratic Republic of the Congo, close to the border area with Uganda. Most records are from high altitude (1,500 m upwards to 2,500 m asl).

Native: Congo (The Democratic Republic of the); Eritrea; Ethiopia; Kenya; Malawi (Ansell and Dowsett, 1988: 46; Monadjem *et al.*, 2010d: 547); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 547); South Africa (Taylor *et al.*, 2015: 50); Sudan; Tanzania; Zambia (Ansell, 1986; Monadjem *et al.*, 2010d: 547); Zimbabwe (Cotterill, 2004a: 260; Monadjem *et al.*, 2010d: 547).

ECHOLOCATION:
See Taylor *et al.* (2005).

POPULATION:
Structure and Density - It has been rarely recorded and is largely known from single dead individuals (Mickleburgh *et al.*, 2008aj; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008aj; IUCN, 2009).

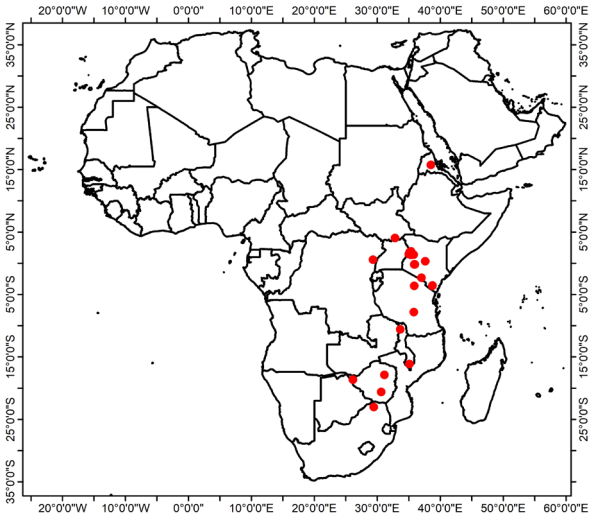


Figure 202. Distribution of *Tadarida ventralis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Eritrea, Kenya, Malawi, South Africa, South Sudan, Tanzania, Zambia, Zimbabwe.

Superfamily VESPERTILIONOIDEA Gray, 1821

*1821. *Vespertilionoidea* Gray, London Med. Repos., 15: 299. Publication date: 1 April 1821. (Current Combination)

1928. *Vespertilionoidea:* Weber, Die Säugetiere, 24. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Introduced as tribe (but actually similar to superfamily) and originally included the families Vespertilionidae J. Gray, 1821, Natalidae J. Gray, 1866, Myzopodidae Thomas, 1904 and Molossidae Gervais, 1855 (see Jackson and Groves, 2015: 265).

TAXONOMY:
Currently recognized families within the Superfamily VESPERTILIONOIDEA within Africa: **CISTUGONIDAE** Van Cakenberghe and Seamark, 2011; **MINIOPTERIDAE** Dobson, 1875; **VESPERTILIONIDAE** Gray, 1821.

COMMON NAMES:
Czech: netopýrov ci.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Ravel *et al.* (2011: 402) suggest that affinities such as the closure of the protofossa, the slender lophes, and a tiny metaconule on the upper molars (in the fossil genus *Dizzya* and an unnamed "Eochiropteran" from the El Kohol Formation in Algeria) could support an African endemic radiation of modern Vespertilionoidea.

Family CISTUGONIDAE Lack, Roehrs, Stanley, Ruedi and Van den Bussche, 2010

2008. *Cistugoinae:* Van Cakenberghe and Seamark, African Chiroptera Report, 213. Publication date: 1 July 2008. - Comments: Spelling used for subfamily. (Name Combination, Alternate Spelling)
2010. *Cistugidae:* Lack, Roehrs, Stanley, Ruedi and Van den Bussche, J. Mamm., 91(4): 980. (Alternate Spelling)
2010. *Cistugonidae:* Benda, Vespertilio, 18-19: 271. - Comments: Type genus: Cistugo Thomas, 1912. (Current Combination, Current Spelling)

TAXONOMY:
Stadelmann *et al.* (2004b) showed that the genus *Cistugo* was not placed with the genus *Myotis*, but was basal to the vespertilioid radiation, which is also supported by Horácek *et al.* (2006). For this reason, the ACR (2008, 2009, 2010) recognized representatives of the genus *Cistugo* as a separate distinct subfamily within the Vespertilionidae.
Lack *et al.* (2010: 980) recognized that taxa within this group should be recognized at a family level and suggested the name “Cistugidae”. Benda (2010: 271) and ACR (2011) used a corrected form of the family (or subfamily) name: Cistugonidae (-goninae) - according to the code (genitive from *Cistugo* is Cistugonis, thus Cistugonidae).

Known genera within the family CISTUGONIDAE: ***Cistugo*** Thomas, 1912.

COMMON NAMES:
Czech: žlázokřídlecovití.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The study by Amador *et al.* (2016: 26) supports the long-time separation from the Vespertilionidae, which probably occurred in the early middle Eocene (crown age 43 MYA).

Genus ***Cistugo*** Thomas, 1912

*1912. *Cistugo* Thomas, Ann. Mag. nat. Hist., ser. 8, 10 (56): 205. Publication date: 1 August 1912 [Goto Description]. - Comments: Type species: *Cistugo seabræ* Thomas, 1912. (Current Combination)

TAXONOMY:
Meester *et al.* (1986) included *Cistugo* as a subgenus of *Myotis*. Baker *et al.* (1974) recorded the karyotype of *Myotis* as 2*n* = 44, AA = 50, but Dippenaar *et al.* (1983) gave it as 2*n* = 50, AA= 48 in both *seabrai* and *lesueuri*.
Hayman and Hill (1971) doubt the validity of *lesueuri* and Corbet and Hill (1980) include it in *seabrai*, while Koopman (1982) retain it as a separate species. It is possible, particularly in view

of their allopatric distribution, that *lesueuri* may best be treated as a subspecies of *seabrai*.

Included as subgenus in *Myotis* by Koopman (1993a: 207), but considered a valid genus by Thomas (1915), Roberts (1919), Rautenbach *et al.* (1993), Bickham *et al.* (2004: 333), Stadelmann *et al.* (2004b: 185), and Simmons (2005). Stadelmann *et al.* (2004b: 185) state that it might be possible that the two genera share closer phylogenetic relationships with other families of bats than with the Vespertilionidae.

Lack *et al.* (2010: 980) erected a new family: Cistugoidae (see family account above for information about corrected spelling of family name), containing only the genus *Cistugo* Thomas, 1912, which they separate from the Vespertilionidae by the presence of 2 to 4 glands in the wing membrane immediately behind the forearm (see also Seamark and Kearney, 2006), which are lacking in all other vespertilionoid bats.

Currently recognized species of the genus *Cistugo*: ***lesueuri*** Thomas, 1912; ***seabrae*** Thomas 1912.

COMMON NAMES:
Czech: žlázokřídlecové. English: Wing-gland Bats. German: Mausohren.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery (2007: 619) reported on the presence of *Cistugo* sp. in Pleistocene deposits at Wonderwerk Cave, South Africa.

GENERAL DISTRIBUTION:
Seamark *et al.* (2012: 116-117) indicate that the ranges of the two species (*C. seabrae* and *C. lesueuri*) might not be allopatric as previously assumed, but might be overlapping.

Cistugo lesueuri Roberts, 1919

*1919. *Cistugo lesueuri* Roberts, Ann. Transv. Mus., 6(3): 112-113. Type locality: South Africa: SW Cape province: Paarl district: near Paarl, Franschhoek [=Frenchhoek] valley: L'Ormarins [=Lormarins] [33 44 S 18 58 E] [Goto Description]. Holotype: TM 2286: ad ♂, skin and skull. Collected by: J.S. Le Sueur Esq. Collection date: 15 September 1917; original number: 154. - Comments: For details on the type locality, see Meester *et al.*, 1986: 49). - Etymology: Named after J.S. le Sueur of L'Ormarins in the Paarl district, Western Cape, who recovered the original specimen from his cat (see Smithers, 1983: 92; Taylor, 2005). (Current Combination)
? *Myotis (Cistugo) lesueuri:* (Name Combination)
? *Myotis lesueuri:* (Name Combination)

TAXONOMY:



Figure 203. A female *Cistugo lesueuri* (TM 48190) caught at the Farm Schaapplaats, Free State, South Africa.

Hayman and Hill (1971) doubt the validity of *lesueuri* and Corbet and Hill (1980) include it in *seabrae*, while Koopman (1982) retain it as a separate species. It is possible, particularly in view of their allopatric distribution, that *lesueuri* may best be treated as a subspecies of *seabrae*.

COMMON NAMES:
Afrikaans: Lesueur se langhaarvlermuis, Lesueur-langhaarvlermuis, Lesueurse Vlerkkliervlermuis. Czech: žlázokřídlec Lesueurův. English: Lesueur's Wing-gland Bat, Lesueur's Hairy Bat, Lesueur's Myotis, Wing-gland bat. French: Murin de Lesueur. German: Leseuers Mausohr.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs, 2008b; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Jacobs, 2004b; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

Regional -

South Africa: 2016 - LC ver 3.1 (2001) (Avenant *et al.*, 2016b). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate, assessed as *Myotis lesueuri* (Smithers, 1986).

MAJOR THREATS:
It is locally threatened in parts of its range by conversion of land to agricultural use (Jacobs, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs (2008b) [in IUCN (2009)] reports that *C. lesueuri* is probably present in a number of protected areas and further studies are needed into the distribution and natural history of this bat.

GENERAL DISTRIBUTION:
This species is restricted to South Africa and Lesotho, where its distribution is best predicted by geology (Babiker Salata, 2012: 50). Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 673,792 km^2.

Native: Lesotho (Lynch and Watson, 1990; Lynch, 1994: 192; Monadjem *et al.*, 2010d: 562); South Africa (Free State - Watson, 1998; Monadjem *et al.*, 2010d: 562; KwaZulu Natal - Monadjem *et al.*, 2010d: 562; Western Cape - Herselman and Norton, 1985; Rautenbach *et al.*, 1993; Seamark and Brand, 2005; Monadjem *et al.*, 2010d: 562).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
For 4 specimens from the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) mention the following parameters: Fa: 36.0 ± 0.4 mm, Wing area: 93.3 ± 1.6 cm^2, Wing span: 23.8 ± 1.1 cm, Wing loading: 7.5 ± 1.4 N/m^2, and aspect ratio: 6.1 ± 0.7.

ECHOLOCATION:
From Algeria Forest Station (RSA), Schoeman and Jacobs (2002: 157) reported the type of calls to be low duty echolocation dominated by frequency modulated calls, with a F_{peak}: 36.8 ± 0.9 kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 50, FN = 48, BA = 0, a submetacentric X chromosome, and an acrocentric Y chromosome, these results were the same as those obtained for *C. seabrae* from Namibia (Rautenbach *et al.*, 1993) .
Protein / allozyme - Unknown.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:



Figure 204. Clockwise from top lateral, ventral and dorsal skull images of TM 2286, holotype of *Cistugo lesueuri* Roberts, 1919.

HABITAT:
In the Free State Province of South Africa collected from broken country (e.g. koppies and cliffs), invariably away from human habitation and constructions, but close to open water (dams and streams). While in the Western Cape it inhabits fynbos and possibly the succulent karoo (Jacobs, 2008b; IUCN, 2009).

Cooper-Bohannon *et al.* (2016: Table S2) mention its occurrence in the following habitat types: Afromontane (43 %), High veld (29 %), SW Cape (13 %) and SW arid (11 %).

HABITS:
In the Free State Province of South Africa specimens were netted in the early evening, between 18:30 and 20:00, with only two specimens being caught after 21:15 (Watson, 1998: 128). When distrubed in their day roost they flew to another roost 50 meters away (Watson, 1998: 128).

ROOST:
Found in a crevice roughly four meters from the ground, on a west-facing dolorite rock face next to a river in the Free State Province of South Africa (Watson, 1998: 127).

DIET:
From the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following prey groups based on 39 faecal pellets from 4 bats (in volume percent): Diptera (47.3 ± 37.3), Hemiptera (32.5 ± 22.8), Hymenoptera (6.8 ± 13.5), Coleoptera (6.3 ± 4.9), Trichoptera (2.5 ± 5.0), Ephemenoptera (1.5 ± 3.0), and unknown (3.3 ± 6.5).

POPULATION:
Structure and Density - Common, but not abundant, in the Free State Province of South Africa a group of approximately 40 individuals was located in a day roost (Watson, 1998: 127). Seamark and Brand (2005) showed that this species made up only 4.6% of the over all catch in the Cederberg, Western Cape. This species is very rarely recorded (Jacobs, 2008b; IUCN, 2009). Trend - 2008 - Decreasing (Jacobs, 2008b; IUCN, 2009). 2004 - Decreasing (Jacobs, 2004b; IIUCN, 2004).

VIRUSES:
Bunyaviridae
Phlebovirus
Rift Valley Fever Virus (RVFV) - Oelofsen and Van der Ryst (1999) tested a single individual from one locality in Lesotho for RVFV antigen using an enzyme linked immunosorbet assay (ELISA), none tested positive.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested 15 individual brains, from four localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

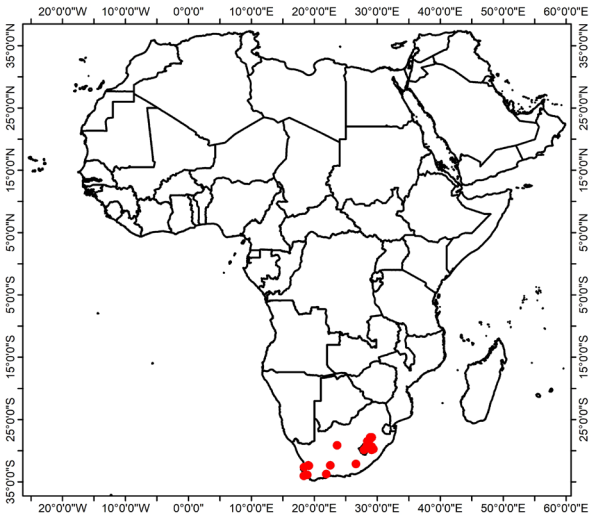


Figure 205. Distribution of *Cistugo lesueuri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Lesotho, South Africa.

Cistugo seabrae Thomas, 1912

*1912. *Cistugo seabræ* Thomas, Ann. Mag. nat. Hist., ser. 8, 10 (56): 205. Publication date: 1 August 1912. Type locality: Angola: Mossamedes [=Moçamedes] [ca. 15 56 S 12 10 E] [Goto Description]. Holotype: BMNH 1906.1.3.3: ad ♀, skull and alcoholic. Presented by the Lisbon Museum. (Current Combination)
2004. *Myotis (Cistugo) sebrai:* Bickham, Patton, Schlitter, Rautenbach and Honeycutt, Mol. Phylogenet. Evol., 33 (2): 333. (Name Combination, Lapsus)
? *Cistugo seabrae:* (Current Spelling)
? *Cistugo seabrai:* (Name Combination, Alternate Spelling)
? *Myotis (Cistugo) seabrai:* (Name Combination)
? *Myotis seabrae:*
? *Myotis seabrai:* (Name Combination)

TAXONOMY:


Figure 206. A male *Cistugo seabrae* (TM 47582) caught at Khamkirri, Northern Cape, South Africa. Note the gland on the wing.

See Simmons (2005).

COMMON NAMES:
Afrikaans: Angola-langhaarvlermuis, Angolase Vlerkkliervlermuis. Czech: žlázokřídlec Seabrův. English: Seabra's Wing-gland Bat, Angolan Wing-gland Bat, Angolan Hairy Bat. French: Murin d'Angola. German: Angola-Mausohr.

ETYMOLOGY OF COMMON NAME:
The colloquial name is derived from the fact that the original specimen originated from Moçâmedes on the south-western coast of Angola (Taylor, 2005).

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because there are no threats, making it unlikely to be declining fast enough to qualify for listing in a more threatened category (Griffin and Jacobs, 2008; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Griffin and Jacobs, 2008; IUCN, 2009). 2004 - NT ver 3.1 (2001), assessed as *Cistugo seabrai* (Jacobs, 2004a; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT D1+D2 ver 3.1 (2001) (Jacobs *et al.*, 2016f). 2004 - VU D2 ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate, assessed as *Myotis seabrai* (Smithers, 1986);

MAJOR THREATS:
There are no major threats to this species. It may be locally threatened by mining operations in a small part of its range (Griffin and Jacobs, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Griffin and Jacobs (2008) [in IUCN (2009)] report that it is not known if there are any direct conservation measures in place for this species, and it is unclear if it occurs within any protected areas. Further studies are needed into the distribution and natural history of this little-known species.

GENERAL DISTRIBUTION:
This southern African species ranges from the type locality of Moçâmedes in southwestern Angola, southwards through western Namibia to the Northern Cape of South Africa.

Native: Angola (Crawford-Cabral, 1989; Thomas, 1912c; Monadjem *et al.*, 2010d: 562); Namibia (Thomas and Hinton, 1925; Shortridge, 1934; Rautenbach *et al.*, 1993; Kearney and Van Schalkwyk, 2009; Monadjem *et al.*, 2010d: 562); South Africa (Herselman and Norton, 1985; Stadelmann *et al.*, 2004b; Seamark and Kearney, 2006; Kearney and Van Schalkwyk, 2009; Monadjem *et al.*, 2010d: 562).

MOLECULAR BIOLOGY:
DNA - Stadelmann *et al.* (2004b).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 50, FN = 48, BA = 0, a submetacentric X chromosome, and an acrocentric Y chromosome, these results were the same as those obtained for *C. lesueuri* from South Africa (Rautenbach *et al.*, 1993).
Protein / allozyme - Unknown.

HABITAT:
Little is known about the natural history of this species. All of the localities from which they have been collected are arid with a mean annual rainfall of less than 100 mm (Skinner and Chimimba, 2005).

HABITS:
Specimens have usually been caught close to open water and have been observed gleaning insects from orange trees (Roberts, 1951; Taylor, 2000; Skinner and Chimimba, 2005).

POPULATION:
Structure and Density - It appears to be a rarely recorded species (Griffin and Jacobs, 2008; IUCN, 2009).
Trend - 2008 - Unknown (Griffin and Jacobs, 2008; IUCN, 2009). 2004- Decreasing (as *Cistugo seabrai*) (Jacobs, 2004a; IUCN, 2004).

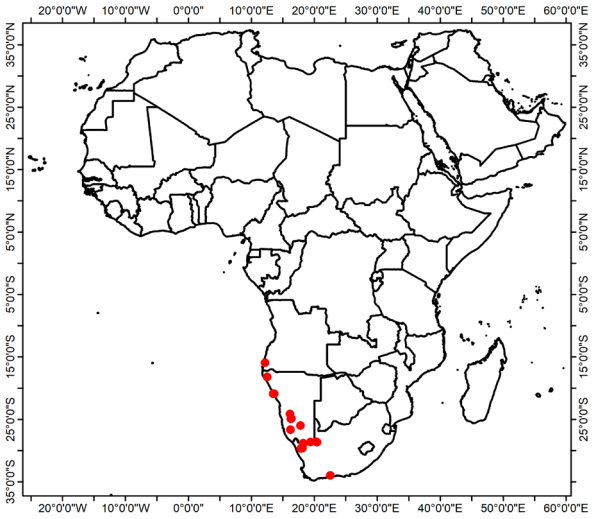


Figure 207. Distribution of *Cistugo seabrae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Namibia, South Africa.

†Family INDETERMINATE

†Genus ***Chambinycteris*** Ravel, 2016

*2016. *Chambinycteris* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 402. Publication date: 30 September 2016. - Etymology: Refers to Chambi, the locality where the specimens were collected (see Ravel *et al.*, 2016: 402).

TAXONOMY:
Ravel *et al.* (2016: 358) indicate that this genus has a basal position within the Emballonuridae.

†***Chambinycteris pusilli*** Ravel, 2016

*2016. *Chambinycteris pusilli* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 403. Publication date: 30 September 2016 [Goto Description]. - Etymology: From the Latin "*pusilli*" meaning puny or sickly, referring to the small size and fragility of the species (see Ravel et al., 2016: 403).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Late lower Eocene to early middle Eocene.
Timeframe:

†Genus ***Drakonycteris*** Ravel, 2016

*2016. *Drakonycteris* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 399. Publication date: 30 September 2016. - Etymology: From the Greek "*δράκων*" meaning dragon and "*νυκτεριο*" meaning bat (see Ravel *et al.*, 2016: 399).

†***Drakonycteris glibzegdouensis*** Ravel, 2016

*2016. *Drakonycteris glibzegdouensis* Ravel, in: Ravel et al., Geodiversitas, 38 (3): 356, 399, figs 23, 24. Publication date: 30 September 2016. Type locality: Algeria: Béchar province: Gour Lazib: Sahara, Hammada du Dra: Glib Zegdou [29 42 49 N 05 45 58 W] [Goto Description]. - Etymology: Referring to the type locality of Glib Zegbou (see Ravel *et al.*, 2016: 399).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS: Late lower Eocene to early middle Eocene.
Timeframe:

Family MINIOPTERIDAE Dobson, 1875

1875. *Miniopteri* Dobson, Ann. Mag. nat. Hist., ser. 4, 16 (95): 349. Publication date: 1 November 1875.
*1875. *Miniopteridae* Dobson, Ann. Mag. nat. Hist., ser. 4, 16 (95): 348. Publication date: 1 November 1875. - Comments: Type genus: *Miniopterus* Bonaparte, 1837. Originally included the genera *Natalus* J. Gray, 1838; *Thyroptera* Spix, 1823 and *Miniopterus* Bonaparte, 1837. (Current Combination)
1898. *Miniopterae* Trouessart, Cat. Mamm, p. 134. - Comments: See Taylor (1934).
1907. *Miniopterinae:* Miller, Bull. U.S. natl. Mus., 57: xi, 227. Publication date: 29 June 1907. - Comments: Type genus: *Miniopterus* Bonapart, 1837.

1977. *Miniopteridae:* Mein and Tupinier, Mammalia, 41 (2): 207, 209. - Comments: Type genus: *Miniopterus* Bonaparte, 1837.

TAXONOMY:
Bannikova *et al.* (2002: 722) indicate that the Miniopterinae do not deserve the rank of independent family (as did Koopman, 1984b, 1993a, 1994; Yoshiyuki, 1989; Corbet and Hill (1992; McKenna and Bell, 1997), but see Hoofer and Van Den Bussche (2003: 13) who make a strong case for attributing family rank. They follow Mein and Tupinier (1977), Groombridge (1994), Gopalakrishna and Chari (1983), Tiunov (1989), Pierson (1986). See also Hawkins *et al.* (2019: 11355).

In their study on rolling-circle transposons (*Helitrons*), Thomas *et al.* (2010: 55) found none of these in the Miniopteridae. They also indicated that these *Helitrons* colonized the Vespertilionidae some 30 - 36 mya, which is much later than the split between Vespertilionidae and Miniopteridae, which occurred some 43 million years ago. Patterson and Webala (2012: 32) indicate that the split between Vespertilionidae and *Miniopterus* occurred between 38 and 47 million years ago.

Herkt *et al.* (2017: Appendix 4S), investigating the IUCN distribution maps and species distribution models, left out the Miniopteridae because of their exceptionally high cryptic diversity and level of phenetic similarity, which leads to unreliably identification of large amounts of published records.

Known genera of the family MINIOPTERIDAE: ***Miniopterus*** Bonaparte, 1837.

COMMON NAMES:
Czech: létavcovití, netopýři dlouhorucí. Dutch: Langvleugelvleermuizen. English: Long-fingered Bats. French: Minioptéridés. German: Langflügelfledermäuse. Italian: Miniottèridi, Minioptèridi. Russian: Длиннокрыловые. Vietnamese: Họ dơi cánh.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Amador *et al.* (2016: 26) estimated the split from the Vespertilionidae at c. 48 MYA, and a stem age at 13 MYA.

MOLECULAR BIOLOGY:
Capanna *et al.* (1968: 240) already pointed out that there was a cytotaxonomic difference between the Vespertilioninae and the Miniopterinae, especially in the average length of the aploid female set.

Platt *et al.* (2016: 9) analyzed the genome data for *M. natalensis* and compared it with that of several other vesper bats and they concluded that *Helitrons* and hATs were introduced into the genome of the Vespertilionidae after their divergence from *Miniopterus*.

Genus ***Miniopterus*** Bonaparte, 1837

*1837. *Miniopterus* Bonaparte, Iconografia Fauna italiana, 1, fasc. 20 [Goto Description]. - Comments: Type species: *Vespertilio ursinii* Bonapate, 1837 (=*Vespertilio schreibersii* Kuhl, 1817). - Etymology: From the Greek "*μινύς*" or "*μινός*", meaning small and "*πτέρυξ*", meaning wing, referring to the very short first phalanx of the third and longest finger (see Palmer, 1904: 426; Flannery, 1995a: 374; Kozhurina, 2002: 16). Lanza *et al.* (2015: 328) mention the following: "According to Bonaparte (1837-41) who described the genus and Lanza (2012), *Miniopterus* is a scientific masculine Latin substantive made up of the proper feminine Latin noun *Minyèias* 'Minyad', i. e. a daughter of Minyas, king of Orchomenus, turned into a bat, and of the Greek neuter substantive *πτερόν*" (pteròn) 'wing', meaning 'flying Minyad'. The etymology proposed by Kozhurina (2002), meaning 'with small (narrow) wings', is incorrect, even if formally logical. Also partially erroneous is the etymology given by some Italian dictionaries, such as Battaglia (1978) and Devoto & Oli (1997), who interpret 'minio' as 'minimum, red-lead', the red colouring agent, which obviously has nothing to do with the greyish brown colour of Miniopterus' wings". (Current Combination)

1846. *Minyopterus:* Agassiz, Nomenclator. Zool., Mamm., 235. - Comments: Variant spelling (Meester *et al.*, 1986: 45) or unjustified emendation (Jackson and Groves, 2015: 263). (Lapsus, Emendation)

1858. *Miniopteris:* Tomes, Proc. zool. Soc. Lond., 1858, XXVI (cccliv): 115. Publication date: 13 May 1858. - Comments: Variant spelling (Meester *et al.*, 1986: 45) or unjustified emendation (Jackson and Groves, 2015: 262). Not *Miniopteris* J. Gray, 1849 (Mammalia,

Chiroptera, Vespertilionidae) (used as genus name for *Myotis macrotarsus* (Waterhouse, 1845) (see Jackson and Groves, 2015: 263). (Alternate Spelling)

1900. *Minneopterus:* Lampe, Jb. nass. Ver. Naturkde, 53: Cat. Säugeth.-Sammlung, p. 12. Publication date: 1900. - Comments: Cat. Säugeth.-Sammlung, p. 12. Lapsus (see Allen, 1939a: 102; Meester *et al.*, 1986: 45). Jackson and Groves (2015: 263) indicate it appeart to be a *nomen nudum* or an unjustified emendation. (Lapsus, Emendation)

1920. *Mineopterus:* Haagner, South African Mammals, 22. (Lapsus)

1980. *Minioterus:* Bernard, Ann. Transv. Mus., 32 (3): 55. Publication date: January 1980. (Lapsus)

2014. *Mineropterus:* Kohl and Kurth, Viruses, 6 (8): 3112. Publication date: 13 August 2014. (Lapsus)

2015. *Minioptera:* Golden and Comaroff, Ecol. Soc., 20 (2): 42: 5. (Lapsus)

? *Miniopterus sp.*

TAXONOMY:

Reviewed (in part) by Peterson (1981). See Goodwin (1979: 119), Maeda (1982), and Hill (1983). All have come to very different conclusions. Molecular systematics and biogeography is discussed by Appleton *et al.* (2004); their DNA data (p. 437) suggest that the number of species currently recognized (11 or 13) is a gross underestimate. Phylogentic analyses performed by Christidis *et al.* (2014: 1) indicate that 18 clades are present within Malagasy *Miniopterus* of which only 11 have Latin binominals.

Šrámek *et al.* (2012: 165) investigated the taxonomic status of the bent-winged bats in the western Palaearctic and distinguished four species: *M. schreibersii* (s.str.) from Europe, coastal Anatolia, Levant, Cyprus, western Transcaucasia, and North Africa; *M. pallidus* from inland Anatolia, Jordan, eastern Transcaucasia, Turkmenistan, Iran and southern Afghanistan (Kandahar); a *Miniopterus* sp., recorded from Nangarhar province in eastern Afghanistan, which was tentatively assigned to *M.* cf. *fuliginosus*; and another *Miniopterus* sp. With Afro-tropic affinities confirmed from south-western Arabia and Ethiopia, which tentatively named *M.* cf. *arenarius*. They also indicate that a possible new taxon (subspecies) within *M. schreibersii* exists in the Atlas Mountains of Morocco. Bilgin *et al.* (2013: 21) indicate that this Maghrebian form possibly even represents a new species, which they tentatively call: *M. maghrebensis*.

See Taylor *et al.* (2019: 318) for a discussion on the recent increase in Afro-Madagascan species.

Known species to the genus *Miniopterus*: ***†horaceki*** Gunnell, Eiting, and Geraads, 1837; ***aelleni*** Goodman, Maminirina, Weyeneth, Bradman, Christidis, Ruedi and Appleton, 2009; ***africanus*** Sanborn, 1936; *australis* Tomes, 1858 – Philippines, Borneo, Java, Timor, Moluccas, southeast to Vanuatu and eastern Australia (Simmons, 2005: 519); ***brachytragos*** Goodman, Maminirina, Bradman, Christidis and Appleton, 2011; ***egeri*** Goodman, Ramasindrazana, Maminirina, Schoeman and Appleton, 2011; ***fraterculus*** Thomas and Schwann, 1906; *fuscus* Bonhote, 1902 – Ryuku Isls (Japan) (Simmons, 2005: 519); ***gleni*** Peterson, Eger and Mitchell, 1995; ***griffithsii*** Goodman, Maminirina, Bradman, Christidis and Appleton, 2009; ***griveaudi*** Harrison, 1959; ***inflatus*** Thomas, 1903; *macrocneme* Revilliod, 1914 – New Guinea to Vanuatu and New Caledonia (Simmons, 2005: 520); *magnater* Sanborn, 1931 – northeastern India, southeastern China, Burma, Thailand, Laos and Vietnam to Malaysia, Sumatra, Java, Timor (Indonesia), Borneo, Moluccas and New Guinea including the Bismarck Arch. (Simmons, 2005: 520); ***mahafaliensis*** Goodman, Bradman, Christides and Appleton, 2009; ***majori*** Thomas, 1906; ***manavi*** Thomas, 1906; *medius* Thomas and Wroughton,1909 – southeastern China, Thailand, western Malaysia, Borneo, Java, Sulawesi, Philippines, New Guinea (Simmons, 2005: 520); ***minor*** Peters, 1867; ***natalensis*** (A. Smith, 1834); *paululus* Hollister, 1913 – Majuyod, Negros and Guimarás Isl (Philippines), Berneo, Selaru (Simmons, 2005: 521); ***petersoni*** Goodman, Bradman, Maminirina, Ryan, Christidis and Appleton, 2008; *pusillus* Dobson, 1876 – India, Nepal and Burma to Sumatra and Timor (Indonesia), Philippines and Moluccas (Simmons, 2005: 520); *robustior* Revilliod, 1914 – Loyalty Isls (east of New Caledonia) (Simmons, 2005: 521); ***schreibersii*** (Kuhl, 1817); *shortridgei* Laurie and Hill, 1957 – Java, Madura, Lombok, Sumbawa, Moyo, Alor, Wetar, Seralu, Timor, Semau, Roti and Savu Isls (Indonesia) (Simmons, 2005: 522); ***sororculus*** Goodman, Ryan, Maminirina, Fhar, Christidis and Appleton, 2007; *tristis* (Waterhouse, 1845) – Philippines, Sulawesi, Sanan Isl, New Guinea, Bismarck Arch., Solomon Isls, New Hebrides (Simmons, 2005: 522).

The 18 Malagasy clades recovery by Christidis *et al.* (2014) in their phylogenetic analysis were

divided in into five primary lineages (representing sister species): (1) *M. griveaudi*; (2) *M. mahafaliensis, M. sororculus* and X3; (3) *M. majori, M. gleni* and *M. griffithsi*; (4) *M. brachytragos; M. aelleni* A, and *M. aelleni* B, and (5) *M. manavi* and *M. petersoni*. These are in turn linked to a group comprising *M. egeri* and five genetically distinct populations referred to as P3, P4, P5, P6 and P7.

COMMON NAMES:
Czech: létavci, netopýři dlouhorucí. English: Long-fingered Bats, Bent-winged Bats. French: Minioptères. German: Langflügelfledermäuse, Sackfledermaus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
The oldest fossil remains for *Miniopterus* date from some 13.65 million years ago (see Shi and Rabosky, 2015: 1532).

Butler (1978) refers to African material of this genus, found from the early Pleistocene at Olduvai, and Avery (2007: 619) reported on the presence of *Miniopterus* sp. in Pleistocene deposits at Wonderwerk Cave, South Africa. Geraads *et al.* (2010: 279) reported *Miniopterus* in Late Cenozoic (ca. 2.5 MYA) deposits in Ahl al Oughlam, Morocco.

Weyeneth (2010) suggested that Malagasy *Miniopterus* colonized the Comoros during the Pleistocene, favored by prevailing winds.

BIOGEOGRAPHY:
Weyeneth *et al.* (2008) suggest that the Comoros were colonized independently at least two or three times by ancestors from Madagascar.

DETAILED MORPHOLOGY:
Brain - Maseko and Manger (2007) describe the nuclear parcellation and neuronal morphology of the cholinergic, catecholaminergic and serotonergic systems within the brain of six adult female *Miniopterus schreibersii* [possibly *M. natalensis* or *M. fraterculus*, not *Miniopterus schreibersii*], captured from caves in northwest region of Gauteng Province, South Africa.

SEXUAL DIMORPHISM:
Goodman and Maminirina (2007) found no notable evidence for sexual dimorphism in Malagasy *Miniopterus* spp.

ECHOLOCATION:
Bioacoustic data of 11 Malagasy (Madagascar and the Comoros) has been collected and investigated by Ramasindrazana *et al.* (2011).

PARASITES:
BACTERIA
Bartonellae
Bartonella - Kosoy *et al.* (2010: 1877) reported a prelevence of *Bartonella* spp. in *Miniopterus* sp. from Kenya of 22/105 (21.0 %) cultured from blood samples. Fifty-one *Bartonella* spp. *gltA* sequences were obtained from 3 identified species of *Miniopterus* (*africanus, minor, natalensis*), were 24 unique *gltA* genotypes representing at least 3 genogroups (Kosoy *et al.*, 2010: 1878). See also Kosoy (2010: 719) for further information.

ACARI
Myobiidae: Fain (1994: 1280) reported the genus *Calcarmyobia* to occur only on bats of the genus *Miniopterus* with 18 species and 8 subspecies.
Trombiculidae: *Trombigastia (Trombigastia) cadei* (Vercammen-Grandjean and Brennan, 1957) was reported by Vercammen-Grandjean and Fain (1958: 26) and Stekolnikov (2018a: 118) on *Miniopterus* sp. specimens from N'Gong, S Kenya.

Uchikawa (1985c: 110) reported the presence of *Pteracarus miniopteri* Uchikawa, 1978 from *Miniopterus* sp. specimens from Madagascar, Central Africa, Cameroon, Kenya (Mombasa), South Africa (Transvaal).

DIPTERA
Streblidae: *Raymondiodes leleupi* Jobling, 1954 described form a poorly identified bat (*Hipposideros caffer* or *Miniopterus* sp.) from Thysville, Congo (Haeselbarth *et al.*, 1966: 104). *Nycteribosca kollari* Frauenfeld, 1855 was reported by Vermeil (1960) from Tunisia.

Nycteribiidae: *Nycteribia tecta* Theodor, 1957 (Haeselbarth *et al.*, 1966: 110). Duron *et al.* (2014: 2108) mention the presence of *Nycteribia stylidiopsis* (Speiser, 1908) on *Miniopterus* sp. from the Comoros, and of *Penicillidia leptothrinax* (Speiser, 1908) from Madagascar. The latter were carrying Enterobacteriales and *Bartonella* and *Wolbachia* bacteria (Szentiványi *et al.*, 2019: Suppl.). Enterobacteriales were also found in *Penicillidia* cf. *fulvida* (Szentiványi *et al.*, 2019: Suppl.).

SIPHONAPTERA
Ischnopsyllidae: Members of the genus *Rhinolophopsylla* Oudemans, 1909 are known to be parasites of *Miniopterus* and *Rhinolophus* (Haeselbarth *et al.*, 1966: 191).

VIRUSES:
Adenoviridae
These viruses were found by Waruhiu *et al.* (2017) in bats from Kenay.

Coronaviridae

18 out of 300 Kenyan *Miniopterus* bats tested by Tao *et al.* (2017: Suppl.) was positive for CoV (6 %).

Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that 13 out of 77 examined Kenyan *Miniopterus* sp. specimens tested positive for *Paramyxovirus* sequences. This was also the case for two out of 41 specimens from the DRC.

Retroviridae
Farkašová *et al.* (2017: 3145) described an endogenous Deltaretrovirus, which only occurs in this family of bats and not in the closely related Vespertilionidae and Cistugonidae. This suggests that the endogenization occurred between 20 and 45 million years ago.

Rhabdoviridae
Lyssavirus - Rabies related viruses
West Caucasian Bat virus (WCBV) - Kuzmin *et al.* (2008b) detected WCBV in four of five localities sampled in Kenya with a seroprevalence of 17-26%.
Horton *et al.* (2014: Table S1) tested 229 Kenyan *Miniopterus* sp. specimens, but failed to find neutralising antibodies to IKOV (Ikoma lyssavirus).
Duvenhage lyssavirus (DUVV) - Banyard A. C. and Fooks A. R. (2017: 18) reported this virus from *Miniopterus* sp. specimens from South Africa and Kenya.

†***Miniopterus horaceki*** Gunnell, Eiting, and Geraads, 2011

*2011. *Miniopterus horaceki* Gunnell, Eiting, and Geraads, N. Jb. Geol. Paläont. Abh., 260 (1): 63, figs. 3B, 7C, 8D-F. Publication date: January 2011. Type locality: Morocco: Ahl al Oughlam [ca. 33 35 N 07 30 W] [Goto Description]. Holotype: INSAP AaO 4605: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Right dentary with p2-p4, m1 trigonid. - Etymology: In honour of Ivan Horácek, in recognition of his many contributions to the understanding of the evolutionary history of bats, and especially of vespertilionids (see Gunnell *et al.*, 2011: 63). (Current Combination)

TAXONOMY:
Gunnell *et al.* (2011: 63) describe it as larger than nearly all extant African and European *Miniopterus* species (including *M. gleni, M. inflatus, M. newtoni, M. fraterculus, M. natalensis, M. manavi, M. noreenae, M. minor, M. williamsi*, and *M. schreibersi*). Generally similar in size to *M. africanus* but differs in having p3-4 relatively broader and more exodaenodont, p3 larger than p2, and in having relatively taller lower premolars. Larger than *M. schreibersi* with p2 smaller compared to p3, but *M. schreibersi* does possess relatively broad premolars similar to the Moroccan species.

Miniopterus aelleni Goodman, Maminirina, Weyeneth, Bradman, Christidis, Ruedi and Appleton, 2009

*2009. *Miniopterus aelleni* Goodman, Maminirina, Weyeneth, Bradman, Christidis, Ruedi and Appleton, Zool. Scr., 38 (4): 339, 353, figs. 3d, 3e, 4, 7 - 10. Publication date: 22 June 2009. Type locality: Madagascar: Antsiranana province: Ankarana special reserve, Canyon d'Antsiroandoa Centre,: 6.2 km NW Mahamasina [12 55.1 S 49 07.6 E, 120 m] [Goto Description]. Holotype: FMNH 173067: ad ♂, skull and alcoholic. Collected by: Vola Razakarivony and Scott G. Cardiff; collection date: 8 April 2002; original number: SMG 12809. See Goodman and Cardiff (2004: 230). Paratype: FMNH 173069: ad ♀, skull and alcoholic. Collected by: Vola Razakarivony and Scott G. Cardiff; collection date: 8 April 2002; original number: SMG. See Goodman and Cardiff (2004: 230). Paratype: FMNH 173070: ad ♀, skull and alcoholic. Collected by: Vola Razakarivony and Scott G. Cardiff; collection date: 8 April 2002; original number: SMG. See Goodman and Cardiff (2004: 230). Paratype: FMNH 173072: ad ♂, skull and alcoholic. Collected by: Vola Razakarivony and Scott G. Cardiff; collection date: 8 April 2002; original number: SMG. See Goodman and Cardiff (2004: 230). Paratype: FMNH 173075: ad ♂, skull and alcoholic. Collected by: Vola Razakarivony and Scott G. Cardiff; collection date: 8 April 2002; original number: SMG. See Goodman and Cardiff (2004: 230). Paratype: FMNH 173076: ad ♂, skull and alcoholic. Collected by: Vola Razakarivony and Scott G. Cardiff; collection date: 8 April 2002; original number: SMG. See Goodman and Cardiff (2004:

230). - Etymology: The name *aelleni* is a patronym for Villy Aellen (1926 - 2000) who was a mammalogist at the Muséum d'histoire naturelle de Genève from 1954 to his retirement in 1989, where he also served as curator, assistant director, and director (Mahnert, 2000; Goodman *et al.*, 2009a: 353). (Current Combination)

TAXONOMY:
See Goodman *et al.* (2009a).

Schoeman *et al.* (2014: 19) refer to Christidis *et al.* (2014) indicating that - from a phylogenetic species perspective - there is evidence that two sister species are present, which are tentatively named: *M. aelleni* A and *M. aelleni* B.

COMMON NAMES:
Czech: létavec Aellenův. English: Aellen's Long-fingered Bat. German: Aellens Langflügelfledermaus.

ETYMOLOGY OF COMMON NAME:
In honour of Villy Aellen (1926 - 2000), who was a mammalogist at the Muséum d'histoire naturelle de Genève from 1954 to his retirement in 1989, where he also served as curator, assistant director, and director. He devoted much of his professional interests to the study of bats, particularly those of Africa (see Goodman *et al.*, 2009a: 353).

GENERAL DISTRIBUTION:
Lowland portions of northern and western Madagascar (Goodman *et al.*, 2009a; Schoeman *et al.*, 2014: 28). Schoeman *et al.* (2014: 31) assigned *M. aelleni* A to the western or dry deciduous region bioclimatic zone, whereas *M. aelleni* B was classified to the humid forest region.

O'Brien (2011: 289) reports it also from the Comoros.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Goodman *et al.* (2009a).

DENTAL FORMULA:
$^{2123}/_{3133}$ = 36.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Goodman *et al.* (2009a).

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls as *M. manavi sen lat.*, these calls were broadband FM/QCF sweeps produced at low duty cycle with most energy at about 58.1 kHz in the fundamental, with pulses having a short duration of about 4 ms. Ramasindrazana *et al.* (2011: 294) recorded 19 calls from 7 *Miniopterus aelleni* specimens, and found the following echolocation call values: Frequency of maximum energy: 51.9 ± 1.57 (49.5 - 54.8) kHz, Maximum frequency: 99.8 ± 8.48 (75.0 - 119.0) kHz, Minimum frequency: 48.0 ± 1.43 (46.0 - 50.0) kHz, Call duration: 4.1 ± 0.65 (3.0 - 5.0) ms, Inter pulse interval: 87.3 ± 16.75 (61.0 - 118.5) ms.

MOLECULAR BIOLOGY:
DNA - See Goodman *et al.* (2009a).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
Dammhahn and Goodman (2013: 108) mention the lower portion of forest structure and partially open areas as the foraging habitat for this species.

Also see Goodman *et al.*, 2009a).

ROOST:
See Goodman *et al.* (2009a).

POPULATION:
Structure and Density - See Goodman *et al.*, 2009a).

PARASITES:
Tortosa *et al.* (2013: 4) report the presence of the Nycteribiid bat fly *Nycteribia stylidiopsis* Speiser, 1908 and Wilkinson *et al.* (2016) report *Penicillidia leptothrinax* Speiser, 1908, which in turn carried *Bartonella* bacteria and the blood parasite *Polychromophilus melanipherus* (Szentiványi *et al.*, 2019: Suppl.). Ramasindrazana *et al.* (2017: Suppl.) report both flies.

Ramasindrazana *et al.* (2016: 6) reported the presence of *Litosoma* Clade 3 (Nematoda: Onchocercidae) on this bat species. They also mention *Litosoma goodmani* Martin, Bain, Jouvenet, Raharimanga, Robert & Rousset, 2006 from a *M. aelleni* specimen, that was previously identified as "*M. manavi*".

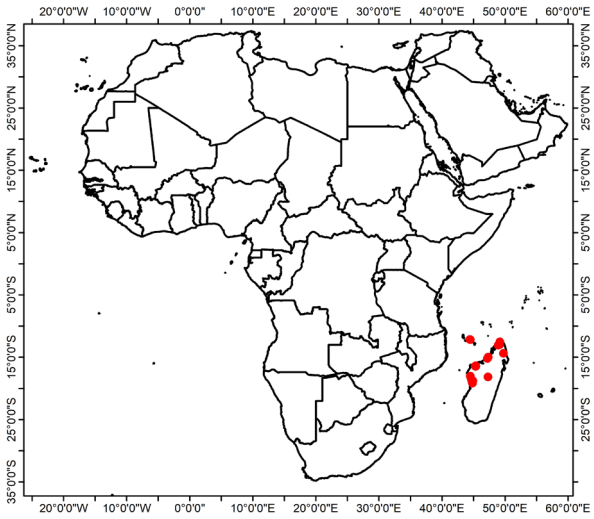


Figure 208. Distribution of *Miniopterus aelleni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Comoros, Madagascar.

Miniopterus africanus Sanborn, 1936

*1936. *Miniopterus africanus* Sanborn, Field Mus. Nat. Hist., Zool. Ser., (362) 20 (14): 111. Publication date: 15 August 1936. Type locality: Ethiopia: Shoa province: Mulo, Sanford's Ranch [ca. 09 00 N 39 00 E, 8000 ft] [Goto Description]. Holotype: FMNH 28769: ad ♀, skin and skull. Collected by: Alfred Marshall Bailey; collection date: 25 October 1926; original number: 73. (Current Combination)
? *Miniopterus inflatus africanus:* (Name Combination)

TAXONOMY:
Included in *inflatus* by Koopman (1993a: 230), but considered a valid species by Peterson *et al.* (1995: 120), Lavrenchenko *et al.* (2004b: 144), Simmons (2005).

COMMON NAMES:
Chinese: 非洲长翼蝠. Czech: létavec východoafrický. English: African Long-fingered Bat. French: Minioptère d'Afrique orientale. German: Afrikanische Langflügelfledermaus.

CONSERVATION STATUS:
Global - LC ver 3.1 (2001) (IUCN, 2004; Schlitter, 2004h).

GENERAL DISTRIBUTION:
Native: Botswana; Eritrea; Ethiopia; Kenya; Namibia; Tanzania.

PARASITES:
Lutz *et al.* (2016: 9) examined 20 *M. africanus* specimens from East Africa and found four of them infected with the haemosporidan parasite *Polychromophilus melanipherus* Dionisi, 1899.

Uchikawa (1985a: 19) reported that the type specimen of *Miniopterus africanus* harboured the "atypical" form of *Calcarmyobia congoensis* Uchikawa, 1982 (Acari: Myobiidae). This species is also a host of *Calcarmyobia kenyaensis* Uchikawa, 1982 in Kenya (see Uchikawa (1985a: 22) as *M. inflatus africanus*). Possibly some other records mentioned by Uchikawa (1985a: 22) as collected from *M. inflatus* from Cameroon, Liberia, and The Democratic Republic of Congo should be included here.
Uchikawa (1985c: 110) also reported on the presence of the mite *Pteracarus miniopteri* Uchikawa, 1978 on some specimens from Kenya, that were identified as *M. inflatus africanus*.
Tortosa *et al.* (2013: 5) and Ramasindrazana *et al.* (2017: Suppl.) mention this species as host for the Nycteribiid bat flies *Nycteribia schmidlii* Schiner, 1853 and *Pencillidia fulvida* Bigot, 1885.

DIPTERA:
Streblidae: *Raymondia intermedia* Jobling, 1936 (Shapiro *et al.*, 2016: 255). *Raymondia seminuda* Jobling, 1954 (Shapiro *et al.*, 2016: 255).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Tong *et al.* (2009) tested 1 bat collected in Kenya during 2006 positive for the presence of coronavirus RNA in a fecal sample. One Kenyan bat tested by Tao *et al.* (2017: Suppl.) was negative for CoV.

Polyomaviridae:
Polyomavirus - Of the nine specimens tested from the Chyulu National Park (Kenya), one tested positive (Conrardy *et al.*, 2014: 259).

Rhabdoviridae:
Rhabdovirus - One of the nine specimens tested from the Chyulu National Park (Kenya) tested positive (Conrardy *et al.*, 2014: 259).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Eritrea, Ethiopia, Kenya, Mozambique, Somalia.

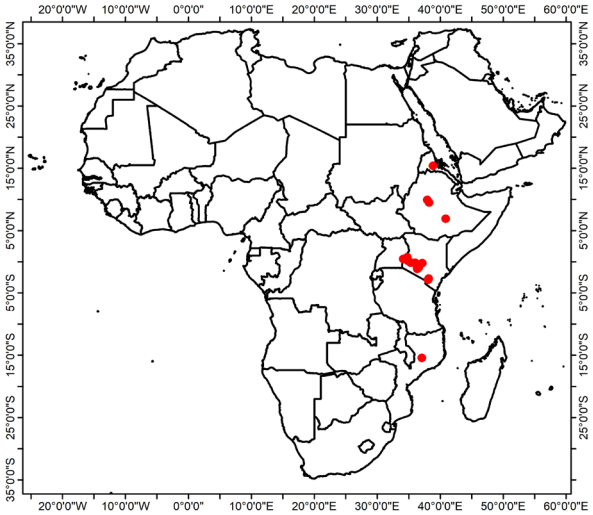


Figure 209. Distribution of *Miniopterus africanus*

Miniopterus ambohitrensis Goodman, Ramasindrazana, Naughton and Appleton, 2015

*2015. *Miniopterus ambohitrensis* Goodman, Ramasindrazana, Naughton and Appleton, Zootaxa, 3936 (4): 538, 543, figs 2 - 5. Publication date: 23 March 2015. Type locality: Madagascar: Province d'Antsiranana: Parc National de la Montagne d'Ambre: Joffreville (Ambohitra), 5.5 km SW: Station Forestière des Roussettes [12 31 37.3 S 49 10 19.1 E, 1000 m] [Goto Description]. Holotype: FMNH 202450: ad ♂, skull and alcoholic. Collected by: Steven M. Goodman; collection date: 9 May 2009; original number: SMG 16169. Presented/Donated by: ?: Collector Unknown. - Etymology: The name *ambohitrensis* is derived from the geographical name of the type locality, which in Malagasy is Ambohitra and in French is Montagne d'Ambre. The nearby village of Joffreville is also referred to as Ambohitra. In the Malagasy language, the root word of Ambohitra is *vohitra* meaning mountain or highlands, giving an ecological context to the specific epithet of this bat, which occurs at higher elevations.

COMMON NAMES:
English: Montagne d'Ambre Long-fingered Bat. French: Minioptère de Montagne d'Ambre. German: Ambre-Langflügelfledermaus.

PARASITES:
Wilkinson *et al.* (2016) report the presence of *Penicillidia leptothrinax* on "*Miniopterus* cf. *ambohitrensis*", which was carrying Enterobacteriales bacteria (Szentiványi *et al.*, 2019: Suppl.).

VIRUSES:
Paramyxoviridae
Mélade *et al.* (2016b: 4) found one out of 19 *M.* cf. *ambohitrensis* specimens they tested to be infected with paramyxoviruses.

Rhabdoviridae
Four out of 15 *M.* cf. *ambohitrensis* specimens tested by Mélade *et al.* (2016a: 6) showed a reaction against *Duvenhage Lyssavirus*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

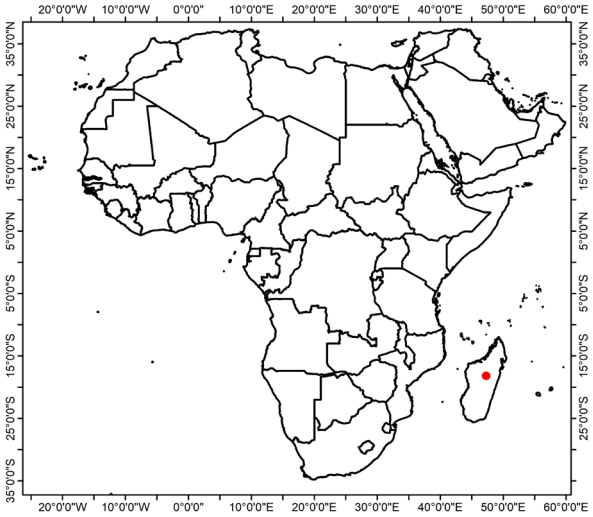


Figure 210. Distribution of *Miniopterus ambohitrensis*

Miniopterus brachytragos Goodman, Maminirina, Bradman, Christidis and Appleton, 2009

*2009. *Miniopterus brachytragos* Goodman, Maminirina, Bradman, Christidis and Appleton, Am. Mus. Novit., 3669: 1, 9, figs 3, 4A–C, 5. Publication date: 30 November 2009. Type locality: Madagascar: Province de Mahajanga: Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National]: Forêt d'Ambovonomby: 26 km NW Andranomavo [16 28.2 S 45 20.9 E, 200 m] [Goto Description]. Holotype: FMNH 175840: ad ♀, skull and alcoholic. Collected by: Steven M. Goodman; collection date: 9 October 2002; original number: SMG 13040. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 172685: Collected by: ?: Collector Unknown; collection date: 5 November 2001. Presented/Donated by: ?: Collector Unknown. Collected in Antsiranana Province, Forêt de Binara, near Analamazava River, 7.5 km SW Daraina (village), 13°15.3'S, 49°37.0'E, 325 - 600 m. Paratype: FMNH 172686: Collected by: ?: Collector Unknown; collection date: 5 November 2001. Presented/Donated by: ?: Collector Unknown. Collected in Antsiranana Province, Forêt de Binara, near Analamazava River, 7.5 km SW Daraina (village), 13°15.3'S, 49°37.0'E, 325 - 600 m. Paratype: FMNH 172867: Collected by: ?: Collector Unknown; collection date: 2 December 2001. Presented/Donated by: ?: Collector Unknown. Collected at the Parc National de Bemaraha, south bank Manambolo River, near Tombeau Vazimba, 3.5 km E Bekopaka, 19°08.4'S, 44°49.7'E, 100 m,. Paratype: FMNH 175846: Collected by: ?: Collector Unknown; collection date: 9 - 10 October 2002. Presented/Donated by: ?: Collector Unknown. Same locality as holotype. Paratype: FMNH 175847: Collected by: ?: Collector Unknown; collection date: 9 - 10 October 2002. Presented/Donated by: ?: Collector Unknown. Same locality as holotype. Paratype: FMNH 175850: Collected by: ?: Collector Unknown; collection date: 9 - 10 October 2002. Presented/Donated by: ?: Collector Unknown. Same locality as holotype. Paratype: FMNH 175851: Collected by: ?: Collector Unknown; collection date: 9 - 10 October 2002. Presented/Donated by: ?: Collector Unknown. Same locality as holotype. Paratype: FMNH 175852: Collected by: ?: Collector Unknown; collection date: 9 - 10 October 2002. Presented/Donated by: ?: Collector Unknown. Same locality as holotype. Paratype: FMNH 175856: Collected by: ?: Collector Unknown; collection date: 9 - 10 October 2002. Presented/Donated by: ?: Collector Unknown. Same locality as holotype. Paratype: FMNH 175864: Collected by: ?: Collector Unknown; collection date: 11 October 2002. Presented/Donated by: ?: Collector Unknown. Collected just outside limit of Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], along Ampandra River, 22 km NW Andranomavo, 16°26.4429'S, 45°24.723'E, 120 m. Paratype: FMNH 175865: Collected by: ?: Collector Unknown; collection date: 11 October 2002. Presented/Donated by: ?: Collector Unknown. Collected just outside limit of Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], along Ampandra River, 22 km NW Andranomavo, 16°26.4429'S, 45°24.723'E, 120 m. Paratype: FMNH 175867: Collected by: ?: Collector Unknown; collection date: 11 October 2002. Presented/Donated by: ?: Collector Unknown. Collected just outside limit of Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], along Ampandra River, 22 km NW Andranomavo, 16°26.4429'S, 45°24.723'E, 120 m. Paratype: FMNH 175869: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175870: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175871: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175872: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175873: Collected by: ?: Collector

Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175874: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175875: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175877: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175879: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175880: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175881: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175882: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175883: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175884: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 175885: Collected by: ?: Collector Unknown; collection date: 14 - 15 October 2002. Presented/Donated by: ?: Collector Unknown. Collected at the Réserve Naturelle Intégrale de Namoroka [status subsequently changed to Parc National], near source of Mandevy River, 32 km NW Andranomavo, 16°22.8'S, 45°20.7'E, 100 m. Paratype: FMNH 188651: Collected by: ?: Collector Unknown; collection date: 14 February 2006. Presented/Donated by: ?: Collector Unknown. Collected in Antsiranana Province, Nosy Komba, 0.9 km SW Ampangorinana, on trail to Station Forestière d'Antanampoera, 13°26.835'S, 48°20.466'E, 100 m. Paratype: FMNH 202523: Collected by: ?: Collector Unknown; collection date: 26 November 2007. Presented/Donated by: ?: Collector Unknown. Collected in Toamasina Province, Masoala Peninsula, 1.8 km S Ambanizana (village), 15°38.291'S, 49°57.944'E, 5 m. - Etymology: From the Greek *brachys* ("short") and *tragos*, meaning "goat," a word ultimately borrowed into New Latin to mean "tragus," and has been chosen as this taxon is easily distinguished from its congeners by its diminutive tragus (see Goodman *et al.*, 2009c: 17).. (Current Combination)

COMMON NAMES:
German: Namoroka-Langflügelfledermaus.

GENERAL DISTRIBUTION:
Occur on Madagascar, from the Masoala Peninsula in the northeast, the Daraina region in the central northeast, and in the karstic zones of

the Namoroka and Bemaraha massifs, as well as on the island of Nosy Komba (see Goodman *et al.*, 2009c: 11).

Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the northwestern part of the island (western or dry deciduous region).

ECHOLOCATION:
Ramasindrazana *et al.* (2011: 294) recorded 30 calls from 8 *Miniopterus brachytragos* specimens, and found the following echolocation call values: Frequency of maximum energy: 59.0 ± 1.06 (57.3 - 61.7) kHz, Maximum frequency: 105.8 ± 11.20 (85.0 - 128.0) kHz, Minimum frequency: 55.7 ± 0.84 (54.0 - 57.0) kHz, Call duration: 3.4 ± 0.49 (2.6 - 4.3) ms, Inter pulse interval: 84.6 ± 18.99 (56.1 - 122.5) ms.

PARASITES:
Rasoanoro *et al.* (2019: 67) refer to Raharimanga *et al.* (2003), who reported *Trypanosoma* sp. from "*Miniopterus manavi*", but one of these bats belonged to the current species.

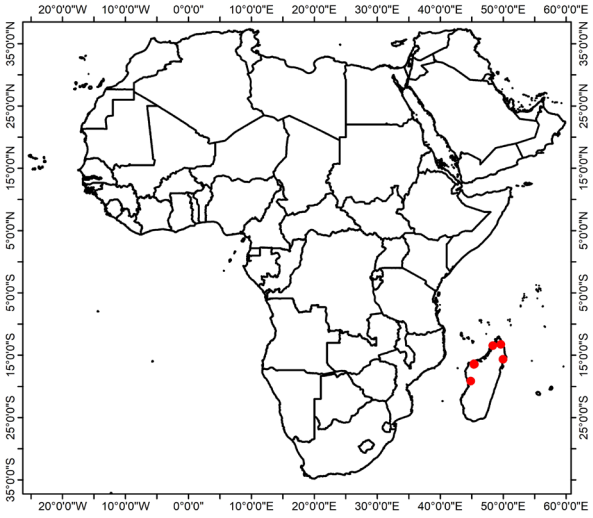


Figure 211. Distribution of *Miniopterus brachytragos*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Miniopterus egeri Goodman, Ramasindrazana, Maminirina, Schoeman, and Appleton, 2011

*2011. *Miniopterus egeri* Goodman, Ramasindrazana, Maminirina, Schoeman, and Appleton, Zootaxa, 2880: 1, 9, figs 3, 4, 5A, 6, 7. Publication date: 17 May 2011. Type locality: Madagascar: Toamasina Province: Sahafina forest: Brickaville, 9.5 km W [18 48 37 S 48 58 48 E, 50 m] [Goto Description]. Holotype: FMNH 209160: ad ♀, skull and alcoholic. Collected by: Steven M. Goodman and Beza Ramasindrazana; collection date: 5 December 2009; original number: SMG 16602. Presented/Donated by: ?: Collector Unknown. - Etymology: in honor of Dr. Judith Eger, Senior Curator, Department of Mammalogy, Royal Ontario Museum, Toronto, for her contribution to taxonomic studies of Old World bats, including Madagascar (see Goodman *et al.*, 2011: 13). (Current Combination)

COMMON NAMES:
English: Eger's long-fingered bat. French: Minioptère d'Eger. German: Eger-Langflügelfledermaus.

GENERAL DISTRIBUTION:
Based on current knowledge it is known from scattered sites occuring across two-thirds of Madagascar's lowland area from near sea level to 550 m (Goodman *et al.*, 2011: 15).

Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the eastern coastal part of the island (eastern humid forest or lowland forest region - humid).

Native: Madagascar (Goodman *et al.*, 2011: 15).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 63) could not find a baculum in the one specimen they examined.

ECHOLOCATION:
Low-duty cycle, frequency modulated/quasi constant (FM/QCF) echolocation call, with a peak frequency of 54.7 kHz (53.2 - 56.3 kHz) and a duration of 2.9 ms (2.5 - 3.4 ms) (Goodman *et al.*, 2011: 8).
Ramasindrazana *et al.* (2011: 294) recorded 16 calls from 2 *Miniopterus egeri* specimens, and found the following echolocation call values: Frequency of maximum energy: 54.7 ± 1.02 (53.2 - 56.3) kHz, Maximum frequency: 113.8 ± 3.62 (107.0 - 123.0) kHz, Minimum frequency: 49.0 ± 0.52 (48.0 - 50.0) kHz, Call duration: 2.9 ± 0.26 (2.5 - 3.4) ms, Inter pulse interval: 62.6 ± 12.57 (43.2 - 81.1) ms.

HABITAT:
Often associated with disturbed forests with mixed native and introduced trees or at the ecotone between degraded anthropogenic habitats and native forest (Goodman *et al.*, 2011: 15).

ROOST:
A day roost site of this species was found in a natural rock shelter in the Poste Forestier de Farankaraina surrounded by slightly disturbed natural lowland humid forest (Goodman *et al.*, 2011: 15).

DIET:
Rasoanoro *et al.* (2015: 63, 64) found that the diet of *M. egeri* mainly consisted of Coleoptera (51.5 vol %), Hymentoptera (28 %), Lepidoptera (10.8 %), and Isoptera (9.7 %).

POPULATION:
Structure and Density - Further information is needed (Goodman *et al.*, 2011: 15).
Trend - In the short term this species does not appear to face a risk of dramatic population decline (Goodman *et al.*, 2011: 15).

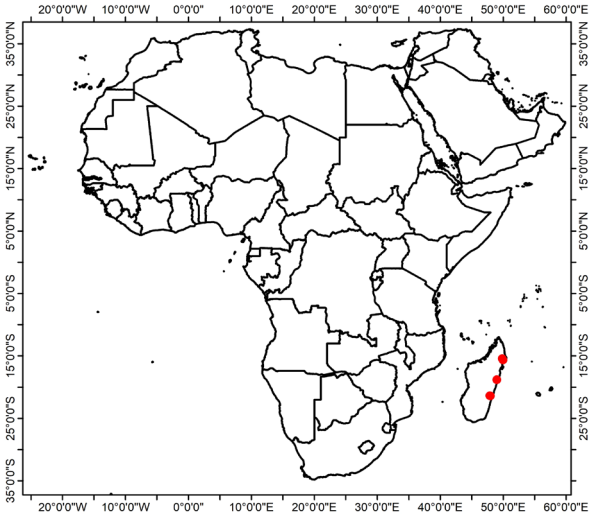


Figure 212. Distribution of *Miniopterus egeri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Miniopterus fraterculus Thomas and Schwann, 1906

*1906. *Miniopterus fraterculus* Thomas and Schwann, Proc. zool. Soc. Lond., 1906, I: 162. Publication date: 7 June 1906. Type locality: South Africa: Southern Cape Province: Knysna [33 53 S 22 59 E] [Goto Description]. Holotype: BMNH 1905.5.7.18: ad ♂, skin and skull. Collected by: Captain Claude Henry Baxter Grant; collection date: 3 October 1905; original number: 1073. See Thomas and Schwann (1906a: 162). - Comments: Coordinates mentioned as 35 56 S 23 06 E by Thorn *et al.* (2009: 49). - Etymology: From the Latin meaning "little brother" (see Goodman *et al.*, 2007b: 1222). (Current Combination)

1917. *Miniopterus breyeri vicinior* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 450. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Aba [03 53 N 30 17 E] [Goto Description]. Holotype: AMNH 49019: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 16 December 1911; original number: 1770. See Allen (1917: 450). - Comments: Considered a subspecies of *fraterculus* by Thorn *et al.* (2009: 49).

1978. *M[iniopterus] fraterreulus:* Herzit-Straschil and Robinson, Koedoe, 21: 104. (Lapsus)

? *Miniopterus cf. fraterculus:*

? *Miniopterus fraterculus fraterculus:* (Name Combination)

TAXONOMY:
Meester *et al.* (1986) state that Harrison and Clancey (1952) and Harrison (1953) have demonstrated that Ellerman *et al.* (1953) are mistaken in regarding *fraterculus* as a synonym of *M. schreibersii natalensis*. Koopman (1966) regards *fraterculus* instead as a subspecies of the extralimital (to southern Africa) *M. minor* Peters, 1867, but Hayman and Hill (1971) disagree. Corbet and Hill (1980) retain *fraterculus* as species, as do Swanepoel *et al.* (1980) and Koopman (1982).

Specimens from Madagascar assigned to *M. fraterculus* by Peterson *et al.* (1995) and Simmons (2005: 519) are now considered to be a distinct species: *Miniopterus sororculus* (Goodman *et al.*, 2007b).

COMMON NAMES:
Afrikaans: Klein grotvlermuis. Chinese: 小长翼蝠. Czech: létavec jihoafrický. English: Lesser Long-fingered Bat, Black Clinging Bat, Lesser bent-winged bat. French: Minioptère d'Afrique australe,

Petit minioptère. German: Kleine Langflügelfledermaus. Portuguese: Morcego pequeno de dedos compridos. SiSwati: Lilulwane.

CONSERVATION STATUS:
Global - Known from a number of discrete ranges. This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its widespread distribution on the African mainland and its ability to live in a wide variety of habitat types (Schlitter *et al.*, 2008; IUCN, 2009). On Madagascar, it is quite rare and further surveys are required.

Assessment History -
2008 - LC ver 3.1 (2001) (Schlitter *et al.*, 2008; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Schlitter, 2004g; IUCN, 2004). 1996 - EN (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (MacEwan *et al.*, 2016c). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).
Swaziland: 2003 - NT B2ab(iv); D2 ver 3.1 (2001) (Monadjem *et al.*, 2003).

MAJOR THREATS:
There are no major threats to this species on the African mainland (Schlitter *et al.*, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter *et al.* (2008) [in IUCN (2009)] report that this species is presumably present in a number of protected areas. In Tanzania it is present in the Manga Forest Reserve of Tanzania (Doggart *et al.*, 1999b). Further studies are needed to better define the range of this species.

GENERAL DISTRIBUTION:
Miniopterus fraterculus is present in Central Africa, East Africa and southern Africa. It is known from a number of discrete ranges, the largest of which stretches down south-eastern Africa, from Malawi, Mozambique and Zimbabwe, down to South Africa (where is extends along the south coast and its distribution is mostly affected by the annual temperature range (Babiker Salata, 2012: 50)). It is also known from eastern Democratic Republic of Congo near the borders with Uganda and Rwanda (although this population needs to be confirmed as *Miniopterus fraterculus*), and recorded from localities in Tanzania, Zambia, and Kenya. A small recorded range in Kenya near the border with Tanzania probably does not represent *Miniopterus fraterculus*.

Taylor *et al.* (2018b: 62) mention *Miniopterus* cf. *fraterculus* from Angola, however based on acoustic evidence only. Beja *et al.* (2019: 388) believe the Angolan records to be mis-identifications.

ROM has 28 specimens from two localities in Cameroon, which need verification as they are well outside the presently known distribution of the species.
Specimens from Madagascar assigned to *M. fraterculus* (Peterson *et al.* (1995; Russ *et al.*, 2001; Simmons, 2005: 519) are now considered to be a distinct species: *Miniopterus sororculus* (Goodman *et al.*, 2007b).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 297,363 km^2. In the RSA, its distribution is most affected by the annual temperature range (Babiker Salata, 2012: 50).

Native: Kenya; Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 539); Mozambique (Monadjem *et al.*, 2010d: 539; Monadjem *et al.*, 2010c: 385 as *M.* cf. *fraterculus*); South Africa (Monadjem *et al.*, 2010d: 539); Swaziland (Monadjem *et al.*, 2010d: 539); Tanzania; Zambia; Zimbabwe.
Presence uncertain: Camaroon; Congo; The Democratic Republic of the; Rwanda; Uganda.

DENTAL FORMULA:
van der Merwe (1985b: 251) examined 44 skulls and found 95 % of them vestigial teeth between the upper canine and the first premolar. In 44 % of the skulls, the teeth were present on both sides.

ECHOLOCATION:
Schoeman and Waddington (2011: 291) mention a peak frequency of 62.1 ± 1.7 kHz and a duration of 3.7 ± 0.6 msec for specimens from Durban, South Africa.

The 135 calls analysed by Eisenring *et al.* (2016: SI 2) from bats in the Aberdares Range in Kenya had the following values: PF: 56.2 ± 1.4 (53.3 - 60.0), HF: 87.1 ± 15.9 (63.8 - 127.6), LF: 52.2 ± 1.6 (47.4 - 56.2), DT: 0.1 ± 0.0 (0.0 - 0.1), DF: 34.9 ± 15.9 (11.5 - 80.1), IPI: 0.8 ± 0.6 (0.3 - 4.8).

For calls from specimens from Swaziland, Monadjem *et al.* (2017c: 179) recorded: F_{min}: 58.5 ± 0.50 (58.1 - 58.8) kHz, F_{knee}: 63.6 ± 1.27 (62.7 - 64.4) kHz, F_c: 59.2 ± 0.40 (58.9 - 59.5) kHz and duration: 2.9 ± 0.32 (2.7 - 3.1) msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Rautenbach *et al.* (1993) described the karyotype as having a diploid number 2*n* = 46, aFN = 50, BA = 6, X = SM, Y = A.

Protein / allozyme - Unknown.

POPULATION:
Structure and Density - It is common and widespread (Schlitter *et al.*, 2008; IUCN, 2009).
Trend - 2008 - Unknown (Schlitter *et al.*, 2008; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Delayed implantation (lasting two-and-a-half months), insemination, ovulation and fertilization occur in the autumn. Embryogenesis proceeds to the blastocyst stage and development is then retarded until arousal in spring, when the blastocyst implants and embryogenisis resumes. The active fetal growth period takes about four months (Bernard, 1980a: 55; Bernard, 1980c).

Bernard (1980b: 111) found that the ovarian and uterine function is asymmetrical as ovulations occurred primarily in the left ovary (94 %), whereas all implantations occurred in the right uterine horn.

PARASITES:
HAEMOSPORIDA
Lutz *et al.* (2016: 9) examined 6 *M.* cf. *fraterculus* specimens from East Africa and found two of them infected with the haemosporidan parasite *Polychromophilus melanipherus* Dionisi, 1899.

ACARI
Myobiidae: Uchikawa (1985a: 16) reported mites belonging to *Calcarmyobia rhinolophia* (Radford, 1940) on bats identified as *M. fuscus fraterculus* from Natal, South Africa.
Trombiculidae: *Leptotrombidium lawrencei* Vercammen-Grandjean and Langston, 1976 (see Stekolnikov, 2018a: 143).

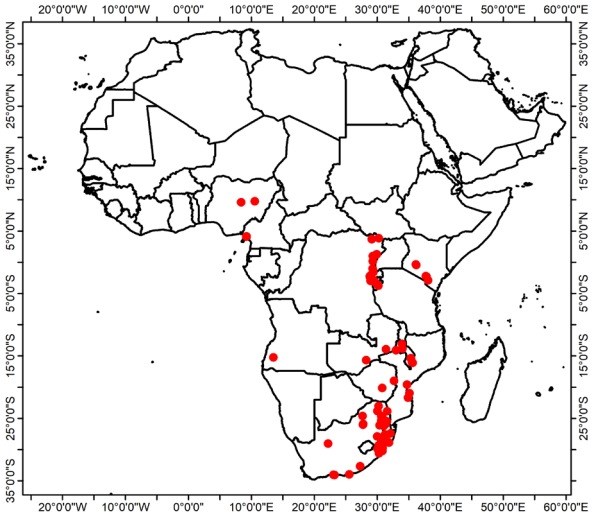


Figure 213. Distribution of *Miniopterus fraterculus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Burundi, Cameroon, Congo (Democratic Republic of the), Kenya, Madagascar, Malawi, Mozambique, Nigeria, Rwanda, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe.

Miniopterus gleni Peterson, Eger and Mitchell, 1995

*1995. *Miniopterus gleni* Peterson, Eger and Mitchell, Faune de Madagascar, Chiroptères, 84: 128, figs 60, 61. Type locality: Madagascar: 20 km S Tuléar: Sarodrano and Saint-Augustin, in a marine cave [23 33 S 43 45 E] [Goto Description]. Holotype: ROM 42567: ad ♂, skin and skull. Collection date: 9 May 1967. (Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: létavec Glenův. English: Glen's Long-fingered Bat. French: Minioptère malgache. German: Glens Langflügelfledermaus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Muldoon *et al.* (2009: 1114) report on subfossil remains from the Ankilitelo fauna (late Holocene, appr. 500 years ago).
Gunnell *et al.* (2014: 3) refer to Goodman and Junker (2013) who also report fossils from the Andrahomana cave.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its widespread distribution in Madagascar. It may be locally threatened in parts of its range by hunting and roost disturbance, but is not thought to be declining fast enough to place it in a higher category of threat (Andriafidison *et al.*, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Andriafidison *et al.*, 2008e; IUCN, 2009). 2000 - LR/nt (IUCN, 2000). 1994 - LR/nt ver 2.3 (1994) (Groombridge, 1994).

MAJOR THREATS:
It is threatened by roost site disturbance. This species is locally hunted in the south-west and north-west of Antananarivo (Goodman, 2006; Goodman *et al.*, 2008d) and as a relatively large species may be subject to similar exploitation elsewhere. There is no evidence that hunting presents a major threat. It is unclear if this species

is forest dependent (Andriafidison *et al.*, 2008e; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008e) [in IUCN (2009)] report that this species is known to exist in a number of protected areas in the north-east (Eger and Mitchell, 2003) and many along the west coast (Goodman *et al.*, 2005a).

GENERAL DISTRIBUTION:
Miniopterus gleni is endemic to the island of Madagascar where it appears to be widely distributed (Eger and Mitchell, 2003; Goodman *et al.*, 2005a). The areas from where it has yet to be recorded may reflect low sampling effort rather than a genuine absence. North of Onilahy river (incl. Ile Sainte-Marie; Rakotonandrasana and Goodman, 2007: 6).

Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the coastal areas of northeast, north, west, and the south of the island (western or dry deciduous region).

Native: Madagascar (Eger and Mitchell, 2003; Goodman *et al.*, 2005a; Rakotonandrasana and Goodman, 2007: 6)

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 63) could not find a baculum in the three males they examined.

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls of eight individuals, which were characterized by broadband FM/QCF pulses produced at low duty cycle with a frequency of maximum energy at about 44.8 kHz, while the fundamental was always the most intense call and pulses are short duration. Ramasindrazana *et al.* (2011: 294) recorded 16 calls from 6 *Miniopterus gleni* specimens, and found the following echolocation call values: Frequency of maximum energy: 42.3 ± 1.29 (40.1 - 44.6) kHz, Maximum frequency: 82.6 ± 8.22 (70.0 - 93.2) kHz, Minimum frequency: 37.4 ± 0.94 (36.0 - 38.9) kHz, Call duration: 3.7 ± 0.49 (3.0 - 4.4) ms, Inter pulse interval: 88.9 ± 17.75 (66.7 - 124.1) ms.

HABITAT:
Dammhahn and Goodman (2013: 108) mention the lower portion of forest structure and partially open areas as the foraging habitat for this species.

ROOST:
On Madagascar, Wilkinson *et al.* (2012: 160) reported the typical roosting site to be caves.

POPULATION:
Structure and Density - There was a maximum of 90 individuals recorded at a roost in Ankarana (S. G. Cardiff *pers. comm.*), but otherwise this species always appears to roost in rather small colonies (Robinson *et al.*, 2006). Its relative abundance, as determined by mist netting, varies from rare (Kofoky *et al.*, 2007) to locally common (Robinson *et al.*, 2006).
Trend - Unknown (Andriafidison *et al.*, 2008e; IUCN, 2009).

PARASITES:
Lagadec *et al.* (2012: 1696) and Dietrich *et al.* (2014: Suppl.) report the presence of spirochaetes bacteria of the genus *Leptospira*, and which were identified as *L. borgpetersenii* by Dietrich *et al.* (2018a: 3).

Ramasindrazana *et al.* (2016: 2) indicate that *Litomosa goodmani* Martin, Bain, Jouvenet, Raharimanga, Robert & Rousset, 2006 (Onchocercidae, Nematoda) was described from a *M. gleni* from northern Madagascar. They also recovered *Litomosa* Clade 1 from this bat species.

Perkins and Schaer (2016: Suppl.) report the presence of the haemosporidan *Polychromophilus* sp. Ramasindrazana *et al.* (2018: Suppl.) identified this parasite as *Polychromophilus melanipherus* Dionisi, 1899.

Tortosa *et al.* (2013: 4) and Ramasindrazana *et al.* (2017: Suppl.) reported the following Nycteribiid bat flies: *Nycteribia stylidiopsis*, *Penicillidia leptothrinax*, and *Penicillidia* sp. The first one was also mentioned by Wilkinson *et al.* (2016), which was found to carry Enterobacteriales and *Bartonella* bacteria, as well as the blood parasite *Polychromophilus melanipherus* (Szentiványi *et al.*, 2019: Suppl.).

VIRUSES:
Astroviridae
One of two *M. gleni* specimens tested by Lebarbenchon *et al.* (2017: Suppl.) was positive for Astroviridae.

Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 7 individuals from the Mauritius using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids.

Mélade *et al.* (2016b: 4) found four out of 22 *M. gleni* specimens they tested to be infected with paramyxoviruses.

UTILISATION:
Goodman (2006) describes the hunting method used by local inhabitants. See also Goodman *et al.* (2008d) and Jenkins and Racey (2008).

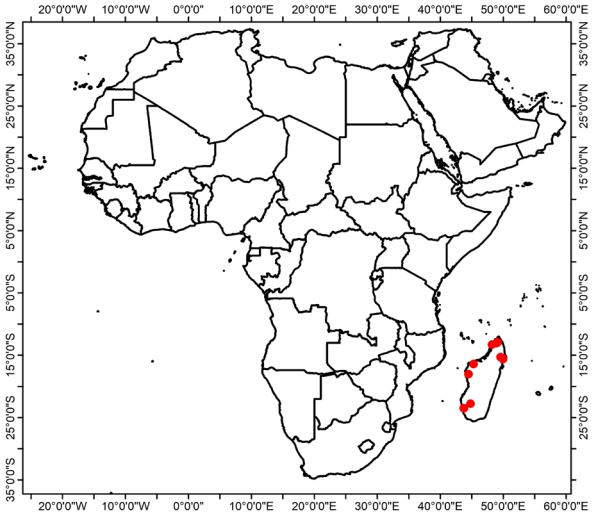


Figure 214. Distribution of *Miniopterus gleni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Miniopterus griffithsi Goodman, Maminirina, Bradman, Christidis and Appleton, 2009

*2009. *Miniopterus griffithsi* Goodman, Maminirina, Bradman, Christidis and Appleton, J. Zool. Syst. Evol. Res., 38: 75, 81, figs 4, 6. Publication date: prior to 25 October 2009. Type locality: Madagascar: Province de Toliara: Grotte d'Androimpano: 4.2 km NE Itampolo (village), on old road to Ejeda [24 39.012 S 43 57.797 E, 110m] [Goto Description]. Holotype: FMNH 184214: ad ♂, skull and alcoholic. Collected by: Steven M. Goodman; collection date: 23 February 2005; original number: SMG 14593. Paratype: FMNH 184153: ad ♂. Grotte de Vitane (Vitany), 4.1 km SE Itampolo, 244208.5S 435749.4E, 25m. Paratype: FMNH 184154: ad ♂. Grotte de Vitane (Vitany), 4.1 km SE Itampolo, 244208.5S 435749.4E, 25m. Paratype: FMNH 184167: ad ♂. Grotte de Vitane (Vitany), 4.1 km SE Itampolo, 244208.5S 435749.4E, 25m. Paratype: FMNH 184215: ad ♂. same locatlity as the holotype. Paratype: FMNH 184216: ad ♂. Same locatlity as the holotype. Paratype: FMNH 184236: ad ♀. Same locatlity as the holotype. Paratype: USNM 577076:. Fivondronana de Tolagnaro, 20 km WNW Ranopiso, 12 km ENE Amboasary, near Itaranta River, 2501S 4630E, 40m. Paratype: USNM 577077:. Fivondronana de Tolagnaro, 20 km WNW Ranopiso, 12 km ENE Amboasary, near Itaranta River, 2501S 4630E, 40m. (Current Combination)

TAXONOMY:
Goodman *et al.* (2009b) examining the phylogeography of the *M. gleni* complex, found that the Onilahy River is a major barrier to gene flow. Subsequently, morphological characters (tragus shape, pelage coloration and skull proportions) were identified, that supported the separation of the populations found on either side of the Onilahy River (Goodman *et al.*, 2009b).

COMMON NAMES:
German: Griffiths Langflügelfledermaus.

ETYMOLOGY OF COMMON NAME:
In honour of Owen Griffiths, founder of Biodiversity Conservation Madagascar, who is a specialist on the terrestrial mollusc fauna of the western Indian Ocean and has been instrumental in preserving key important areas of habitat on Mauritius and Madagascar. He has generously supported many initiatives for documenting the rich Malagasy fauna (including genetic studies on *Miniopterus*) (see Goodman *et al.*, 2009a: 346).

CONSERVATION STATUS:
IUCN - EN (Goodman *et al.*, 2009b).

GENERAL DISTRIBUTION:
Miniopterus griffithsii is endemic to Madagascar, where it seems to be restricted to the region between the southern banks of the Onilahy River and the Mandrare River (Itampolo east to near Ranopiso).

Schoeman *et al.* (2014: 28,31) found the most suitable area for this species to be located in the

south/southwestern coastal part of the island (south-west sub-arid or spiny bush).

Native: Madagascar.

ECHOLOCATION:
Ramasindrazana *et al.* (2011: 294) recorded 8 calls from 2 *Miniopterus griffithsi* specimens, and found the following echolocation call values: Frequency of maximum energy: 44.1 ± 0.67 (43.5 - 45.3) kHz, Maximum frequency: 80.4 ± 15.66 (61.0 - 99.0) kHz, Minimum frequency: 40.0 ± 0.0 (40.0 - 40.0) kHz, Call duration: 3.2 ± 0.29 (2.9 - 3.6) ms, Inter pulse interval: 89.2 ± 27.42 (56.4 - 128.5) ms.

ROOST:
Wilkinson *et al.* (2012: 160) indicate that caves are the typical roosting sites for these bats on Madagascar.

MIGRATION:
Reher *et al.* (2019: 121) found that *M. griffithsi* was only present in the Vintany Cave (southwestern Madagascar) during the wet season, whereas other species such as *Triaenops menamena* and *Miniopterus mahafaliensis* were present in both the dry and wet season.

PARASITES:
Lagadec *et al.* (2012: 1696), Dietrich *et al.* (2014: Suppl.) and Gomard *et al.* (2016: 5) report the presence of spirochaetes bacteria of the genus *Leptospira*, and which were further identified as *L. borgpetersenii* by Dietrich *et al.* (2018a: 3).

The haemosporidian *Polychromophilus melanipherus* Dionisi, 1899 was reported from this species by Ramasindrazana *et al.* (2018: Suppl.).

Ramasindrazana *et al.* (2016: 6) recovered *Litomosa* Clade 2 (Nematoda: Onchocercidae) from this bat species.

VIRUSES:
Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 2 individuals from the Mauritius using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids.

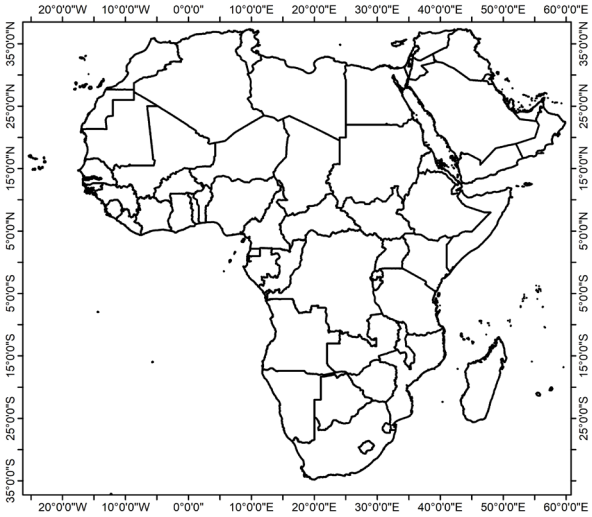


Figure 215. Distribution of *Miniopterus griffithsi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Miniopterus griveaudi Harrison, 1959

*1959. *Miniopterus minor griveaudi* Harrison, Durban Mus. Novit., 5 (15): 192. Publication date: 30 April 1959. Type locality: Comoros: Grand Comoro [11 35 S 43 20 E] [Goto Description]. Holotype: BMNH 1967.1231: ad ♀, alcoholic (skull not removed). Collected by: Paul Griveaud; collection date: 10 August 1958. Formerly HZM 3.2803, see Harrison (1959a: 192). - Comments: The museum labels of the two other specimens, on which Harrison (1959a) based his description (HZM 4.2804 and 5.2805), have the following note by P. Griveaud: "couloir souterrain et grotte sous coulée de lave Niombadjée". Niombadjée is a toponym for Niombadjou (also spelled as Niumbadju), located on the western lower flank of Mt. Karthala at 11° 47' 57" S, 43° 17' 50" E (approximately 600 m) and where members of the expedition were based from 8 August 1958 to 23 August 1958: see Goodman *et al.* (2009a: 342). - Etymology: In honour of Mr. Paul Griveaud, the collector of the type specimen.
? *Miniopterus griveaudi (Clade 3):* Goodman, Maminirina, Weyeneth, Bradman, Christidis, Ruedi and Appleton, Zool. Scr., 38: 351 - 353, 362 - 363.
? *Miniopterus griveaudi:* (Current Combination)

TAXONOMY:
Originally synonomised with *Miniopterus minor*. Then moved as a synonym of *Miniopterus manavi* (Peterson *et al.*, 1995: 135; Simmons, 2005: 520). Peterson *et al.* (1995: 119) suggest that it may be a vaild species, which Simmons (2005: 520)

recognises as a valid subspecies. Juste [B.] *et al.* (2007: 32) consider *griveaudi* a valid species based on mtDNA data, a view supported by Weyeneth *et al.* (2008).

COMMON NAMES:
Czech: létavec komorský. English: Griveaud`s Long-fingered bat. French: Minioptère des Comores. German: Komoren-Langflügelfledermaus.

ETYMOLOGY OF COMMON NAME:
In honour of Mr. Paul Griveaud, the collector of the type specimen.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Juste, 2008a; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Juste, 2008a; IUCN, 2009).

MAJOR THREATS:
The threats to this species are not known (Juste, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Juste (2008a) [in IUCN (2009)] reports that it is not known if the species is present in any protected areas. Further studies are needed into the distribution, abundance, natural history, and threats to this species.

GENERAL DISTRIBUTION:
Miniopterus griveaudi is endemic to Grand Comore Island in the Comoros.

O'Brien (2011: 289) also reports it from Madagascar. Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the northwestern part of the island (western or dry deciduous region).

Native: Comoros (Koopman, 1993a: 231 [as *minor*], Simmons, 2005: 521 [as *minor*], Juste [B.] *et al.*, 2007: 32).

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls as *M. manavi s.l.*, these calls were broadband FM/QCF sweeps produced at low duty cycle with most energy at about 58.1 kHz in the fundamental, with pulses having a short duration of about 4 ms.
Ramasindrazana *et al.* (2011: 294) recorded 49 calls from 17 *Miniopterus griveaudi* specimens from Madagascar, and found the following echolocation call values: Frequency of maximum energy: 59.9 ± 1.73 (56.4 - 62.4) kHz, Maximum frequency: 105.6 ± 12.05 (82.0 - 130.0) kHz, Minimum frequency: 55.9 ± 1.36 (53.0 - 58.0) kHz, Call duration: 3.5 ± 0.54 (2.7 - 4.4) ms, Inter pulse interval: 85.7 ± 19.80 (40.0 - 123.6) ms.
For 27 calls of 8 specimens from the same species from Anjoun, Ramasindrazana *et al.* (2011: 294) reported the following echolocation call values: Frequency of maximum energy: 59.2 ± 0.73 (58.2 - 60.8) kHz, Maximum frequency: 104.3 ± 8.86 (86.0 - 123.0) kHz, Minimum frequency: 54.5 ± 1.22 (53.0 - 57.0) kHz, Call duration: 3.2 ± 0.53 (2.7 - 4.6) ms, Inter pulse interval: 83.8 ± 15.60 (57.6 - 128.1) ms.
And 22 calls of 6 specimens from Grande Comore gave the following echolocation call values: Frequency of maximum energy: 59.4 ± 0.78 (58.2 - 60.9) kHz, Maximum frequency: 110.0 ± 11.10 (74.0 - 124.0) kHz, Minimum frequency: 55.0 ± 0.76 (53.0 - 56.0) kHz, Call duration: 3.1 ± 0.34 (2.6 - 3.6) ms, Inter pulse interval: 83.5 ± 13.18 (66.1 - 123.9) ms.

MOLECULAR BIOLOGY:
DNA - Unknown
Karyotype - Richards *et al.* (2010) reported one female with a $2n$=46 and a FNa=50. The karyotype consists of two large metacentric, one medium metacentric and 19 acrocentric chromosomal pairs. As FISH with the complete set of *Myotis* probes was applied, the X chromosome could be identified as a submetacentric element. Volleth and Eick (2012: 167) also mention a segment number of 23.

HABITAT:
Dammhahn and Goodman (2013: 108) mention the lower portion of forest structure and partially open areas as the foraging habitat for this species.

ROOST:
Wilkinson *et al.* (2012: 160) indicated that caves are the typical roosting site for this species on the Comoros.

POPULATION:
Structure and Density - The abundance and population size of this species are not known (Juste, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Juste, 2008a; IUCN, 2009).

PARASITES:
Lagadec *et al.* (2012: 1696), Lei and Olival (2014: Suppl.) and Gomard *et al.* (2016: 5) found this species to be infected by *Leptospira* bacteria on the Comoro Islands. These were further identified as *L. borgpetersenii* by Dietrich *et al.* (2018a: 3).

The haemosporidian *Polychromophilus melanipherus* Dionisi, 1899 was reported from this species by Ramasindrazana *et al.* (2018: Suppl.), as wel as an unidentified *Haemosporida* sp.

Tortosa *et al.* (2013: 4) reported these bats to be parasitized by *Nycteribia stylidiopsis* on both the Comoro Islands and on Madagascar. On the latter island, two additional Nycteribiid bat flies were found: *Penicillidia leptothrinax* and *Penicillidia* sp. *N. stylidiopsis* and *P. leptothrinax* were also reported by Wilkinson *et al.* (2016) and Ramasindrazana *et al.* (2017: Suppl.). Wilkinson *et al.* (2016) furthermore reported the presence of "*Penicillidia* sp. (cf. *fulvida*)". The *N. stylidiopsis* flies were found to carry Enterobacteriales, and the *P.* cf. *fulvida* the blood parasite *Polychromophilus murinus* as well as Enterobacteriales and *Bartonella* bacteria, whereas *P. leptothrinax* was carrying Enterobacteriales and *Bartonella* and *Wolbachia* bacteria (Szentiványi *et al.*, 2019: Suppl.).

Ramasindrazana *et al.* (2016: 6) recovered *Litomosa* Clades 1, 2 and 3 (Nematoda: Onchocercidae) from this bat species, as well as an unnamed filariod.

VIRUSES:

Astroviridae

26 bats were tested by Lebarbenchon *et al.* (2017: Suppl.) of which 15 were positive for Astroviridae.

Paramyxoviridae

Wilkinson *et al.* (2012: 160) tested 20 individuals from the Comoros using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 3 positive results for viral nucleic acids. Wilkinson *et al.* (2014) tested 17 individuals from Amabhibe in Madagascar with an RT-PCR specific for the *Respiro-*, *Morbilli-* and *Henipavirus* genera, four of the 17 individuals tested positive for paramyxovirus RNA.

18 out of 116 Madagascan specimens tested by Mélade *et al.* (2016b: 4) were positive for paramyxoviruses.

Rhabdoviridae

Mélade *et al.* (2016a: 6) tested 33 specimens for *Lagos bat lyssavirus* and two of them showed seroreactivity. This was also the case for 10 out of 29 specimens they tested for *Duvenhage lyssavirus*.

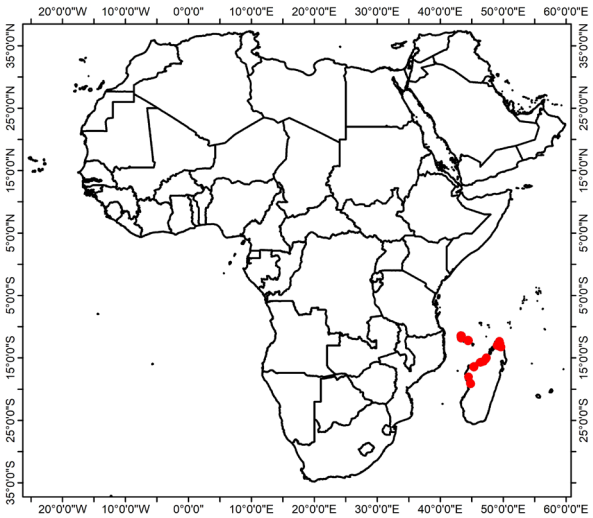


Figure 216. Distribution of *Miniopterus griveaudi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Comoros, Madagascar.

Miniopterus inflatus Thomas, 1903

*1903. *Miniopterus inflatus* Thomas, Ann. Mag. nat. Hist., ser. 7, 12 (72): 634. Publication date: 1 December 1903. Type locality: Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. Holotype: BMNH 1903.2.4.8: ad ♂, skin only. Collected by: George Latimer Bates Esq. Collection date: 24 July 1901. - Etymology: From the masculine Latin adjective *inflatus*, meaning "inflated, swollen", referring to its inflated skull (see Lanza *et al.*, 2015: 329). (Current Combination)

? *Miniopterus infatus:* (Lapsus)

TAXONOMY:

Koopman (1975: 230) included *africanus*, but see Peterson *et al.* (1995: 120), Simmons (2005: 520) and Juste [B.] *et al.* (2007: 28).

Simmons (2005: 520) recognises *rufus* Sanborn, 1936 as a valid subspecies.

COMMON NAMES:

Afrikaans: Groot grotvlermuis. Chinese: 大长翼蝠. Czech: létavec větší. English: Greater Long-fingered Bat, High-crowned bat. French: Grand minioptère africain, Grand minioptère, Minioptère à couronne. German: Aufgeblasene Langflügelfledermaus. Italian: Miniòttero maggióre di Thòmas, Miniòptero maggióre di Thòmas. Portuguese: Morcego grande de dedos

compridos. Spanish (Castillian): Murciélago de Ala Larga.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Schlitter, 2008h; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [includes *africanus* Sanborn, 1936] (Schlitter, 2008h; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Schlitter, 2004j; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional-
South Africa: 2016 - NT D1 ver 3.1 (2001) (Richards *et al.*, 2016c).

MAJOR THREATS:
There do not appear to be any major threats to this species. Some roosting caves are disturbed by tourism activities (Schlitter, 2008h; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008h) [in IUCN (2009)] report that this species has been recorded from a number of protected areas. There is a need to limit disturbance of important roosting caves. Further studies are needed into the distribution of this species in West Africa.

GENERAL DISTRIBUTION:
Patchily recorded over much of sub-Saharan Africa. It has been reported from Liberia and Guinea in West Africa; from Cameroon, Equatorial Guinea, Gabon, Central African Republic and the Democratic Republic of the Congo in Central Africa; from Ethiopia, Uganda, Kenya and Tanzania in East Africa; and from Namibia, Zimbabwe and Mozambique in southern Africa.

The distribution of this species is somewhat unclear in West Africa due to confusion with records of *Miniopterus schreibersii* (Simmons, 2005:520).

Native: Burundi (Simmons, 2005: 520); Cameroon (Simmons, 2005: 520); Central African Republic; Congo (Bates *et al.*, 2013: 329 - 1st authenticated records); Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Simmons, 2005: 520; Monadjem *et al.*, 2010d: 539); Equatorial Guinea; Ethiopia; Gabon (Simmons, 2005: 520); Guinea; Kenya (Simmons, 2005: 520); Liberia (Simmons, 2005: 520); Malawi (Monadjem *et al.*, 2010d: 539); Mozambique (Smithers and Lobão Tello, 1976; Simmons, 2005: 520; Monadjem *et al.*, 2010d: 539; Monadjem *et al.*, 2010c: 385); Namibia (Monadjem *et al.*, 2010d: 539); South Africa (Monadjem *et al.*, 2010d: 539); Tanzania; Uganda (Kityo and Kerbis, 1996: 62; Simmons, 2005: 520); Zambia (Ansell, 1974; Monadjem *et al.*, 2010d: 539); Zimbabwe (Monadjem *et al.*, 2010d: 539).
Presence uncertain: Nigeria (Simmons, 2005: 520).

DENTAL FORMULA:
van der Merwe (1985b: 251) examined three skulls and found vestigial teeth between the upper canine and the first premolar in all of them.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Ruedas *et al.* (1990) described the karyotype as having a diploid number of 2*n* = 46, aFN = 50, BA = 6, X = M, Y = A.
Protein / allozyme - Unknown.

HABITAT:
In the Mount Nimba area, Monadjem *et al.* (2016y: 371) recorded this species from a variety of forested and disturbed habitats between 500 and 1,000 m.

ROOST:
Monadjem *et al.* (2016y: 371) found a roost of this species in an old mine adit.

POPULATION:
Structure and Density - This is generally considered to be a locally rare species, although it can be common in some areas (Schlitter, 2008h; IUCN, 2009).
Trend - 2008 - Unknown (Schlitter, 2008h; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Brosset and Saint Girons (1980: 227) indicate that in Gabon all females were pregnant between August and September, and births were taking place in October. Between January and July, none of the females were either having any fetuses or young or were lactating. The males were non-reproductive between 9 October and 10 February.

PARASITES:
Fain (1959a: 342) described *Nycteridocoptes miniopteri* (Acari: Sarcoptidae) from a *M. inflatus* specimen collected in Mulungu, Kivu, DRC.

Uchikawa (1985a: 22) reported *Calcarmyobia kenyaensis* Uchikawa, 1982 (Acari: Myobiidae) from *Miniopterus inflatus* specimens from Cameroon, Liberia, The Democratic Republic of Congo, Uganda and Kenya. Some Kenyan bats

were identified as belonging to *Miniopterus inflatus africanus*, which might indicate that the host should actually be *M. africanus*.
Uchikawa (1985b: 52) further collected two paratypes of *Calcarmyobia producta* from a *M. inflatus* specimen from N Chyulu Hills, Kenya.
Uchikawa (1985c: 110) furthermore reported on several specimens from Kenya and The Democratic Republic of Congo, infected with four female *Pteracarus miniopteri* Uchikawa mites.

Justine (1989b: 555) described a new stomach parasite: *Capillaria magnova* from a *M. inflatus* from Belinga (Gabon).

Duval *et al.* (2012: 1559) indicate that the haemosporidan *Polychromophilus (Polychromophilus) corradetti* Landau et al., 1980 was described from *M. inflatus* specimens from Gabon (see Landau *et al.*, 1980b: 22). They also report (p. 1561) on five haplotypes belonging to the *Polychromophilus melanipherus* group and isolated during their study in Gabon.

ACARI
Laelapidae: *Neospinolaelaps Illiniopteri* Zumpt and Patterson, 1952 was reported by Taufflieb (1962: 112).
Sarcoptidae: Fain (1959d: 157) described *Notoedres (Metanotoedres) miniopteri* from *M. inflatus* from Thysville (=Mbanza-Ngungu), DRC.
Spinturnicidae: Taufflieb (1962: 112) reported *Spinturnix selllilunaris* de Meillon and Lavolplerre, 1944.

DIPTERA:
Streblidae: *Brachytarsina allaudi* (Falcoz, 1923) in Gabon (Obame-Nkoghe *et al.*, 2016: 5). *Raymondia huberi* Frauenfeld 1856 in Guinea-Bissau (Haeselbarth *et al.*, 1966: 102). *Raymondia seminuda* Jobling, 1954 (Shapiro *et al.*, 2016: 255). *Raymondia tauffliebi* Theodor, 1968 in Congo (Shapiro *et al.*, 2016: 256).

Nycteribiidae: *Nycteribia exacuta* Theodor, 1957 from Dalaba, Guinea (Haeselbarth *et al.*, 1966: 108). *Nycteribia schmidlii* Schiner, 1853 (Haeselbarth *et al.*, 1966: 108; Tortosa *et al.*, 2013: 5; Duron *et al.*, 2014: 2108; Obame-Nkoghe *et al.*, 2016: 5; Ramasindrazana *et al.*, 2017: Suppl.), which was in Gabon carrying the blood parasite *Polychromophilus melanipherus* (Szentiványi *et al.*, 2019: Suppl.). *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114; Duron *et al.*, 2014: 2109; Obame-Nkoghe *et al.*, 2016: 5), which in Gabon was also carrying the same blood parasite as above (Szentiványi *et al.*, 2019: Suppl.). *Eucampsipoda africana* Theodor, 1955 (Obame-Nkoghe *et al.*, 2016: 5).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibody to SARS-CoV in sera in 34 individuals from Oriental Province, DRC, one tested positive (1/34, 2.9 %). Tong *et al.* (2009) tested 7/12 bats collected in Kenya during 2006 positive for the presence of coronavirus RNA in a fecal sample.
Anthony *et al.* (2017b: Suppl.) mention the alpha-coronaviruses: Kenya_Cov_KY33 and Predict_CoV_28. One out of two Kenyan specimens tested by Tao *et al.* (2017: Suppl.) was positive for CoV.

Filoviridae - Filoviruses
Marburgvirus
This virus is reported by Becquart *et al.* (2010: 1), Kuzmin *et al.* (2010b: 353), Luis *et al.* (2013: Suppl), Changula *et al.* (2014: 486), Simons *et al.* (2014: 2090), and Willoughby *et al.* (2017: Suppl.).

Ebolavirus
On 24 January 2019, a series of newspaper articles was published, where several scientists from EcoHealth Alliance were quoted (Simon J. Anthony, Jonathan Epstein) stating that in a mouth swab one Liberian *Miniopterus inflatus* (out of 150 tested) RNA material of the Zaire Ebolavirus was found. Epstein, however, pointed out that if the bat was a natural host for the virus, it would have been found in more than one bat. He also pointed out that the bat could have become infected by another bat species living in the same habitat. Fabian Leendertz (veterinary epidemiologist at the Robert Koch Institute - not involved in the study) indicated that the virus itself wasn't isolated but only about one-fifth of its genome (Grady, 2019; Kupferschmidt, 2019; Su, 2019; Brainard, 2019).

Nairoviridae
Orthonairovirus
9 out of 51 *M. inflatus* specimens from Gabon tested by Müller *et al.* (2016: 3) were positive for Crimean Congo hemorrhagic fever virus (CCHFV).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that two of the 125 specimens they examined from Gabon tested positive for *Rubulavirus*.

In their overview table, Maganga *et al.* (2014a: 8) reported the following viruses were already found on *M. inflatus*: Marburg virus (MBGV), Coronavirus, Rubulavirus.

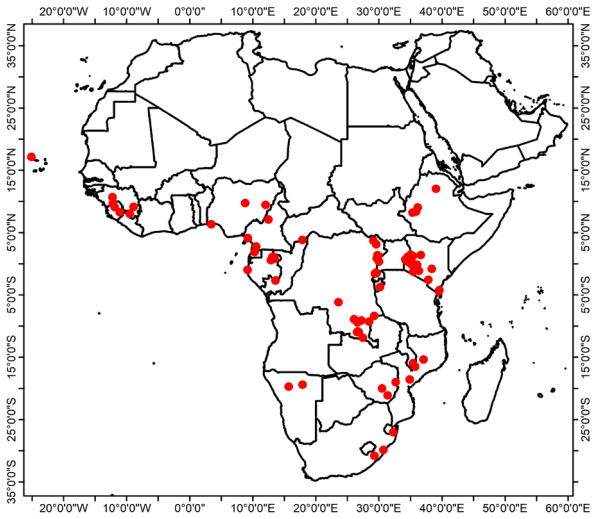


Figure 217. Distribution of *Miniopterus inflatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Cameroon, Cape Verde, Central African Republic, Congo (Democratic Republic of the), Ethiopia, Gabon, Guinea, Kenya, Liberia, Madagascar, Malawi, Mozambique, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, Uganda, Zambia, Zimbabwe.

Miniopterus inflatus inflatus Thomas, 1903

*1903. *Miniopterus inflatus* Thomas, Ann. Mag. nat. Hist., ser. 7, 12 (72): 634. Publication date: 1 December 1903. Type locality: Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. - Etymology: From the masculine Latin adjective *inflatus*, meaning "inflated, swollen", referring to its inflated skull (see Lanza *et al.*, 2015: 329). (Current Combination)

? *Miniopterus inflatus inflatus:* (Name Combination, Current Combination)

Miniopterus inflatus rufus Sanborn, 1936

*1936. *Miniopterus rufus* Sanborn, Field Mus. Nat. Hist., Zool. Ser., (362) 20 (14): 112. Publication date: 15 August 1936. Type locality: Congo (Democratic Republic of the): Tanganyika-Moero: Lualaba River, 40 mi (64 km) below Bukama: Katobwe [08 51 S 26 05 E] [Goto Description]. Holotype: FMNH 29416: ad ♂, skin and skull. Collected by: John Todd Zimmer; collection date: 28 November 1926; original number: 566.

? *Miniopterus inflatus rufus:* (Name Combination, Current Combination)

PARASITES: Lutz *et al.* (2016: 9) examined 31 "*M. rufus*" specimens from East Africa and found 22 of them infected with the haemosporidan parasite *Polychromophilus melanipherus* Dionisi, 1899.

Miniopterus maghrebensis Puechmaille, Allegrini, Benda, Bilgin, Ibañez and Juste, 2014

*2014. *Miniopterus maghrebensis* Puechmaille, Allegrini, Benda, Bilgin, Ibañez and Juste, in: Puechmaille, Allegrini, Benda, Gürün, Šrámek, Ibáñez, Juste and Bilgin, Zootaxa, 3794 (1): 108, 112, figs 2, 3a-b, 4a-b, 5a-b. Publication date: 5 May 2014. Type locality: Morocco: Er Rachidiyah Province: 5.7 km S of Ksar Tazougart, 19 km W-NW of Boudenib: Kef Azigza Cave (or Tazzouguert Cave) [32 01 46.6 N 03 47 16.7 W, 1060 m] [Goto Description]. Holotype: NMP 94426: ad ♂, skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 28 April 2008; original number: pb3907. Presented/Donated by: ?: Collector Unknown. Paratype: EBD MAM 25780: ad ♂, alcoholic (skull not removed). Collected by: Carlos J. Ibáñez Uargui, Javier Juste, J.A. Garrido and Juan Quetglas; collection date: 30 April 2000. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 90047: ♂, alcoholic (skull not removed). Collected by: Petr Benda; collection date: 30 August 2003. Presented/Donated by: ?: Collector Unknown. Talknout, Oued Tessaoud. Paratype: NMP 90051: ♂, skull and alcoholic. Collected by: Petr Benda; collection date: 30 August 2003. Presented/Donated by: ?: Collector Unknown. Talknout, Oued Tessaoud. Paratype: NMP

90103: ♀, skull and alcoholic. Collected by: Petr Benda; collection date: 9 September 2003. Presented/Donated by: ?: Collector Unknown. Sebt-es-Âït-Serhrouchèn, Oued El Ammar. Paratype: NMP 94505: alcoholic (skull not removed). Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94506: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94507: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94508: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94509: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94510: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94511: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94512: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94513: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94514: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. Paratype: NMP 94515: skull and alcoholic. Collected by: Petr Benda, Jaroslav Cervený, Adam Konecný and Peter Vallo; collection date: 26 April 2008. Presented/Donated by: ?: Collector Unknown. Kef Azigza Cave. - Etymology: The name maghrebensis refers to the region (the Maghreb; the region of northern Africa located between the Atlantic Ocean, the Mediterranean Sea, and the Sahara) where the new species was discovered (see Puechmaille *et al.*, 2014a: 118). (Current Combination)

TAXONOMY:
Bilgin *et al.* (2016: 330) calculated that the split between *M. maghrebensis* and *M. schreibersii* took place some 72,041 years ago (95 % HDP Interval = 5,637 - 139,570 years).

COMMON NAMES:
Czech: létavec maghrebský. Dutch: Maghrebijns langvleugelvleermuis. English: Maghrebian bent-wing bat. French: Minioptere du Maghreb. German: Maghreb-Langflügelfledermaus. Spanish (Castillian): Murrcielago de cueva magrebí.

GENERAL DISTRIBUTION:
Northern Morocco to south of the High Atlas Mountains and northern Tunisia.

SEXUAL DIMORPHISM:
Šrámek and Benda (2014: 222) found that most of the cranio-dental measurements in males were larger than in females, except for the dimensions associated with skull and rostral width. In dental characters, on the other hand, females were larger in 38 of 57 variables and the sexes highly diverged ($P < 0.001$) in the length of the lower canine; slightly diverged in widths of the second lower incisor, second upper molar (in central part) and third lower molar.

ECHOLOCATION:
Puechmaille *et al.* (2014a: 113) provide the following data [(avg ± sd (min - max)]: Peak frequency: 52.89 ± 0.74 (51.00 - 54.78) kHz; Start frequency: 74.69 ± 7.66 (63.57 - 101.07) kHz; End frequency: 50.36 ± 0.81 (48.92 - 51.85) kHz; Duration: 4.48 ± 0.67 (3.20 - 5.60) msec; Interval between pulses: 107.14 ± 27.35 (67.20 - 239.20) msec.

MOLECULAR BIOLOGY:
The GenBank sequence (partial Cytochrome *b*, tRNA-Threonine, tRNA-Proline, HV1) of the holotype corresponds to the accession numbers KJ535784 & KJ535824 (see Puechmaille *et al.*, 2014a: 117).

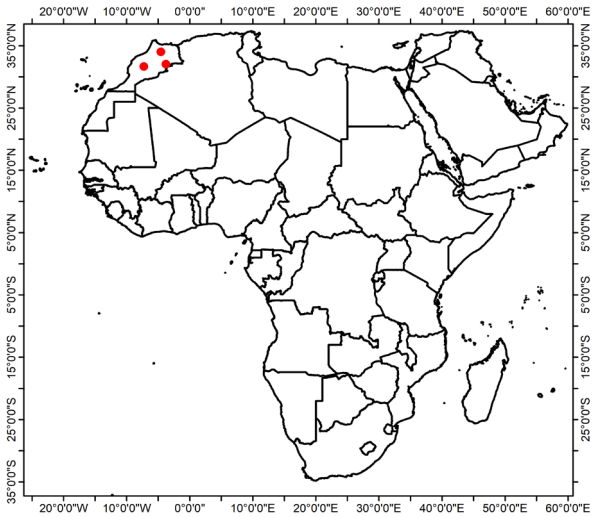


Figure 218. Distribution of *Miniopterus maghrebensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Morocco.

Miniopterus mahafaliensis Goodman, Bradman, Christides and Appleton, 2009

*2009. *Miniopterus mahafaliensis* Goodman, Bradman, Christides and Appleton, Am. Mus. Novit., 3669: 1, 17, figs 4D-E, 6, 7. Publication date: 30 November 2009. Type locality: Madagascar: Province de Toliara: Parc National de Tsimanampetsotsa: 6.5 km NE Efoetse: near Mitoho Cave [24 03.0 S 43 45.0 E, 50 m]. Holotype: FMNH 173179: ad ♂. Collected by: Steven M. Goodman; collection date: 2 March 2002; original number: SMG 12649. Paratype: FMNH 172918:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172919:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172920:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172921:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172922:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172923:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172924:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172925:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172926:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172927:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172928:; collection date: 7 May 2002. Grotte d'Ambanilia, 3.7 km SSE Sarodrano, 23°32.397' S, 43°44.763' E, sea level. Paratype: FMNH 172929:; collection date: 8 May 2002. Grotte de Bisihiko, 0.75 km E St. Augustin, 23°32.933' S, 43°46.044' E, 10 m. Paratype: FMNH 172930:; collection date: 8 May 2002. Grotte de Bisihiko, 0.75 km E St. Augustin, 23°32.933' S, 43°46.044' E, 10 m. Paratype: FMNH 172931:; collection date: 8 May 2002. Grotte de Bisihiko, 0.75 km E St. Augustin, 23°32.933' S, 43°46.044' E, 10 m. Paratype: FMNH 172932:; collection date: 8 May 2002. Grotte de Bisihiko, 0.75 km E St. Augustin, 23°32.933' S, 43°46.044' E, 10 m. Paratype: FMNH 172933:; collection date: 8 May 2002. Grotte de Bisihiko, 0.75 km E St. Augustin, 23°32.933' S, 43°46.044' E, 10 m. Paratype: FMNH 173154:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173189:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173190:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173191:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173192:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173193:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173194:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near

Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173195:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173196:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173198:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173199:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173200:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173201:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173202:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173203:. Parc National de Tsimanampetsotsa, 6.5 km NE Efoetse, near Mitoho Cave, 24°03.0' S, 43°45.0' E, 50 m. Paratype: FMNH 173204:; collection date: 4 March 2002. Parc National de Tsimanampetsotsa, Malaza Manga Aven, 24°1.827' S, 43°45.283' E, 80 m. Paratype: FMNH 173252:; collection date: 24 July 2001. Antafiky, 23°29'16.0" S, 44°04'39.1" E, 50 m. Paratype: FMNH 173253:; collection date: 4 February 2002. Antafiky, 23°29'16.0" S, 44°04'39.1" E, 50 m. Paratype: FMNH 175991:; collection date: 9 December 2002. Province de Fianarantsoa, Parc National de l'Isalo, along Sahanafa River, at foot of Bevato, 28 km SE Berenty-Betsileo, 22°19.0' S, 45°17.6' E, 550 m. Paratype: FMNH 176096:; collection date: 11 November 2002. Province de Toliara, Parc National de Kirindy-Mite, 13 km W Marofihitsa, 20°47.4' S, 44°08.8' E, 30 m. Paratype: FMNH 176097:; collection date: 11 November 2002. Province de Toliara, Parc National de Kirindy-Mite, 13 km W Marofihitsa, 20°47.4' S, 44°08.8' E, 30 m. Paratype: FMNH 176098:; collection date: 11 November 2002. Province de Toliara, Parc National de Kirindy-Mite, 13 km W Marofihitsa, 20°47.4' S, 44°08.8' E, 30 m. Paratype: FMNH 176099:; collection date: 11 November 2002. Province de Toliara, Parc National de Kirindy-Mite, 13 km W Marofihitsa, 20°47.4' S, 44°08.8' E, 30 m. Paratype: FMNH 176100:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176101:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176102:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176103:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176104:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176105:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176106:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176107:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176108:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176109:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176110:; collection date: 16-17 November 2002. Parc National de Kirindy-Mite, near village of Betakilotra, 11 km SE Marofihitsa, 20°53.2' S, 44°04.8' E, 35 m. Paratype: FMNH 176167:; collection date: 14, 15, and 18 February 2003. Forêt des Mikea, 9.5 km W Ankililoaka, 22°46.7' S, 43°31.4' E, 80 m. Paratype: FMNH 176168:; collection date: 14, 15, and 18 February 2003. Forêt des Mikea, 9.5 km W Ankililoaka, 22°46.7' S, 43°31.4' E, 80 m. Paratype: FMNH 176169:; collection date: 14, 15, and 18 February 2003. Forêt des Mikea, 9.5 km W Ankililoaka, 22°46.7' S, 43°31.4' E, 80 m. Paratype: FMNH 176170:; collection date: 14, 15, and 18 February 2003. Forêt des Mikea, 9.5 km W Ankililoaka, 22°46.7' S, 43°31.4' E, 80 m. Paratype: FMNH 176508:; collection date: 4 June 2002. Mahaleotse, 23°31'38.8" S, 44°05'16.1" E, 70 m. Paratype: FMNH 176509:; collection date: 27 November 2002. Fiherenana, 23°14'17" S, 43°52'23" E. Paratype: FMNH 176510:; collection date: 27 November 2002. Fiherenana, 23°14'17" S, 43°52'23" E. Paratype: FMNH 177376:; collection date: 16 August 2003. Ranobe, 23°14.033' S,

43°52.493' E, approximately 50 m. Paratype: FMNH 184155:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184156:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184157:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184158:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184159:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184160:; collection date: 29 May 2005. Grotte d'Amborombe, 4.0 km Itampolo, 24°37'42.7" S, 43°58'56.9" E, 70 m. Paratype: FMNH 184168:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184217:; collection date: 18 February 2005. 10.5 km SE Itampolo (village), 24°44.2' S, 44°1.79' E, 120 m. Paratype: FMNH 184218:; collection date: 18 February 2005. 10.5 km SE Itampolo (village), 24°44.2' S, 44°1.79' E, 120 m. Paratype: FMNH 184219:; collection date: 18 February 2005. 10.5 km SE Itampolo (village), 24°44.2' S, 44°1.79' E, 120 m. Paratype: FMNH 184220:; collection date: 18 February 2005. 10.5 km SE Itampolo (village), 24°44.2' S, 44°1.79' E, 120 m. Paratype: FMNH 184221:; collection date: 18 February 2005. 10.5 km SE Itampolo (village), 24°44.2' S, 44°1.79' E, 120 m. Paratype: FMNH 184222:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184223:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184224:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184225:. Grotte d'Andraimpano, 4.2 km NE Itampolo, 24°39.012' S, 43°57.797' E.m,. Paratype: FMNH 184226:; collection date: 26 February 2005. Grotte d'Antagneotsy, 5.0 km NE Vohombe, 24°23.001' S, 43°50.742' E, 100 m. Paratype: FMNH 184470:; collection date: 1 November 2004. Ihosy, commune rurale d'Akily, Grotte d'Andranomilitry, 22°23.111' S, 46° 03.355' E, 950 m. Paratype: FMNH 184471:; collection date: 1 November 2004. Ihosy, commune rurale d'Akily, Grotte d'Andranomilitry, 22°23.111' S, 46° 03.355' E, 950 m. Paratype: FMNH 184472:; collection date: 1 November 2004. Ihosy, commune rurale d'Akily, Grotte d'Andranomilitry, 22°23.111' S, 46° 03.355' E, 950 m. Paratype: FMNH 184473:; collection date: 1 November 2004. Ihosy, commune rurale d'Akily, Grotte d'Andranomilitry, 22°23.111' S, 46° 03.355' E, 950 m. Paratype: FMNH 202484:; collection date: 8 May 2002. Grotte de Bisihiko, 0.75 km E St. Augustin, 23°32.933' S, 43°46.044' E, 10 m. Paratype: FMNH 202485:; collection date: 8 May 2002. Grotte de Bisihiko, 0.75 km E St. Augustin, 23°32.933' S, 43°46.044' E, 10 m. Paratype: FMNH 75774:; collection date: 18 June 1953. Betroka, 23°15'50" S, 46°05'30" E, 800 m. - Etymology: The name *mahafaliensis* is derived from the Malagasy word mahafaly, meaning ‘‘to make taboos,’’ but here specifically referring to one of the local cultural groups in southwestern Madagascar, the Mahafaly, and the Mahafaly Plateau, a limestone karst area, from whence many of the specimens of this taxon were collected. In the region of the Forêt des Mikea (see Goodman *et al.*, 2009c: 28). (Current Combination)

COMMON NAMES:
German: Mahafaly-Langflügelfledermaus.
Malagasy: kitrotroke.

GENERAL DISTRIBUTION:
Madagascar (known from numerous sites on or in close proximity to the limestone Mahafaly Plateau in the southwestern portion of the island, including the zone from Itampolo north across the Onilahy River to Sarodrano spanning the elevational range from sea level to 120 m. Its distribution then continues further north to the Forêt des Mikea (70 - 80 m) and based on current data ends in the Kirindy-Mite region (30 - 35 m). Further, it is known from the more inland and upland sites of Ihosy and near Betroka from 800 - 950 m and within the Isalo formation at 550 m.).

Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the southwestern quarter of the island (south-west sub-arid or spiny bush).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 63) could not find a baculum in the one specimen they examined.

ECHOLOCATION:
Ramasindrazana *et al.* (2011: 294) recorded 24 calls from 9 *Miniopterus mahafaliensis* specimens, and found the following echolocation call values: Frequency of maximum energy: 59.6 ± 1.46 (57.3 - 62.2) kHz, Maximum frequency: 113.7 ± 8.08 (95.0 - 123.0) kHz, Minimum frequency: 55.1 ± 1.47 (53.0 - 57.0) kHz, Call duration: 3.3 ± 0.25

(2.9 - 3.8) ms, Inter pulse interval: 68.7 ± 14.04 (43.5 - 95.3) ms.

ROOST:
Wilkinson *et al.* (2012: 160) reported caves to be the typical roosting site for these bats on Madagascar.

DIET:
Ramasindrazana *et al.* (2012: 120-121) examined feacal pellets from bats in the Tsimanampetsotsa NP, and found them to contain 47.5 ± 5.5 volume percent Lepidoptera, 39.9 ± 5.5 Coleoptera, 6.9 ± 2.9 Hymenoptera, 3.4 ± 0.6 Psocoptera, 1.1 ± 0.4 Diptera, 1.0 ± 0.2 Aranea, and 0.1 ± 0.0 Homoptera/Hemiptera. During the dry season, 52.9 ± 6.1 volume percent Coleoptera were found and 35.2 ± 5.7 Lepidoptera. The latter order was represented by 82.3 ± 7.7 percent in the wet season, whereas the Coleoptera dropped to 3.2 ± 0.8 percent.

PARASITES:
Lagadec *et al.* (2012: 4696), Dietrich *et al.* (2014: Suppl.), Lei and Olival (2014: Suppl.) and Gomard *et al.* (2016: 5) report the presence of spirochaetes bacteria of the genus *Leptospira*, which were identified as *L. borgpetersenii* by Dietrich *et al.* (2018a: 3).

The haemosporidian *Polychromophilus melanipherus* Dionisi, 1899 was reported from this species by Ramasindrazana *et al.* (2018: Suppl.), as wel as an unidentified *Haemosporida* sp. Rasoanoro *et al.* (2019: 67) refer to Raharimanga *et al.* (2003) who reported *Trypanomsoma* sp. from a "*Miniopterus manavi*".

Ramasindrazana *et al.* (2016: 6) recovered *Litomosa* Clade 2 (Nematoda: Onchocercidae) from *M. mahafaliensis*.

On Madagascar, Tortosa *et al.* (2013: 4) found Nycteribiid bat flies belonging to *Penicillidia leptothrinax*.

VIRUSES:
Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 11 individuals from the Mauritius using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids.

In their extensive study, Mélade *et al.* (2016b: 3) found that *M. mahafaliensis* was the least infected species of Madagascan bat, with only 4 out of 89 specimens (4.5 %) infected.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

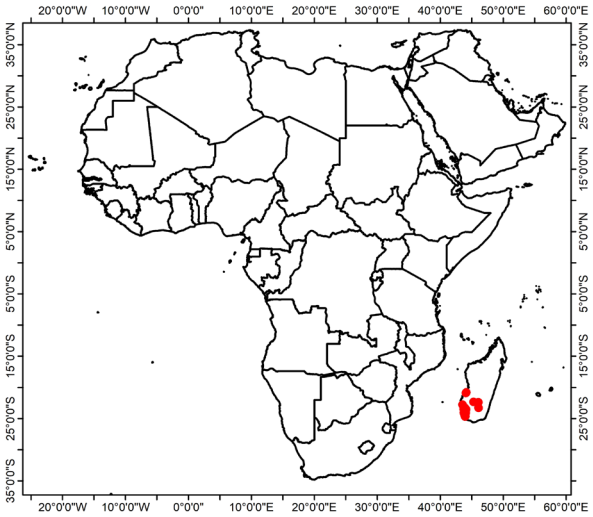


Figure 219. Distribution of *Miniopterus mahafaliensis*

Miniopterus majori Thomas, 1906

*1906. *Miniopterus Majori* Thomas, Ann. Mag. nat. Hist., ser. 7, 17 (98): 175. Publication date: 1 February 1906. Type locality: Madagascar: SE Betsileo: Imasindrary [=Sahamananina] [20 17 S 47 31 E, 1 600 m] [Goto Description]. Holotype: BMNH 1897.9.1.38: ad ♀, skin and skull. Collected by: Dr. Charles Immanuel Forsyth Major; collection date: 3 July 1895; original number: 457. - Etymology: In honour of Dr. C.I. Forsyth Major, collector of the type specimen (see Thomas, 1906a: 176). (Current Combination)
? *Miniopterus majori majori:* (Name Combination)
? *Miniopterus majori:* (Current Spelling)

TAXONOMY:
Included in *schreibersi* by Koopman (1993a: 231), but considered a valid species by Peterson *et al.* (1995: 131), Hutson *et al.* (2001: 32), Russ *et al.* (2001), Simmons (2005: 520).

COMMON NAMES:
Czech: létavec východomadagaskarský. English: Major Long-fingered Bat, Major's Long-fingered Bat. French: Grand minioptère malgache. German: Majors Langflügelfledermaus.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its relatively wide range, ability to live in a wide variety of habitats from intact forests to heavily degraded areas, and because there is no evidence of a decline that would warrant listing in a higher category of threat (Jenkins and Rakotoarivelo, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jenkins and Rakotoarivelo, 2008a; IUCN, 2009). 2003 - DD (IUCN, 2003). 2001 - DD (IUCN/SSC Action Plan, 2001).

MAJOR THREATS:
The major threats to this species are not known. It could be susceptible to cave disturbance in some sites and it could perhaps be hunted in some areas (Jenkins and Rakotoarivelo, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Jenkins and Rakotoarivelo (2008a) [in IUCN (2009)] report that this species is reported from a few protected areas, such as Parc National de Masoala and Parc National de Mantadia (Russ and Bennet, 1999; Randrianandriananina *et al.*, 2006). Some of these records may need to be reassessed in view of the ongoing taxonomy of this genus in Madagascar (Goodman and Maminirina, 2007).

GENERAL DISTRIBUTION:
Miniopterus majori is endemic to Madagascar and has a sympatric distribution with *Miniopterus sororculus* in the highlands of Madagascar (Goodman *et al.*, 2007b) and is widely, but patchily, distributed across the island (Peterson *et al.*, 1995; Eger and Mitchell, 2003).

Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the eastern part of the island (higher elevations of the Central Highlands - sub-humid region).

Goodman and Maminirina (2007) suggest that the only specimens known form the Comoro Islands were collected by M. Humbolt and may have been incorrectly provenanced. Until new material is available from the island to confirm that *M. majori* exists, it is removed from the known distribution of the species, and is restricted at this time to Madagascar.

Native: Madagascar (Peterson *et al.*, 1995; Eger and Mitchell, 2003; Simmons, 2005: 520; Goodman and Maminirina, 2007).
Presence incorrectly assigned: Comoro Islands (Simmons, 2005: 520).

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls as *Miniopterus majori/sororculus*, which produced broadband FM/QCF echolocation calls at low duty cycle, but with a lower maximum energy, at about 48.5 kHz. The fundamental being most intense with short duration pulses of about 4.5 ms.
Ramasindrazana *et al.* (2011: 294) recorded 39 calls from 12 *Miniopterus majori* specimens, and found the following echolocation call values: Frequency of maximum energy: 48.5 ± 1.15 (46.1 - 52.0) kHz, Maximum frequency: 82.5 ± 11.78 (64.0 - 102.0) kHz, Minimum frequency: 44.4 ± 0.97 (43.0 - 46.0) kHz, Call duration: 3.6 ± 0.42 (2.8 - 4.5) ms, Inter pulse interval: 85.0 ± 16.34 (59.5 - 134.8) ms.

DIET:
Kemp *et al.* (2018: Suppl.) used DNA metacarcoding to detect insect pest species in the diet of these bats and found the following prey orders (in descending order): Lepidoptera (*Ericeia inangulata* (Guenée, 1852), *Pandemis* sp., *Celsumaria elongata* Brown, 2017, *Meyrickiella homosema* (Meyrick, 1887), *Emmalocera* sp., *Palpita* sp., *Pandemis retroflua* Diakonoff, 1960, *Achaea euryplaga* (Hampson, 1913), *Eublemma viettei* (Berio, 1954), *Herpetogramma licarsisalis* (Walker, 1859), *Chloroclystis androgyna* Herbulot, 1957, *Idiodes oberthuri* Dognin 1911, *Scopula* AH01Md, *Ectropis* AH27Md), Hemiptera, Blattodea, Trombidiformes, Diptera (*Simulium lineatum* (Meigen, 1804)), Coleoptera, Hymenoptera, Ephemeroptera, Trichoptera, Sarcoptiformes, Astigmata

POPULATION:
Structure and Density - There is no information on its population status (Jenkins and Rakotoarivelo, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Jenkins and Rakotoarivelo, 2008a; IUCN, 2009).

PARASITES:
Dietrich *et al.* (2014: Suppl.) and Gomard *et al.* (2016: 5) report the presence of spirochaetes of the genus *Leptospira* in bats from Fianarantsoa, Madagascar. These were identified as *L. borgpetersenii* by Dietrich *et al.* (2018a: 3).

Uchikawa (1985b: 45) reports *Calcarmyobia comoresensis* mites of bat specimens from Vobima and Bersroha, Madagascar. Uchikawa (1985c: 111) mentions the presence of *Pteracarus miniopteri* Uchikawa, 1978 mites on *M. schreibersi majori* specimens from Madagascar. Tortosa *et al.* (2013: 4), furthermore, reported the presence of Nycteribiid bat flies: *Nycteribia stylidiopsis* and *Penicillidia leptothrinax*. The *Nycteribia* is also reported by Ramasindrazana *et al.* (2017: Suppl.).

Ramasindrazana *et al.* (2016: 6) recovered *Litomosa* Clade 1 (Nematoda: Onchocercidae) from this bat species.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar.

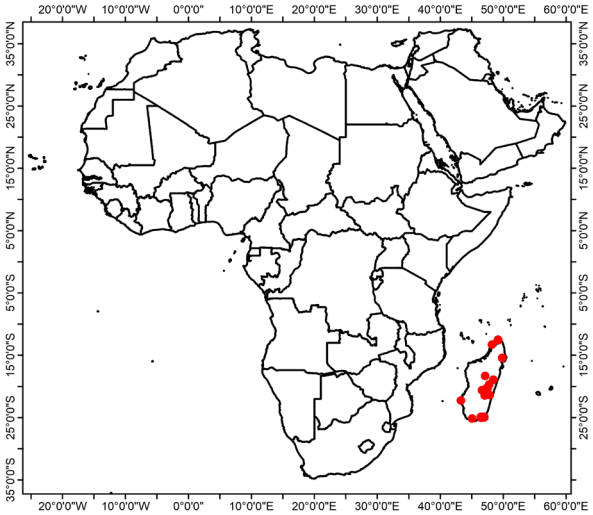


Figure 220. Distribution of *Miniopterus majori*

Miniopterus manavi Thomas, 1906

*1906. *Miniopterus manavi* Thomas, Ann. Mag. nat. Hist., ser. 7, 17 (98): 176. Publication date: 1 February 1906. Type locality: Madagascar: Eastern/Northeastern Betsileo: Fandriana region [20 17 S 47 31 E] [Goto Description]. Holotype: BMNH 1897.9.1.37: ad ♂, skin and skull. Collected by: Dr. Charles Immanuel Forsyth Major; collection date: 3 July 1895; original number: 453. See Peterson *et al.* (1995: 135). Topotype: MCZ 45101: ♀, complete skeleton. Collected by: The Grandidier Collection; collection date: 3 July 1895. Presented/Donated by: ?: Collector Unknown. - Comments: [Imansindrary = ? Masindrary, 15 km ESE Fandriana, see Jenkins and Carleton, 2005 (in Goodman *et al.*, 2009a: 340)]. (Current Combination)

1993. *Miniopterus minor grivaudi:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 231. (Lapsus)

2007. *Miniopterus (griveaudi) manavi:* Goodman and Maminirina, Mammalia, 71 (4): 151. (Name Combination)

2009. *Miniopterus manavi (Clade 1):* Goodman, Maminirina, Weyeneth, Bradman, Christidis, Ruedi and Appleton, Zool. Scr., 38: 346-351, 362.

? *Miniopterus manavi manavi:* (Name Combination)

TAXONOMY:
Included in *minor* by Koopman (1993a: 231), but considered a valid species by Peterson *et al.* (1995: 135), Hutson *et al.* (2001: 32), Russ *et al.* (2001), and Simmons (2005: 520).

Simmons (2005: 520) recognised *griveaudi* Harrison, 1959 as a vaild subspecies of *M. manavi*, Juste [B.] *et al.* (2007: 33) elevated *griveaudi* as a separate species, which is followed in this account.

Weyeneth *et al.* (2008) used mitochondrial DNA markers to demonstrate that the specimens from the Comoro islands are not closely related to *M. minor* from the African mainland, and that these islands were probably populated as a result of two or three invasions originating from Madagascar.

COMMON NAMES:
Czech: létavec manavijský. English: Manavi Long-fingered Bat, Manavil Long-fingered Bat. French: Petit minioptère malgache. German: Manavi-Langflügelfledermaus.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its widespread distribution (near suitable caves) across Madagascar. While it is locally threatened by hunting, this is not thought to be a major threat of this species across its range (Andriafidison *et al.*, 2008f; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Andriafidison *et al.*, 2008f; IUCN, 2009). 2003 - DD [as *M. menavi*] (IUCN, 2003). 2001 - DD [as *M. menavi*] (IUCN/SSC Action Plan, 2001). 2000 - DD.

MAJOR THREATS:
There are no major threats to the species. In Makira, this species is eaten by people (Golden,

2005), but it is not known if this species is hunted in other parts of its range. It is probably not forest dependent, but is rarely netted in areas without vegetation stands (Andriafidison *et al.*, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008f) [in IUCN (2009)] report that this species occurs in many of the forest protected areas in western and eastern Madagascar and as such does not require specific conservation measures. Additional information on its ecology would be helpful to better understand how it responds to deforestation and roost disturbance. There is some uncertainty about the taxonomy of *M. manavi* and that this taxon is actually a complex of new species (F. Ratromomanarivo *pers. Comm.*). Further studies on morphology, acoustics and genetics are therefore needed.

GENERAL DISTRIBUTION:
Miniopterus manavi is found on Madagascar including the islands of Nosy Be and Nosy Komba (Rakotonandrasana and Goodman, 2007: 6), where it is widely distributed (Eger and Mitchell, 2003; Goodman *et al.*, 2005a). It has a wide elevational range, from 20 to 1,500 m above sea-level.

Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the eastern part of the island, but not along the coast (higher elevations of the Central Highlands - sub-humid region).

Grand Comoro (Peterson *et al.*, 1995; Simmons, 2005: 520). Removed by Juste [B.] *et al.* (2007: 33), due to the removal of *griveaudi* as a separate species.

Native: Madagascar (Peterson *et al.*, 1995; Eger and Mitchell, 2003; Goodman *et al.*, 2005a; Simmons, 2005: 520; Rakotonandrasana and Goodman, 2007: 6).

ECHOLOCATION:
Russ *et al.* (2003) describe the echolocation as a freqency-modulated sweep that terminates in a constant-frequency portion with maximum energy around 57 kHz. Kofoky *et al.* (2009: 382) reported the calls as *M. manavi s.l.*, these calls were broadband FM/QCF sweeps produced at low duty cycle with most energy at about 58.1 kHz in the fundamental, with pulses having a short duration of about 4 ms. Low-duty cycle, frequency modulated/quasi constant (FM/QCF) echolocation call, with a peak frequency of 57.2 kHz (55.5 - 58.2 kHz) and a duration of 2.5 ms (2.1 - 3.0 ms) (Goodman *et al.*, 2011: 9).

Ramasindrazana *et al.* (2011: 294) recorded 9 calls from 2 specimens tentatively assigned to *Miniopterus 'manavi'*, and found the following echolocation call values: Frequency of maximum energy: 57.2 ± 0.77 (55.5 - 58.2) kHz, Maximum frequency: 98.4 ± 7.60 (89.0 - 110.0) kHz, Minimum frequency: 53.0 ± 0.0 (53.0 - 53.0) kHz, Call duration: 2.5 ± 0.32 (2.1 - 3.0) ms, Inter pulse interval: 66.0 ± 8.70 (54.1 - 84.7) ms.

DIET:
Razakarivony *et al.* (2005) found Araneae in 2 % of stomachs examined. Rakotoarivelo *et al.* (2007), in Madagascar, found *M. manavi* to mainly consume Hemiptera.

Kemp *et al.* (2018: Suppl.) used DNA metacarcoding to detect insect pest species in the diet of these bats and found the following prey orders (in descending order): Lepidoptera (*Pandemis retroflua* Diakonoff, 1960), Hymenoptera, Coleoptera, Hemiptera, Blattodea, Diptera (*Simulium lineatum* (Meigen, 1804), *Anopheles squamosus* Theobald, 1901, *Coquillettidia* sp.), Ephemeroptera, Mesostigmata, Sarcoptiformes, Trombidiformes, Astigmata, Neuroptera.

POPULATION:
Structure and Density - It is locally abundant in cavities or rocky overhangs that provide suitable roosting features. A colony of approximately 4,000 was found in Makira (Bayliss and Hayes, 1999).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008f; IUCN, 2009).

PARASITES:
Gomard *et al.* (2016: 5) reported the presence of *Leptospira* bacteria in 5 out of 7 tested bats (73.7 %).

Megali *et al.* (2010: 1042) and Duval *et al.* (2012: 1563) reported Genbank data for *Polychromophilus* sp. (*Haemosporida*) from *M. manavi*. Ramasindrazana *et al.* (2018: Suppl.) identified the parasite as *Polychromophilus melanipherus* Dionisi, 1899, and the bat as "*M. manavi* s.l.".
Raharimanga *et al.* (2003: 72) reported *Trypanosoma* sp. from *M. manavi*, but these bats were later re-identified as *M. mahafaliensis* and *M. brachytragos* (see Rasoanoro *et al.*, 2019: 67).

Uchikawa (1985b: 45) reported a mite belonging to *Calcarmyobia comoresensis* from the type specimen of *M. manavi*. From the same specimen, Uchikawa (1985c: 110) also reported mites belonging to *Pteracarus miniopteri* Uchikawa, 1978. Furtermore, he also described

two mite subspecies: *Calcarmyobia steatosetae steatosetae* and *Calcarmyobia steatosetae rectipenis* from several other bat specimens.

The presence of the Nycteribiid bat fly *Penicillidia leptothrinax* was reported by Tortosa *et al.* (2013: 4) and Ramasindrazana *et al.* (2017: Suppl.). Additionally, Ramasindrazana *et al.* (2017: Suppl.) reported both "*Penicillidia* sp. and *P. leptothrinax* from one and the same bat identified as "*Miniopterus* cf. *manavi*".

Ramasindrazana *et al.* (2016: 6) reported the presence of *Litosoma* Clade 1 (Nematoda: Onchocercidae) on this bat species.

UTILISATION:
In Makira, this species is eaten by people (Golden, 2005), also see Goodman *et al.* (2008d).

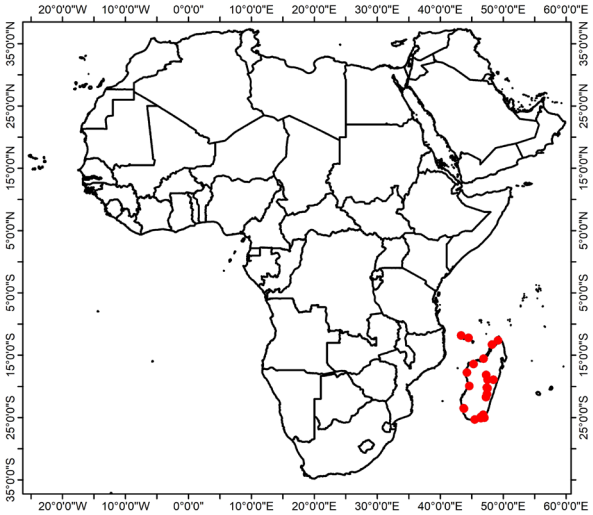


Figure 221. Distribution of *Miniopterus manavi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Comoros, Madagascar.

Miniopterus minor Peters, 1867

*1867. *Miniopterus minor* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 870 (for 1866). Publication date: 1867. Type locality: Tanzania: Coast opposite Zanzibar Island [Goto Description]. Holotype: ZMB 3268: ♂, skin and skull. Collected by: Baron Karl Klaus von der Decken. See Turni and Kock (2008: 52). - Comments: Peters (1867a: 885) mentions "Ein einziges ausgewachsenes Männchen von der Küste von Zanzibar". - Etymology: From the masculine Latin adjective *minor*, meaning "smaller", used as comparative of *parvus*, meaning "small", referring to the relatively small size of the species (see Lanza *et al.*, 2015: 334). (Current Combination)

1992. *Miniopterus minor occidentalis* Juste and Ibáñez, Bonn. zool. Beitr., 43 (3): 358, 362. Publication date: 21 October 1992. Type locality: Congo: Koilou, Meya-Nzouari Cave [03 53 S 14 31 E]. Holotype: MHNG 1074.013: ad ♀, skull and alcoholic. Collected by: M. Taufflieb; collection date: 1 July 1961. - Comments: (see Simmons, 2005). - Etymology: From the Latin for western. (Name Combination)

? *Miniopterus minor minor:* (Name Combination)

TAXONOMY:
Koopman (1993a: 231) included *griveaudi* Harrison, 1959 and *manavi* Thomas, 1906, but Peterson *et al.* (1995: 119, 135) and Simmons (2005: 520) recognised *manavi* as a distinct species, with *griveaudi* as a subspecies. Juste [B.] *et al.* (2007: 33) elevated *griveaudi* as a separate species.
Simmons (2005: 521) recognised *newtoni* Bocage, 1889 and *occidentalis* Juste and Ibáñez, 1992 as vaild subspecies of *M. minor*. Juste [B.] *et al.* (2007: 33) elevated *newtoni* as a separate species.
Reviewed by Juste and Ibáñez (1992).

COMMON NAMES:
Chinese: 侏长翼蝠. Czech: létavec nejmenší. English: Least Long-fingered Bat. French: Petit minioptère africain, Minioptère minuscule. German: Zwerg-Langflügelfledermaus. Italian: Miniòttero minóre, Miniòptere minóre.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing problems with its taxonomy as well as absence of recent information on its extent of occurrence, ecological requirements and threats (Jacobs *et al.*, 2008n; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) [includes *occidentalis* Juste and Ibáñez, 1992] (Jacobs *et al.*, 2008n; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Jacobs *et al.*, 2004o; IUCN, 2004). 2003 - LR/nt (IUCN, 2003). 2001 - LR/nt (IUCN/SSC Action Plan, 2001). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is presumably threatened in parts of its range by habitat loss resulting from logging operations and the conversion of land to agricultural use.

CONSERVATION ACTIONS:
Jacobs *et al.* (2008n) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It has been recorded from the Kambai Forest Reserve in Tanzania by Cunneyworth (1996b). Further studies are needed into the taxonomy, distribution, natural history and threats to this poorly known species.

GENERAL DISTRIBUTION:
Miniopterus minor recorded from very few locations over a wide area. It has been reported from a small area on the border between Congo and the Democratic Republic of the Congo, a single locality in southwestern Democratic Republic of the Congo, and from a small area of coastal Kenya and Tanzania (including the island of Unguja [see O'Brien, 2011: 289]).

São Tomé (Koopman, 1993a: 231; Simmons, 2005: 521) removed by Juste [B.] *et al.* (2007: 33) due to the removal of *newtoni* as a separate species.

Native: Angola; Congo (Juste and Ibáñez, 1992: 363; Simmons, 2005: 521; Bates *et al.*, 2013: 337); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Juste and Ibáñez, 1992: 363; Van Cakenberghe *et al.*, 1999; Simmons, 2005: 521; Monadjem *et al.*, 2010d: 539); Kenya (Simmons, 2005: 521); Tanzania (Simmons, 2005: 521).

ROOST:
McWilliam (1982: 176) found this bat to be roosting in caves.

MIGRATION:
In Kenya, McWilliam (1982: 175) found that most long distance movements were made by females, whereas males showed a larger site specificity.

POPULATION:
Structure and Density - There are very few records of this species (Jacobs *et al.*, 2008n; IUCN, 2009). Trend - 2008 - Unknown (Jacobs *et al.*, 2008n; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
In Kenya, *M. minor* exhibits seasonal torpor between April and September, when the temperatures are lower (McWilliam, 1982: 184).

MATING:
McWilliam (1982: 176, 177) described a small "mating dome" within the Homa Lime cave in Kenya, which was almost exclusively occupied by mature males, which returned the following years. Immature males were excluded from the dome.
During the mating period (May to July), the males produced a pungent odour (resembling rotting cocoa) in their urine (McWilliam, 1982: 181).

PARASITES:
Uchikawa (1985b: 50) described the mite *Calcarmyobia minoris* from *Miniopterus minor minor* from Similani Cave, 16 km S. of Mombasa, Coast Province, Kenya. Uchikawa (1985c: 110) also reported three female mites belonging to *Pteracarus miniopteri* Uchikawa, 1978 from bats from Kenya.

Adam and Landau (1973a: 5) and Landau and Adam (1973: 6) report on the presence of a protozoan parasite of the genus *Polychromophilus* (Haemoproteidae) in *M. minor minor* from the Republic of Congo. About 50 % of the specimens they examined, were found to be infected. Gametocytes were found year-round. The bats were also infested by the nycteribiids *Penicillidia fulvida* Bigot, 1885 and *Nycteribia schmidlii scotti* Falcoz, 1923, of which the prior was a major carrier of *Polychromophilus* sporozoites. Garnham (1973: 237) reports the parasite as *Polychromophilus melanipherus*.
Polychromophilus sp. was also reported by Rosskopf *et al.* (2018: 31) from Gabonese *M. minor occidentalis*, where both of the examined specimens were infected.
Landau and Adam (1973: 6) also report on another prozotoan parasite: *Hepatocystis*, of which schizonts were found in the liver and lungs.

Duval *et al.* (2012: 1559) and Landau *et al.* (2012: 142) indicate that the haemosporidan *Polychromophilus (Polychromophilus) adami* Landau *et al.*, 1980 was described from *M. minor minor* specimens in the Republic of Congo (see Landau *et al.*, 1980b: 27). Landau *et al.* (2012: 142) also mention this bat as the type host for *Bioccala murinus* (Dionisi, 1899).

Lutz *et al.* (2016: 9) examined 13 *M. minor* specimens from East Africa and found five of them infected with *Polychromophilus melanipherus* Dionisi, 1899.

Nycteribiidae: *Nycteribia schmidlii* Schiner, 1853 (Haeselbarth *et al.*, 1966: 108).

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in

Miniopterus minor: Astroviruses, Coronaviruses, Paramyxoviruses and Polyomaviruses.

Coronaviridae - Coronaviruses
SARS-CoV - Tong *et al.* (2009) tested 1 bat collected in Kenya during 2006 positive for the presence of coronavirus RNA in a fecal sample. 22.6 % (66 out of 292) of the Kenyan bats tested by Tao *et al.* (2017: 3) were positive for CoV.

Paramyxoviridae:
Paramyxovirus - Conrardy *et al.* (2014: 259) tested 16 bats from the Three Caves (Kenya) and found one of them to be positive. Mortlock *et al.* (2015: 1841) tested 151 Kenyan bats and found 14 to be positive.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Central African Republic, Comoros, Congo, Congo (Democratic Republic of the), Kenya, Madagascar, São Tomé and Principé, Tanzania.

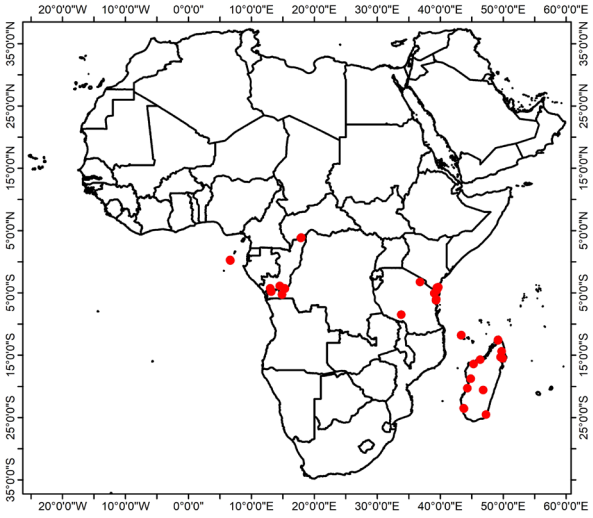


Figure 222. Distribution of *Miniopterus minor*

Miniopterus mossambicus Monadjem, Goodman, Stanley and Appleton, 2013

*2013. *Miniopterus mossambicus* Monadjem, Goodman, Stanley and Appleton, Zootaxa, 3746 (1): 123, 129, figs 3, 6, 7. Publication date: 10 December 2013. Type locality: Mozambique: Nampula province: outskirts of Nampula town: Bamboo Inn [15.10306 S 39.21748 E, 420 m] [Goto Description]. Holotype: FMNH 213651: ad ♂, skull and alcoholic. Collected by: Steven M. Goodman and Ara Monadjem; collection date: 9 October 2010; original number: SMG-16875. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213652: ad ♂, alcoholic (skull not removed). Collected by: Steven M. Goodman and Ara Monadjem; collection date: 9 October 2010; original number: SMG-16876. Presented/Donated by: ?: Collector Unknown. - Etymology: Refers to the country from which the species was collected (see Monadjem *et al.*, 2013a: 129). (Current Combination)

COMMON NAMES:
Chinese: 莫桑比克长翼蝠. English: Mozambique long-fingered bat. German: Mossambique-Langflügelfledermaus.

GENERAL DISTRIBUTION:
Native: Kenya (López-Baucells *et al.*, 2017: 20); Malawi; Mozambique; Zambia; Zimbabwe.

ECHOLOCATION:
Monadjem *et al.* (2013a: 139) mention a knee frequency of 55 kHz.

PARASITES:
BACTERIA:
Dietrich *et al.* (2018a: 4) report the presence of *Leptospira borgpetersenii*.

DIPTERA:
Streblidae: *Raymondia aspera* Maa, 1968 from Mozambique (Shapiro *et al.*, 2016: 254).

VIRUSES:
Astroviridae
Two out of 21 bats tested positive in the study by Hoarau *et al.* (2018: 2).

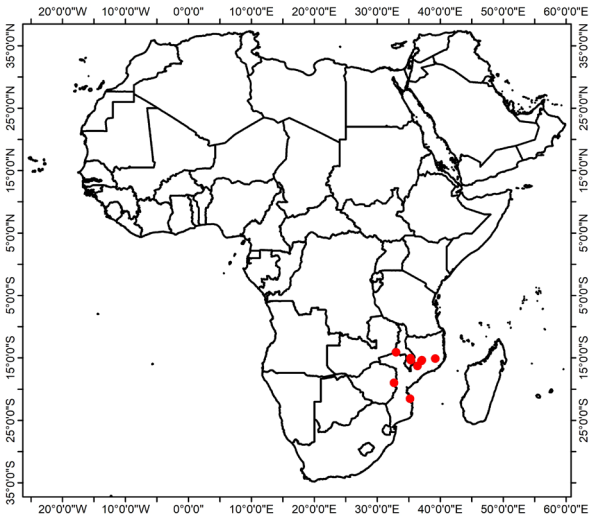


Figure 223. Distribution of *Miniopterus mossambicus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Malawi, Mozambique, Zambia, Zimbabwe.

Miniopterus natalensis (A. Smith, 1833)

*1833. *Vespertilio Natalensis* A. Smith, S. Afr. Quart. J., ser. 2, 1 (2): 59. Publication date: November 1833. Type locality: South Africa: KwaZulu-Natal: Durban [29 52 S 31 00 E] [Goto Description]. Cotype: BMNH 1846.6.2.19:. Shared cotype for *Vespertilio natalensis* and *Vespertilio scotinus* - this needs further investigation as it is unlikely that Sundeval examined material described by Andrew Smith. It is possible that this co-type should only be assigned to one of these species. Cotype: BMNH 1848.6.12.19:. - Comments: Concerning the type locality, Meester *et al.* (1986: 46) remark: "Durban nominated by Roberts (1951: 73)").

1840. *Vespertilio d'asythrix* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe. Tome Seconde, 2: 268. Publication date: 1840. Type locality: South Africa: "Interior of Caffraria" [Goto Description]. Syntype: BMNH 1849.8.16.25:. Syntype: RMNH MAM.25093:. - Comments: .

1846. *Vespertilio scotinus* Sundevall, Öfvers. kongl. Sv. Vet.-Akad. Förhandl., 3 (4): 119. Publication date: 1846. Type locality: South Africa: KwaZulu-Natal: Durban [29 52 S 31 00 E]. Cotype: BMNH 1846.6.2.19:. Shared cotype for *Vespertilio natalensis* and *Vespertilio scotinus* - this needs further investigation as it is unlikely that Sundeval examined material described by Andrew Smith. It is possible that this co-type should only be assigned to one of these species. - Comments: Type locality originally mentioned as "variis Caffrariæ locis allata"; Meester *et al.* (1986: 46) state: "Durban nominated by Roberts (1951: 74)".

1909. *Miniopterus breyeri* Jameson, Ann. Mag. nat. Hist., ser. 8, 4 (23): 471. Publication date: 1 November 1909. Type locality: South Africa: N Transvaal province: Waterberg district: Gat(s)koppies [Goto Description]. Holotype: BMNH 1909.7.2.6: imm ♀. Collected by: Henry Paul William Lyster Jameson; original number: 398.

1912. *Miniopterus natalensis arenarius* Heller, Smiths. Misc. Coll., 60 (12): 2. Publication date: 4 November 1912. Type locality: Kenya: Central province: Nanyuki district: Northern Guaso Nyiro: Nyuki (=Nanyuki) river [00 01 N 37 04 E] [Goto Description]. Holotype: USNM 181811: ad ♀. Collected by: Edmund Heller; collection date: 4 October 1911; original number: 4413. - Comments: Coordinates mentioned as 00 21 N 36 55 E by Thorn *et al.* (2009: 49). (Name Combination)

1927. *Miniopterus smitianus* Thomas, Proc. zool. Soc. Lond., 373. Publication date: 12 July 1927. Type locality: Namibia: E Damaraland, 40 mi (64 km) W of Gobabis: Witvlei. Holotype: BMNH 1926.12.7.15:.

2018. *Miniopteris schriebersii:* Adams and Kwiecinski, Diversity, 10 (3) 103: 7. Publication date: 18 September 2018. (Lapsus)

? *Miniopterus africanus natalensis:* (Name Combination)

? *Miniopterus breyeri breyeri:*

? *Miniopterus natalensis dasythrix:* (Name Combination)

? *Miniopterus natalensis natalensis:* (Name Combination)

? *Miniopterus natalensis smitianus:* (Name Combination)

? *Miniopterus natalensis:* (Name Combination, Current Combination)

? *Miniopterus schreibersi arenarius:*

? *Miniopterus schreibersi dasythrix:*

? *Miniopterus schreibersi natalensis:* (Name Combination)

? *Miniopterus schreibersi:*

? *Miniopterus schreibersii natalensis A:*

? *Miniopterus schreibersii natalensis B:*

? *Miniopterus schreibersii natalensis:* (Name Combination)

? *Miniopterus schreibersii:*

? *Vesperugo scotinus:*

TAXONOMY:
Considered a synonym of *schreibersi* by Koopman (1993a: 231). O'Shea and Vaughan (1980), Koopman (1994), Peterson *et al.* (1995) and Horácek *et al.* (2006: 105) suggested that *natalensis* may be distinct from *schreibersi*. Considered a valid species by Simmons (2005: 521).

Simmons (2005: 521) recognised *arenarius* Heller, 1912 as valid subspecies.

COMMON NAMES:
Chinese: 纳塔尔长翼蝠. Czech: létavec natalský. English: Natal Long-fingered Bat, Natal Clinging Bat. French: Minioptère du Natal. German: Natal-Langflügelfledermaus, Südafrikanischen Sackfledermaus, Kaffern-Sackfledermaus. SiSwati: Lilulwane.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
This species is present in the later half of the upper Pleistocene sequence and in the late Holocene at Border Cave, and probably at Nkupe during the middle and late Holocene (Avery, 1991: 6). Further Holocene material is reported by Avery and Avery (2011: 20) from Blinkklipkop, Limerock, and Zoovoorbij (Northern Cape province, South Africa), who also reported Pleistocene remains from Wonderwerk.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008aj; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008aj; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Jacobs *et al.*, 2004ai; IUCN, 2004).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (MacEwan *et al.*, 2016b). 2004 - NT ver 3.1 (2001) [assessed as *M. schreibersii*] (Friedmann and Daly, 2004:263).
Swaziland: 2003 - NT B2ab(iv); D2 ver 3.1 (2001) [assessed as *M. schreibersii*] (Monadjem *et al.*, 2003: 184).

MAJOR THREATS:
In view of its wide range, there appear to be no major threats to this species. In parts of the species distribution it is locally threatened by habitat loss resulting from conversion of land to agricultural use, incidental poisoning with insecticides, and the disturbance of roosting and maternity caves by tourist activities (Jacobs *et al.*, 2008aj; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008aj) [in IUCN (2009)] report that there appear to be no conservation measures in place for this species. There is a need to identify and protect important roost sites (especially maternity caves). In view of the species wide range, it is presumably present in some protected areas. There is a need to better determine the range of this species when compared to that of *Miniopterus schreibersii*.

GENERAL DISTRIBUTION:
Miniopterus natalensis is a widely distributed species, recorded from southern and East Africa, with some records from Central African and from the Arabian Peninsula. In Africa it ranges south from Angola and southern Democratic Republic of the Congo, into Namibia, Botswana, South Africa, Lesotho, Mozambique, Malawi, Zimbabwe and Zambia, and from here north into Tanzania, Kenya, possibly Uganda, possibly southern Sudan and possibly Ethiopia. On the Arabian Peninsula it has been reported from Saudi Arabia and Yemen (Harrison and Bates, 1991, Benda *et al.*, 2011b: 45). Because of frequent misidentification between this species and *Miniopterus schreibersii*, there is a need to carefully review the distribution of *Miniopterus natalensis*.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,227,870 km^2. In the RSA, its distribution is best predicted by geology (Babiker Salata, 2012: 50).

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 539; Taylor *et al.*, 2018b: 62); Botswana (Smithers, 1971; Monadjem *et al.*, 2010d: 539); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 539); Ethiopia (Lavrenchenko *et al.*, 2004b: 132); Kenya; Lesotho (Lynch, 1994: 191 [as "*M. schreibersii*"]; Monadjem *et al.*, 2010d: 539); Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988: 35; Monadjem *et al.*, 2010d: 539); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 539; Monadjem *et al.*, 2010c: 385); Namibia (Monadjem *et al.*, 2010d: 340); Saudi Arabia; South Africa (Simmons, 2005: 521, Seamark and Kearney, 2007: 4; Monadjem *et al.*, 2010d: 540); Swaziland (Monadjem *et al.*, 2010d: 540); Tanzania (Stanley and Goodman, 2011: 47 as *M. schreibersii*); Yemen (Benda *et al.*, 2011b: 45); Zambia (Ansell, 1974; Ansell, 1978; Monadjem *et al.*, 2010d: 540); Zimbabwe (Monadjem *et al.*, 2010d: 540).

Presence uncertain: Sudan (Simmons, 2005: 521); Uganda.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Schoeman and Jacobs (2002: 157) reported the following wing parameters for one "*M. schreibersii*" specimen from the Algeria Forestry Station (RSA): Fa: 46.6 mm, Wing area: 137.7 cm^2, Wing span: 30.9 cm, Wing loading: 7.8 N/m^2, and aspect ratio: 6.9.

DENTAL FORMULA:
I $^2/_3$ C $^1/_1$ P $^2/_3$ M $^3/_3$ = 36 (van der Merwe, 1985a: 73).

van der Merwe (1985a: 73) also indicates that the deciduous tooth replacement starts in the lower jaw and is completed prior to that of the upper jaw. The replacement starts at an age of one and a half weeks. In general the replacement sequence is: i_3, i_1, c_1, i_2, p_4, p_3, and all teeth are replaced at week 5. In the upper jaw, the replacement starts two and a half weeks (p^4, p^3, i^2, i^3, c^1) and is generally completed in week 6

FUNCTIONAL MORPHOLOGY:
Moussy *et al.* (2012: 189), referring to Miller-Butterworth *et al.* (2003), indicate that isolation of different populations in South Africa has led to local adaptation in *Miniopterus schreibersii natalensis*, which is strongly associated with four biomes and results in differences in wing morphology and migratory behaviour. The animals from the northeastern population have a higher wing aspect ratio, which forms an advantage for long-distance flight, allowing for migrations over longer distances.

Brown (1999: 170) found that "*M. schreibersii*" is able to thermoregulate in temperatures between 5 and 40°C.

ECHOLOCATION:
See Jacobs (1999) and Taylor (1999b).

Schoeman and Waddington (2011: 291) mention a peak frequency of 51.1 ± 0.9 kHz and a duration of 6.8 ± 0.4 msec for specimens from Durban, South Africa.

For *Miniopterus natalensis* specimens from Swaziland and Namibia, Taylor *et al.* (2013b: 17) recorded the following parameters for 21 calls: F_{max}: 65.9 ± 5.76 (59.0 - 80.9) kHz, F_{min}: 53.7 ± 0.58 (52.5 - 54.9) kHz, F_{knee}: 56.5 ± 0.31 (55.7 - 57.0) kHz, F_{char}: 54.1 ± 0.78 (52.7 - 55.5) kHz, duration: 2.6 ± 0.48 (1.9 - 3.8) msec. Values for a further 11 specimens from Swaziland were reported by Monadjem *et al.* (2017c: 179): F_{min}: 53.2 ± 0.87 (51.3 - 54.8) khz, F_{knee}: 57.0 ± 0.96 (55.5 - 58.5) kHz, F_c: 53.6 ± 0.83 (51.6, 55.0) kHz and duration: 2.8 ± 0.37(2.2 - 3.7) msec. They also indicated that the maximum detection distance for this species is 5 m.

At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 56 (56 - 57) kHz.
Schoeman and Jacobs (2002: 157) reported a F_{peak} of 53.6 kHz for one "*M. schreibersii*" from the Algeria Forestry Station (RSA). Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg area (RSA): F_{min}: 52 - 55 kHz, F_{char}: 45 - 62 kHz, F_{knee}: 56 - 57 kHz, Slope: 235 - 622 OPS, duration: 2 - 4 msec.
In the Mapungubwe National Park (RSA), Parker and Bernard (2018: 57) recorded 15 calls with F_{char}: 49.91 ± 0.95 kHz, F_{max}: 67.84 ± 4.75 kHz, F_{min}: 49.39 ± 0.88 kHz, F_{knee}: 53.61 ± 2.27 kHz, duration: 4.96 ± 1.31 msec and 7.30 ± 2.65 calls/sec.

Eisenring *et al.* (2016: SI 2) reported for 17 calls of bats from the Aberdares Range in Kenya the follow values: PF: 44.1 ± 3.5 (41.5 - 54.8), HF: 66.6 ± 17.7 (51.3 - 104.4), LF: 40.4 ± 1.5 (38.5 - 44.0), DT: 0.1 ± 0.0 (0.1 - 0.1), DF: 26.1 ± 17.5 (12.5 - 63.9), IPI: 1.0 ± 0.5 (0.5 - 2.5).

MOLECULAR BIOLOGY:
DNA - Teeling *et al.* (2017: 32) mention the assembly size for *M. natalensis* to be 1.80 Gb.

Karyotype - *M. schreibersii* from Namibia and South Africa now assigned to *M. natalensis*, were karyotyped by Rautenbach *et al.* (1993) who described the karyotype as having a diploid number of 2*n* = 46, aFN = 50, BA = 6, X = SM, Y = A.

Banerjee *et al.* (2017: 10) detected potential c-Rel binding sites in *M. natalensis*. This protein has a potential role in the DNA repair pathway as a regulator of inflammatory gene expression.

HABITAT:
Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *M. natalensis* activity was not significantly, nor positively influenced by size of wetland, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body. *M. natalensis* prefered trees and orchards surrounding wetlands (Sirami *et al.*, 2013: 35).

Voigt *et al.* (2013: 751) investigated stable isotope ratios of carbon, nitrogen and hydrogen in the fur keratin of *M. natalensis* on the slopes of Mount Kilimandjaro and found that this species migrates seasonally between low and high elevations. They

found that *M. natalensis* captured before and after the cold period at around 1,800 m above sea level originated from around 1,400 m a.s.l. or lower, which they suggest might be the result of a search for colder hibernacula at higher elevations.

HABITS:
van der Merwe (1973b: 380) indicates that in the Transvaal *M. natalensis* forms hibernating (winter) and maternity (summer) colonies, and he reports on maternity caves housing 50,000 to 100,000 animals. The bats usually form closely packed clusters, hanging from the roofs of caves, although some might be hanging against the walls. Hibernation started at the beginning of May and lasted until the end of July.

At De Hoop Nature Reserve (Western Cape Province, South Africa), Thomas and Jacobs (2013: 124) found that *M. natalensis* emerged significantly later during early summer than in late summer.

ROOST:
van der Merwe (1973b: 380) reports "*M. schreibersi natalensis*" to occur in colonies of hundreds or thousands of animals occupying a wide range of caves. At Peppercorn's cave and at Sandspruit Cave No. 1 clusters of 50,000 and 100,000 individuals were reported.

van der Merwe (1973a: 133) found that the bats preferred caves with lower temperature for hibernation.

Brown (1999: 171) reported the mean temperature in tunnel roosts is on average 19.5°C in summer (max: 22°C) and 14°C in winter.

DIET:
At the Umbilo River (KwaZulu Natal, RSA), Naidoo *et al.* (2011: 26) found the following percentage volume diet composition: Lepidoptera (35.7 ± 10.3), Coleoptera (11 ± 9.1), Hemiptera (28.3 ± 12.9), and Trichoptera (25.0 ± 13.9). No data were provided for the winter.

Schoeman and Jacobs (2002: 157) reported the following volume percentages found in 20 faecal pellets from one "*M. schreibersii*" from the Algeria Forestry Station (RSA): Diptera (49), Hemiptera (33), Lepidoptera (6), Coleoptera (6), and Trichoptera (6).

For 21 "*M. schreibersii*" specimens from Sudwala (RSA), Jacobs (2000: 201) reported the following prey proportions: Lepidoptera (23.1 ± 31.2), Coleoptera (4.5 ± 16.7), Isoptera (70.8 ± 32.2), Diptera (0.6 ± 2.3), Hemiptera (0.6 ± 2.3), and Mantodea (0.4 ± 0.3).

PREDATORS:
Avery *et al.* (2005: 1054) found this species (reported as *M. schreibersii*) to be present in pellets from *Tyto alba* in South Africa. van der Merwe (1980a: 15) already reported the barn owl as a predator, but indicated that these bats do not rank high on its diet, although there was an increase when other terrestrial and subterrestrial preys are descreasing in availability.

POPULATION:
Structure and Density - This species can be found in colonies of more than 2,500 animals (Jacobs *et al.*, 2008aj; IUCN, 2009). Mason *et al.* (2010: 165) observed that the number of bats in the De Hoop maternity chamber increased from a few hundred to several thousand from 18th August to the 25 September 2006.
Trend - 2008 - Unknown (Jacobs *et al.*, 2008aj; IUCN, 2009).

LIFESPAN:
Based on mark-recapture techniques, van der Merwe (1989b: 87) determined the maximum life expectancy for this species in the wild to be 13 years.

REPRODUCTION AND ONTOGENY:
Delayed implantation, insemination, ovulation and fertilization occur in the autumn (April to May in South Africa, see Bernard *et al.* (1991: 31), as *M. schreibersii*). Embryogenesis proceeds to the blastocyst stage and development is then retarded until arousal in spring, when the blastocyst implants and embryogenisis resumes (van der Merwe, 1980b). van der Merwe (1982b: 319) also mentions that implantation is centric and superficial in the right uterine horn, as was already noticed by Ginther (1967: 580) and van der Merwe (1996: 154), who also indicated [referring to Matthews (1941)], that the implantation occurs in the uterine horn opposite to the ovary containing the corpus luteum. van der Merwe (1979a: 17) and Bernard (1980a: 55) indicated that the delayed implantation period for "*M. schreibersi natalensis*" lasted for four months (120 days), which is as long as the active fetal growth period, giving a gestation period of 240 days. van der Merwe (1981: 172) presented the following formula to calculate the embryo's age in days (t) based on its body mass (W): $t = W^{1/3}/0.0145 + 144$.

Bernard and Davison (1996: 218) investigated the relation between calcium availability (from the poor source that insects are) and the reproduction of "*M. schreibersii*" and found that seasonal changes in insect abundance could not explain the delayed implantation, but that lactating females nevertheless had the lowest bone calcium

concentrations. This is probably the reason why parturition occurs in seasons with maximum insect availabitiy.

Mason *et al.* (2010: 165) found at De Hoop that in mid August 2006 the bats sampled were either not pregnant or at a very early stage of pregnancy and no embryos were present. However, on the 8th September the first bat sampled was pregnant and carried an embryo at the limb bud stage (CS13), this is found approximately the same time of year as those of the KwaZulu Natal and Eastern Cape populations. No twins were observed and pregnant bats collected on the same day never had embryos from only one stage of development (Mason *et al.*, 2010). Mason *et al.* (2010: 168) found that the period of early to mid-embryonic development (CS11 to CS21) occurred over a period of about two weeks in both years sampled, however this period appeared to occur about two weeks later in 2008 than in 2006, this delay in pregnancy may be due to environmental factors. Also the embryonic stages were not the same among individuals sampled on the same day, indicating that although reproductive events may be synchronous (within the period of a month) in this species, exact developmental events were not highly synchronized between individuals.

At the Gatkop cave (RSA), Dietrich *et al.* (2018b: 4) were only able to trap non-scrotal males in September 2015. In November 2015, 90 % of the females they trapped had given birth very recently, and in January 2016, large amounts of juveniles were present, together with post-lactating females.

The mass of pregant females varied greatly and was not correlated to the developmental stage of the embryos that they carried (Mason *et al.*, 2010: 165). Pretorius *et al.* (2019: 319), however, found that lactating females with sclerotized nipples were 6 % heavier than non-reproductive females and pregnant females were 25 % heavier than non-reproductive females, a difference - which at least in part - was attributed to foetus mass. Over three successive years (2015 - 2017), the proportion of active breeding females was found to be 31 %, 33 % and 70 %.

Mason *et al.* (2015) studied the embryological development of the fore- and hindlimbs, and found that that the transcription factor *Meis2* has a significantly higher expression in bat forelimb autopods compared to hindlimbs. Eckalbar *et al.* (2016: 528) found over 7,000 genes and noncoding RNAs (incl. Tbx5-as1 and Hottip), that were differentially expressed between forelimb and hindlimb, and across different stages of development.

MATING:
van der Merwe (1973b: 384) reported that the period of mating was still uncertain, although he assumed that it occurred at the wintering caves prior to hibernation.

PARASITES:
BACTERIA:
Dietrich *et al.* (2016b: 3) tested 17 bats from Irene (RSA) and found two testing positive for *Bartonella* and one for *Rickettsia*. Five out of 8 bats from Vanderkloof Dam (RSA) also tested positive for *Bartonella*.
Dietrich *et al.* (2015a: 3) reported the presence of the Enterobacteria *Hafnia* and *Nitrococcus*. They also found *Leptospira* in the urine sample, and *Bartonella* in urine and saliva samples. Dietrich *et al.* (2018a: 4;2018b: 4) reported the presence of bacteria related to *Leptospira borgpetersenii* and a second group closely related to *L. interrogans* and *L. kirschneri*.

HAEMOSPORIDA
Lutz *et al.* (2016: 9) examined 42 *M. natalensis* specimens from East Africa and found 20 of them infected with *Polychromophilus melanipherus* Dionisi, 1899.
Kassahun *et al.* (2015: 168) examined two *M. arenarius* specimens from Masha (Ethiopia), and found one of them to be infected by *Leishmania* parasites.

Gastro-intestinal
Helminthes - See Ortlepp (1932) and Junker *et al.* (2008a).

NEMATODA:
Genov *et al.* (1992) reported *Molinostrongylus omatus* (Mönnig, 1927) from *M. natalensis* from South Africa. Ramasindrazana *et al.* (2016: 2) indicate that *Litomosa chiropterorum* Ortlepp, 1932 (Onchocercidae) was redescribed from a *M. natalensis* population from South Africa. This Nematode was already reported from a bat from Katanga (DRC) by Durette-Desset and Chabaud (1975: 304).

ACARI:
Myobiidae: Uchikawa (1985a: 15) corrected the type host for *Calcarmyobia rhinolophi* from *Rhinolophus lobatus* to *Miniopterus natalensis arenarius*. Uchikawa (1985a: 19) also reported that the type specimens of *Miniopterus breyeri*, *M. dasythrix*, and *M. scotinus* harboured the "atypical" form of *Calcarmyobia congoensis* Uchikawa, 1982, and he also (Uchikawa, 1985a: 22) mentioned *Calcarmyobia kenyaensis* Uchikawa, 1982 on "*Miniopterus schreibersi*" from Belgian Congo and on "*Miniopterus schreibersi arenarius*" (and *M. natalensis arenarius*) from Kenya.

Uchikawa (1985c: 110) furthermore reported on the presence of *Pteracarus miniopteri* Uchikawa, 1978 on bats from South Africa, Kenya, Zambia, Uganda, Cameroon, Namibia (as either *M. natalensis arenarius*, *M. schreibersi arenarius*, *M. schreibersi natalensis*, *M. schreibersi villiersi* or *M. smitianus*).
Trombiculidae: Stekolnikov (2018a: 147) mentioned *Microtrombicula armata* Vercammen-Grandjean, 1965 from a South African "*M. schreibersii*".

DIPTERA
Streblidae: *Ascodipteron africanum* Jobling, 1939 from Kapretwa and Mt. Kenya, Kenya, other records referred to this species are misidentification (Haeselbarth *et al.*, 1966: 106). *Ascodipteron theodori* Maa 1965 from Rooiberg, South Africa (Haeselbarth *et al.*, 1966: 106). *Raymondi waterstoni* Jobling 1931 which may be accidental (Haeselbarth *et al.*, 1966: 104) (see also Shapiro *et al.*, 2016: 256).
Nycteribiidae: *Nycteribia capensis* Karaman, 1939 from the Cape and Pietermaritzburg, South Africa (Haeselbarth *et al.*, 1966: 108). *Nycteribia latiterga* Theodor, 1957 from Mt. Menengai, Kenya (Haeselbarth *et al.*, 1966: 108). *Nycteribia schmidlii* Schiner, 1853 (Zumpt, 1950: 97; Haeselbarth *et al.*, 1966: 108; Blackwell, 1980: 146 - infected by the fungus *Arthrorhynchus eucampsipodae* Thaxter, 1901 [see also Haelewaters *et al.*, 2018: 794; Szentiványi *et al.*, 2019: Suppl.]). *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114; Blackwell (1980: 144 - infected by the fungus *Arthrorhynchus nycteribiae* (Peyritsch) Thaxter [see also Haelewaters *et al.*, 2018: 794; Szentiványi *et al.*, 2019: Suppl.]).

SIPHONAPTERA:
Ischnopsyllidae: *Oxyparius isomalus* (Waterston, 1915) known from several localities in southern Africa (Transvaal, Natal of South Africa, Botswana and Namibia) and from the foothills of Mt. Elgon, Kenya (Haeselbarth *et al.*, 1966: 188). *Rhinolophopsylla ectopa* (Jordan, 1937) found in a cave in the foothills of Mt. Elgon, Kenya (Haeselbarth *et al.*, 1966: 191).

ACARI:
Argasidae: *Argas vespertilionis* (Latreille, 1802) from a "*M. schreibersi*" from Pretoria (see Howard, 1908: 168).
Dermanyssidae: Zumpt and Till (1954: 49) report *Steatonyssus natalensis* Zumpt and Patterson, 1951 from bats from Natal. Zumpt (1950 92) found a new mite of the genus *Bdellonyssus*.
Macronyssidae: Zumpt (1950: 89) described *Hirstesia transvaalensis* from bats from the Sterkfontein cave (RSA).
Myobiidae: *Myobia miniopterus* Womersley, 1941 (see Zumpt, 1950: 92).
Spinturnicidae: *Spinturnix semilunaris* De Meillon and Lavoipierre, 1944 (see Zumpt, 1950: 92).

VIRUSES:
Bunyaviridae
Phlebovirus
Rift Valley Fever Virus (RVFV) - Oelofsen and Van der Ryst (1999) tested [as *M. schreibersi*] 49 individuals from one locality in the Free State Province, South Africa for RVFV antigen using an enzyme linked immunosorbet assay (ELISA), none tested positive.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested [as *M. schreibersi*] between 1986 and 1999, for antibody to SARS-CoV in sera in one individual from Limpopo Province, South Africa, none were tested positive (0/1). Tong *et al.* (2009) tested 1 bat collected in Kenya during 2006 positive for the presence of coronavirus RNA in a fecal sample. Nine out of 53 (17 %) Kenyan bats tested by Tao *et al.* (2017: Suppl.) was positive for CoV.
One out of 14 specimens tested by Geldenhuys *et al.* (2013: 517) from Irene Caves, Gauteng, RSA tested positive for CoV.

Paramyxoviridae
Conrardy *et al.* (2014) detected a paramyxovirus sequence in one of eight bats sampled in Kenya. This virus does not group with the known paramyxoviruses and remains an unclassified paramyxovirus.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Duvenhage - van der Merwe (1982a) implicated *Miniopterus schreibersii*, as an isolate of the virus but the bat was never positively identified. This record was also referred to by Hayman *et al.* (2011a: 88), who indicated that the bas was possibly a *M. natalensis*.
Rabies - Oelofsen and Smith (1993) tested [as *M. schreibersi*] 137 individual brains, from 5 localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

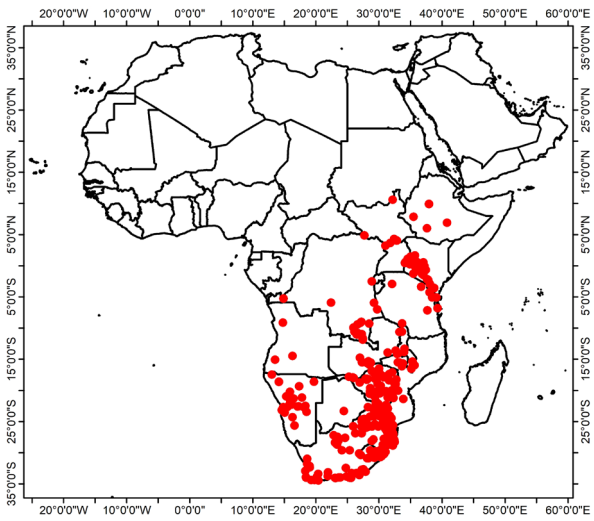


Figure 224. Distribution of *Miniopterus natalensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Botswana, Congo (Democratic Republic of the), Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

Miniopterus newtoni Bocage, 1889

*1889. *Miniopterus Newtoni* Bocage, J. Sci. mat. phys. nat., ser. 2, 1 (3): 198. Publication date: December 1889. Type locality: São Tomé and Principé: São Tomé Island [Goto Description]. Neotype: EBD MAM 17350: ad ♂, skull and alcoholic. Collected by: Javier Juste and Carlos J. Ibáñez Uargui; collection date: 4 April 1988. São Tomé Island, Santa Catarina, in a cave near the seashore (00 16 N 06 29 E), designated as neotype by Juste and Ibáñez (1992: 361). (Current Combination)

? *Miniopterus newtoni:* (Current Spelling)

TAXONOMY:
Recognised as a synonym (Koopman, 1993a: 231) or a subspecies (Simmons, 2005: 521) of *M. minor* Peters, 1867. Removed from *minor* by Juste [B.] *et al.* (2007: 33), based on mtDNA analyses. Juste and Ibáñez (1992: 361) designated a neotype for *newtoni* Bocage, 1889.

COMMON NAMES:
Czech: létavec tomášský. English: Sao Thome Long-fingered bat. French: Minioptère de São Tomé. German: Sao Thome Langflügelfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Juste, 2008b; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Juste, 2008b; IUCN, 2009).

MAJOR THREATS:
The threats to this species are not well known (Juste, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Juste (2008b) [in IUCN (2009)] reports that it is not known if the species is present in any protected areas. Further studies are needed into the natural history and threats to this species.

GENERAL DISTRIBUTION:
Miniopterus newtoni is endemic to the island of São Tomé (São Tomé and Príncipe) where it is widespread (Juste [B.] *et al.*, 2007).

Native: São Tomé and Principe (Koopman, 1993a: 231 [as *minor*]; Simmons, 2005: 521 [as *minor*]; Juste [B.] *et al.*, 2007; Rainho *et al.*, 2010a: 33).

ECHOLOCATION:
Rainho *et al.* (2010a: 21) reports the calls of 14 individuals from São Tomé.

POPULATION:
Structure and Density - It is a common species (Juste B. and Ibáñez, 1994b).
Trend - 2008 - Unknown (Juste, 2008b; IUCN, 2009).

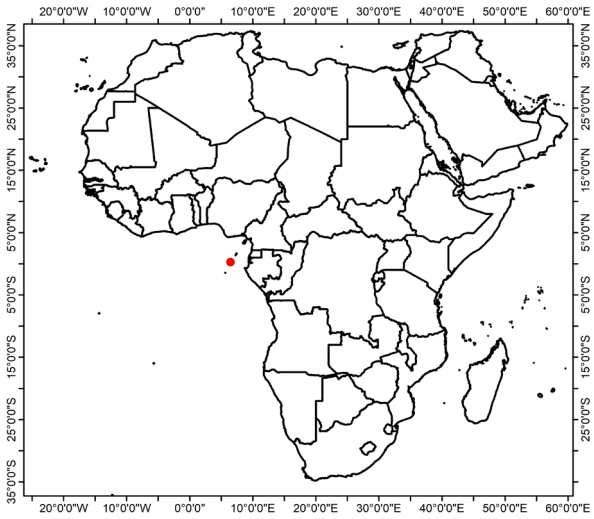


Figure 225. Distribution of *Miniopterus newtoni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
São Tomé and Principé.

Miniopterus petersoni Goodman, Bradman, Maminirina, Ryan, Christidis & Appleton, 2008

2007. *Miniopterus cf. sororculus:* Goodman, Ryan, Maminirina, Fahr, Christidis and Appleton, J. Mamm., 88 (5): 1229.

2008. *Miniopterus cf. petersoni:* Goodman, Bradman, Maminirina, Ryan, Christidis, and Appleton, Mamm. biol., 73: 202.

*2008. *Miniopterus petersoni* Goodman, Bradman, Maminirina, Ryan, Christidis and Appleton, Mamm. biol., 73: 199, 200, 201, figs 2 - 5. Type locality: Madagascar: Province de Toliara: Cascade de Manantantely: Tolagnaro, 5.2km NW [2459.343S 4655.370E, 65m]. Holotype: FMNH 194136: ad ♂. Collected by: Steven M. Goodman; collection date: 20 February 2007; original number: SMG 15833. Paratype: USNM 577096:. Paratype: USNM 577097:. Paratype: USNM 577098: Collected by: G. Kenneth Creighton and E. Raholimavo; collection date: 19-30 October 1990. Presented/Donated by: ?: Collector Unknown. Paratype: USNM 577099:. Paratype: USNM 577100:. Paratype: USNM 577101:. - Etymology: The name *petersoni* is a patronym in honour of Randolph L. Peterson of the Royal Ontario Museum, Toronto, Canada, who made pioneering contributions to the study of Malagasy bats, based on a 1967 collecting trip to the island, as well as other fields in mammalogy (Eger and Mitchell, 1990; Goodman *et al.*, 2008a). (Current Combination)

TAXONOMY:
See Goodman *et al.* (2008a).

COMMON NAMES:
Czech: létavec Petersonův. English: Peterson's Long-fingered Bat. French: Minioptère de Peterson. German: Petersons Langflügelfledermaus.

SIMILAR SPECIES:
See Goodman *et al.* (2008a).

CONSERVATION STATUS:
Global - This species is listed as Data Deficient (DD ver 3.1 (2001)) because although it appears to have a restricted range in the southeast of Madagascar and is associated with forest, there is taxonomic uncertainty about specimens from the north of Madagascar (which if proved valid would greatly extend the known range). There is also limited information on the population status and threats to this species (Jenkins and Rakotoarivelo, 2008b; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jenkins and Rakotoarivelo, 2008b; IUCN, 2009).

MAJOR THREATS:
Although robust data are lacking and there are still some taxonomic uncertainties of specimens from the north of Madagascar, the information on *M. petersoni* from the southeast suggests that this species is closely associated with natural forest formations and is therefore threatened by the loss or degradation of these habitats (Goodman *et al.*, 2008a). Threats to roosting colonies have not yet been documented (Jenkins and Rakotoarivelo, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Jenkins and Rakotoarivelo (2008b) [in IUCN (2009)] report that none of the known collecting localities for verified specimens of this species are from within protected areas (Goodman *et al.*, 2008a). The taxonomic status of specimens from north Madagascar requires further study.

GENERAL DISTRIBUTION:
Miniopterus petersoni is endemic to the island of Madagascar and appears to be restricted to lowland (< 550 m elevation) habitats in the south-east (Goodman *et al.*, 2008a).

Schoeman *et al.* (2014: 28, 31) found the most suitable area for this species to be located in the southeastern part of the island, but reaching along the coast to the northeast, where the suitability seems to increase again (eastern humid forest or lowland forest region - humid).

The taxonomic status of specimens from the north of Madagascar remain unresolved (Goodman *et al.*, 2008a).

Native: Madagascar (Goodman *et al.*, 2008a).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Goodman *et al.* (2008a).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Goodman *et al.* (2008a).

ECHOLOCATION:
Low-duty cycle, frequency modulated/quasi constant (FM/QCF) echolocation call, with a peak frequency of 53.2 kHz (52.0 - 53.9 kHz) and a duration of 2.9 ms (2.5 - 3.3 ms) (Goodman *et al.*, 2011: 9).
Ramasindrazana *et al.* (2011: 294) recorded 6 calls from 1 *Miniopterus petersoni* specimen, and found the following echolocation call values: Frequency of maximum energy: 53.2 ± 0.75 (52.0 - 53.9) kHz, Maximum frequency: 106.5 ± 6.66 (95.0 - 115.0) kHz, Minimum frequency: 49.0 ± 0.63 (48.0 - 50.0) kHz, Call duration: 2.9 ± 0.32 (2.5 - 3.3) ms, Inter pulse interval: 71.0 ± 4.63 (63.8 - 76.7) ms.

MOLECULAR BIOLOGY:
DNA - See Goodman *et al.* (2008a).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
See Goodman *et al.*, 2008a).

HABITS:
See Goodman *et al.* (2008a).

ROOST:
See Goodman *et al.* (2008a).

MIGRATION:
May be involved in seasonal migrations between cave roost sites (Goodman *et al.*, 2008a).

POPULATION:
Structure and Density - This species was only formally described in 2008 and there is no information on its population (Goodman *et al.*, 2008a).
Trend - 2008 - Unknown (Jenkins and Rakotoarivelo, 2008b; IUCN, 2009).

PARASITES:
Tortosa *et al.* (2013: 4) and Ramasindrazana *et al.* (2017: Suppl.) reported the presence of the Nycteribiid bat flies *Nycteribia stylidiopsis* and *Penicillidia leptothrinax*. The latter is also reported by Wilkinson *et al.* (2016), and was found to be carrying *Rickettsia* bacteria Szentiványi *et al.*, 2019: Suppl.).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

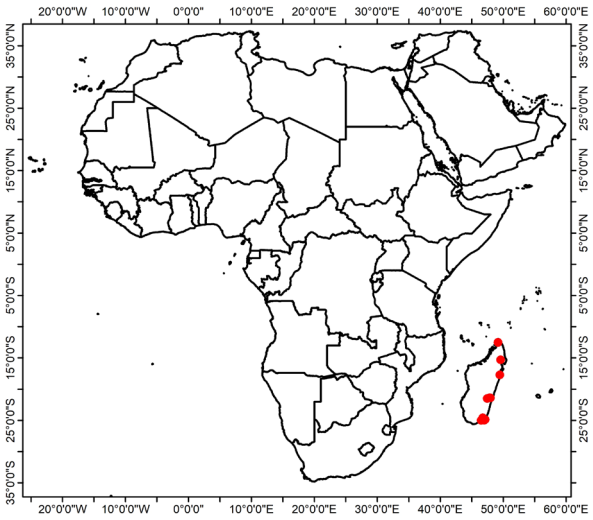


Figure 226. Distribution of Miniopterus petersoni

Miniopterus schreibersii (Kuhl, 1817)

*1817. *Vespertilio schreibersii* Kuhl, Die Deutschen Fledermäuse, Hanau, 14. Type locality: Romania: S Ban(n)at Mnts, near Coronini, left bank Danube: Kolumbács Cave [=Kulmbazer cave] [ca. 44 37 N 21 40 E]. - Comments: Turni and Kock (2008) mention

that the type and three "doublets" should have been present in the NMW, but are no longer found. - Etymology: In honour of Karl Franz Anton, Ritter von Schreibers (1775 - 1852), then director of the Vienna Museum (Flannery, 1995a: 378; 1995b: 452; Kozhurina, 2002: 17).

1827. *Vespertilio Screbersii:* Lesson, Manuel de Mammalogie, 89. (Lapsus)
1855. *V[espertilio] Schreibersi:* Giebel, Die Säugethiere, 950. (Name Combination)
1953. *Miniopterus schrebersii:* Harrison, Durban Mus. Novit., 4 (5): 65. Publication date: 30 June 1953. (Lapsus)
1995. *M[iniopterus] screibersi:* Pavlinov, Borissenko, Kruskop and Jahonton, Arch. Zool. Mus., Moscow State Univ., 133: 119. (Lapsus)
2013. *Miniopterus schreibersiias:* Shi, Sci. China Life Sci., 56 (8): 679. (Lapsus)
? *Miniopterus schreibersi schreibersi:* (Name Combination)
? *Miniopterus schreibersii dasythrix:* (Name Combination)
? *Miniopterus schreibersii schreibersii:* (Name Combination)
? *Miniopterus schreibersii villiersi:* (Name Combination)
? *Miniopterus schreibersii:* (Name Combination, Current Combination)

TAXONOMY:
Molecular systematics and biogeography are discussed by Appleton *et al.* (2004: 436 - 437), who indicate that based on their data *M. schreibersii* would be restricted to Europe and North Africa; the Ethiopian representatives would belong to a second species and the Oriental-Australian a third (see also Stadelmann *et al.*, 2004b: 188). Tian *et al.* (2004: 303) confirm the views presented by Appleton *et al.* (2004), and suggest *M. schreibersii* for the European specimens, *M. fuliginosus* for the Asian representatives and *M. oceanensis* for the Australian ones (which was already suggested by Maeda (1982), although he separated the specimens from Hainan from the other Asian representatives, which is no longer supported by Appleton *et al.* (2004).

Reviewed by Crucitti (1976) and Hill (1983).

If *Miniopterus schreibersii* is restricted to northern Africa, then *Miniopterus inflatus villiersi* Aellen, 1956 should possibly be assigned to *Miniopterus natalensis*, but as already indicated by Fahr *et al.* (2006a: 74) and Monadjem *et al.* (2016y: 371), *villiersi* represents a distinct species, restricted to the Upper Guinea forest zone.

COMMON NAMES:
Afrikaans: Schreibers se grotvlermuis, Schreiber-grotvlermuis. Albanian: Miniopteri i Schreibers-it, Lakuriq nate I Schreiber-it. Arabian: Khaffash. Armenian: Սովորական երկարաթև չղջիկ. Azerbaijani: Adi uzunqanad yarasa. Basque: Schreibers saguzar, Schreiber saguzarra. Belarusian:Даўгакрыл звычайны. Bosnian: Šrajberov šišmiš, Dugokrili slijepi miš. Breton: Miniopter Schreibers. Bulgarian: Пещерен дългокрил. Castilian: Murciélago de cueva. Catalan: Ratpenat de cova, Rat penat de cova, Ratapinyada de cova. Croatian: Dugokrili pršnjak. Czech: Létavec stehovavý (nedopír širokouchý, létavec stě hovavý). Danish: Schreibers' langfingerflagermus. Dutch: Langvleugelvleermuis, Schreibers' vleermuis, Grote Schreiber's vleermuis. English: Schreiber's Bent-winged Bat, Schreiber's Bat, Long-wing Bat, Schreibers's Long-fingered Bat, Common Bent-winged Bat, Greater Bent-winged Bat, Large Bentwing Bat, Bent-winged bat, Common Long-fingered Bat, large bent-winged bat. Estonian: Euroopa pikktiib. Finnish: Pitkäsiipiyökkö. French: Minioptère de Schreibers, Minioptère à longues ailes, Chauve-souris de Schreiber, Minioptère. Frisian: Schreibers'langwjukflearmûs. Galician: Morcego das covas. Georgian: ჩვეულებრივი ფრთაგრძელი. German: Langflügelfledermaus, Gemeine Langflügelfledermaus, Schreibers Langflügelfledermaus, Europäische Sackfledermaus, Schreibers Fledermaus. Greek: Πτερυγονυχτερίδα. Hebrew: Kanfan. Hungarian: Európai hosszúszárnyú-denevér, Törpe denevér, Hosszúszárnyú denevér, Nycteris i macropterys. Indonesian: Kelelawar mini schreiber, Tomosu Biasa, Kelelawar mini biasa. Irish Gaelic: Ialtóg mhéarfhada Schreiber. Italian: Miniottero, Miniòttero di Schrèibers, Miniòptero di Schrèibers. Latvian: Šreibersa siksparnis. Lithuanian: Šreiberio ilgapirštis. Luxembourgish: Laangflillekefliedermaus. Macedonian: Долгокрилест лилјак, Dolgokrilest Liljak. Maltese: Farfett il-Lejl ta' Xrajber. Montenegrin: Dugorili prstenjak. Norwegian: Middelhavslangvinge. Polish: Podkasaniec Schreibersa. Portuguese: Morcego-de-peluche, Morcego de schreiber. Rhaeto-Romance: Miniopter da l'ala lunga, Minopter ad ala lunga. Romanian: Liliacul cu aripi lungi, Liliac-cu-aripi-lungi. Russian: Длиннокрыл обыкновенный, Обыкновенный длиннокрыл [= Obyknovennyj dlinnokryl]. Serbian: Европски дугокрилаш. Serbian Latin: Evropski dugokrilaš. Scottish Gaelic: Ialtag mheur-fhada Schreiber. Sinhalese:

Schreibersge dik-angeli wawula. Slovak: Lietavec stahovavý. Slovenian: Dolgokrili netopir. Swedish: Europeisk vikvinge. Tamil: ஸ்ரைப ர்ஸ்-ன் நீண்ட விரலுள்ள வெளவால், Sraipars-ந Nīṇṭa Viraluḷḷa Veḷavāl. Turkish: Uzunkanatlı Yarasa. Ukrainian: Довгокрил звичайний. Welsh: Ystlum adain-gam Schreiber.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Gunnell *et al.* (2015a: 22) report skeletal remains from a Pleistocene deposit at Olduvai Gorge (Tanzania), which they assigned to *Miniopterus* cf. *M. schreibersi*.

CONSERVATION STATUS:
Global - Listed as Near Threatened NT ver 3.1 (2001). Significant population declines and range contractions have been recorded in a number of range states and although it is stable in the Balkans and Turkey, overall the rate of population decline may approach 30 % (almost qualifies as VU under A2a) (Hutson *et al.*, 2008c; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Hutson *et al.*, 2008c; IUCN, 2009). 2004 - LC ver 3.1 (2001) [included *natalensis*] (Schlitter, 2004i; IUCN, 2004). 1996 - LR/nt [included *M. natalensis*] (Baillie and Groombridge, 1996).

Regional -
Mediterranean: 2008 - NT ver 3.1 (2001) (IUCN, 2009).

MAJOR THREATS:
The main threat in Africa is disturbance in roosts. In Europe, the disturbance and loss of underground habitats and pesticide use may threaten this species. In the Caucasus, disturbance caused by tourism in caves is a problem (K. Tsytsulina *pers. comm.,* 2005).

The cause of recent mass mortality events is unknown. In 2002 mass mortalities of this species were reported for populations in France, Spain and Portugal. There are also historical records for such mortalities in Italy, Australia and a possible incidence in Iran. A meeting was held at the 9th European Bat Research Symposium to discuss these incidents. Veterinary investigations in Spain did not identify any disease as the cause of the die offs, and there is increasing belief that the die offs are caused by bad weather in late winter/early spring (Hutson *et al.*, 2008c; IUCN, 2009).

The species's small range, cave/tree roosting and aerial hawking feeding style are believed to be the most important risk factors in view of climatic change (Sherwin *et al.*, 2012: 174).

CONSERVATION ACTIONS:
Hutson *et al.* (2008c) [in IUCN (2009)] report that in Europe, it is protected by national legislation in most range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention in parts of the range where these apply. It is included in Annex II (and IV) of the EU Habitats and Species Directive, and hence requires special measures for conservation including designation of Special Areas for Conservation. There is some habitat protection through Natura 2000, and some roosts are already protected by national legislation. There have been a number of LIFEfunded projects for this species in Spain, Italy, Romania and Germany.

The species is found in many protected areas throughout its range.

Care is required when fencing caves to minimise mortality. Further research is required into the causes of the recent mass mortality events.

GENERAL DISTRIBUTION:
Miniopterus schreibersii occurs from south-western Europe and North and West Africa through Anatolia and the Middle East to the Caucasus. In Africa it is known from records in North Africa (Morocco, Algeria, Tunisia, Libya), and West Africa (Guinea, Sierra Leone, Liberia, Nigeria, Cameroon). It is patchily distributed over its range in some huge and vulnerable colonies. It typically occurs at altitudes of up to 1,400 m asl (commuting up to 2,600 m asl).

Native: Afghanistan; Albania; Algeria; Armenia; Azerbaijan; Bosnia and Herzegovina; Bulgaria; Cameroon; Croatia; Cyprus; France [Corse]; Georgia; Gibraltar; Greece [East Aegean Isands; Kriti]; Holy See [Vatican City State]; Hungary; Israel; Italy [Sardegna, Sicilia]; Jordan; Lebanon; Liberia; Macedonia, the former Yugoslav Republic of; Malta; Monaco; Montenegro; Morocco (Benda *et al.*, 2010a: 158; El Ibrahimi and Rguibi Idrissi, 2015: 364); Nigeria; Palestinian Territory, Occupied; Portugal; Romania; Russian Federation; San Marino; Serbia; Sierra Leone; Slovakia; Slovenia; Spain [Baleares]; Switzerland; Syrian Arab Republic; Tunisia (Dalhoumi *et al.*, 2014: 53; 2016b: 867); Turkey.
Possibly extinct: Austria.
Regionally extinct: Germany; Ukraine.
Presence uncertain: Libyan Arab Jamahiriya.

DETAILED MORPHOLOGY:
Bhide (1979: 1) described the anatomy, histology and histochemistry of this bat's stomach

In Korea, three types of lingual papillae were on the tongue by Park and Lee (2009: 267): filiform, fungiform, and circumvallate.

Cebesoy and Karakas (2013: 382) report on the muscle fiber types in primary flight muscles of specimens from Turkey, where they recognized three types: I, IIa, and IIb, which respectively make up 14 %, 70 % and 16 % of the *serratus ventralis*. In their study on take-off performance, Gardiner *et al.* (2014: 1059) determined a wing beat frequency of 11.95 ± 0.17 Hz.

ECHOLOCATION:
The data for 61 animals from Greece are the following: F_{start}: 93.0 ± 11.84 kHz, F_{end}: 50.8 ± 1.16 kHz, F_{peak}: 54.9 ± 5.32 kHz, bandwidth: 17.8 ± 14.30 kHz, duration 6.7 ± 1.29 msec and interpulse interval: 94.1 ± 35.73 msec (Papadatou *et al.*, 2008b: 133). Walters *et al.* (2012: suppl.) report the following figures for 31 calls from France, Greece, Italy and Switzerland: duration: 6.37 ± 2.89 msec, F_{max}: 73.24 ± 12.13 kHz, F_{min}: 49.75 ± 1.33 kHz, bandwidth: 23.49 ± 11.29, F_{peak}: 52.02 ± 1.68 kHz. Davies *et al.* (2013b: Table S8) report a peak frequency of 56.07 kHz and a range between 52.1 and 85.2 kHz.

From Morocco, Disca *et al.* (2014: 226) indicate that the type of call is FM-QFC, with the following parameters: F_{start}: 97.3 ± 11.3 kHz, F_{end}: 50.6 ± 1.4 kHz, F_{peak}: 53.4 ± 1.2 kHz, $F_{QFC\text{-}peak}$: 52.3 ± 1.1 kHz, bandwidth: 43.2 ± 11.4 kHz, duration: 6.2 ± 1.2 msec.

For 3 calls from the Kalahari Desert, the characteristics were: F_{char}: 47.6 ± 6.5 kHz, F_{max}: 76.7 ± 7.7 kHz, F_{min}: 53.2 ± 4.9 kHz, duration: 2.6 ± 0.4 msec(Adams and Kwiecinski, 2018: 4).

MOLECULAR BIOLOGY:
DNA - Barragán *et al.* (2002), Appleton *et al.* (2004), Tian *et al.* (2004), Bilgin *et al.* (2006, 2008).

Karyotype - Matthey and Bovey (1948) and Bovey (1949) described the karyotype from Switzerland as having a diploid number of 2*n* = 46, aFN = 48, X = submetacentric, Y = acrocentric. Rushton (1970: 463) reported 2*n* = 46, FN = 50, X = metacentric, Y = minute. Capanna and Civitelli (1965 - Italy), Baker *et al.* (1974 - Tunisia), Bickham and Hafner, 1978 - Yugoslavia), Zima (1978 - Czechoslovakia), Pérez-Suárez *et al.* (1991 - Spain), Albayrak (2006 - Turkey) found the fundamental number to be aFN = 50, and X = metacentric for Zima (1978). The autosomal chromosomes contain two large metacentrics, one medium-sized metacentric, 17 acrocentric and two dot-like pairs (one of these pairs may be bi-armed) (Arslan and Zima, 2014: 14). In Turkey, Asan Baydemir (2015: 350) found Nucleolus Organising Regions (NORs) on the secondary constriction in 2 pairs of chromosomes (pairs 18 and 20). Capanna and Civitelli (1965: 546) mention 22 pairs of autosomes, of which 3 are metacentric, 17 acrocentric, and two very small; the X chromosome is a medium sized metacentric and the Y chromosome is a very small one. Capanna and Manfredi Romanini (1971: 474) mention 2*n* = 45, aFN = 50, 2 pairs of metacentrics, 1 pair of submetacentrics, 19 pairs of acrocentrics.

Gürün *et al.* (2014: 73) confirmed the pattern of local differentiation previously detected in mitochondrial DNA as they also found significant differences in the nuclear DNA between bats from North Africa, Lebanon, Cyprus, Anatolia, Russia, Thrace-Balkans, Slovakia, Italy, France, and Iberia.

HABITS:
In southern France, Vincent *et al.* (2011: 57) found that during pregnancy and lactation, females might switch roosts within a 30 km radius around the maternity colony. During the night, the females travelled between 4.1 and 29.2 km to their foraging areas. They also estimated the individual home-ranges for pregnant females to be 10,837 ha, and for lactating females 22,318 ha.

DIET:
Presetnik and Aulagnier (2013: 297) investigated the diet of *M. schreibersii* in Slovenia and found this to consist primarily of Lepidoptera (79 % by volume). Neuroptera (mostly Chrysopidae) accounted for 9.2 %), Diptera for 7.4 %, Trichoptera for 2.2 %, and Coleoptera for 1.4 %. This seems to indicate that *M. schreibersii* is an aerial hawker. Gardiner *et al.* (2014: 1058) assessed its foraging strategy as "high altitude fast aerial hawking".

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - See Hutson *et al.* (2008c) [in IUCN (2009)] for information of populations outside Africa.
Trend - 2008 - Decreasing (Hutson *et al.*, 2008c; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Supp.) reports a maximum longevity of 22 years.

REPRODUCTION AND ONTOGENY:
Tuttle and Stevenson (1982: 122) indicate that both sexes need about 16 months to attain sexual maturity.
Kurta and Kunz (1987: 82) report that, at birth, the young weights about 20.4 % of the mother's body mass (3.4 g versus 20.4 g), and that its forearm length is 35.5 % of its mother's (16.7 versus 47.0 mm).

Szekely *et al.* (2015: Suppl.) report that males become sexually mature after 730 days (24 months) and females after 577 days (19 months). The young is born after a gestation period of 100 days with a weight of 2.8 g (22 % of the adult). After weaning (66 days), its weight is increased to 12.8 g.

Chari and Gopalakrishna (1984: 464) describe the development of the foetal membranes and the changes in the structure of the placenta in the Indian *Miniopterus schreibersii fuliginosus*, and they indicate that this bat has some unique embryological features.

POSTNATAL DEVELOPMENT:
In Iran, Sharifi and Vaissi (2013: 1) found that newborns had a mass of 3.74 ± 0.09 g and forearm length of 24.3 ± 0.31 mm. Both of these increased linearly over the first two weeks (at about 0.54 g/day and 1.39 mm/day), after which they remained rather stable. The epiphyseal gap of the fourth metacarpal phalangeal joint increased until the thirteenth day, then decreased linearly until the 70th day and thereafter fused. The eyes opened during the first week and the ears bekame erect. The pups also began to move by that time. At 21 days, their ability to fly improved, and they started to fly freely in the cave. At that time their average body mass was 11.32 g (91.6 % of adult weight).

PARASITES:
Lei and Olival (2014: Suppl.) mention this species to be a host for *Bartonella* bacteria.

Landau *et al.* (2012: 142) mention the Heamosporidians *Polychromophilus melaniferus* (Dionisi, 1899) and *Polychromophilus corradetti* Landau *et al.*, 1980.

In Europe, Genov *et al.* (1992) reported the following Nematodes: *Molinostrongylus panousei* Dollfus, 1954, *M. skrjabini* Skarbilovitch, 1934, *M. alatus* (Ortlepp, 1932), and *M. ornatus* (Mönning, 1927).

Uchikawa (1985a: 22) proposed the new name *Calcarmyobia dusbabeki* (Acari: Myobiidae) for a mite found on *Miniopterus schreibersii* from amongst others Tunisia and Algeria. The Spinturnicid mites *Spinturnix psi* (Kolenati, 1856) and *Spinturnix myoti* (Kolenati, 1856) were reported by Postawa and Furman (2014: 390) from Central Anatolia and the Levant.

Calcarmyobia ? parenzani Lombardini, 1956 was found on a *M. schreibersii* from Ras el Qued cave, Morocco.

Rhipicephalus sanguineus (Latreille, 1806) (Arachnidae: Ixodida: Ixodidae) were reported from Algerian bats by Bendjeddou *et al.* (2013: 325). Bendjeddou *et al.* (2017: 15) reported the following ectoparasites from Algeria: Nycteribiidae: *Nycteribia (Nycteribia) pedicularia* Latreille, 1805, *Penicillidia (Penicillidia) dufourii* Westwood, 1835 and *Phthiridium biarticulatum* Hermann, 1804; Streblidae: *Brachytarsina (Brachytarsina) flavipennis* Macquart, 1851; and Siphonaptera: *Rhinolophopsylla unipectinata arabs* Jordan and Rothschild, 1921.

In Italy, Voyron *et al.* (2011: 193) reported the following fungal entities from *M. schreibersii* carcasses: *Aspergillus* sp., *Chrysosporium merdarium*, *Fusarium equiseti*, Ophiostomatacea, *Thielavia* sp., *Mucor hiemalis f. hiemalis*.

Ševcík *et al.* (2012: 35) report on the presence of the bat flies *Nycteribia schmidlii schmidlii* Schiner, 1853 and *Penicillidia conspicua* Speiser, 1901 on bats from Crete and Cyprus. These bat flies are vector hosts for the malaria parasite *Polychromophilus melanipherus* (see Witsenburg *et al.*, 2013: 169). Haelewaters *et al.* (2017: 1) furthermore reported *Nycteribia kolenati* Theodor & Moscona, 1954 from Hungary.

Additionally, Tortosa *et al.* (2013: 6) also reported the Nycteribiid bat fly *Penicillidia oceanica* (Bigot, 1885).
The bat flies *Nycteribia schmidlii* Schiner, 1853, *Penicillidia dufourii* (Westwood, 1834), and *Penicillidia conspicua* Speiser, 1901 were reported by Postawa and Furman (2014: 390) from Central Anatolia and the Levant. Haelewaters *et al.* (2018: 794) additionally reported the flies *Nycteribia parvula, Penicillidia indica, P. jenynsii*, and *P. oceanica* from non-specified areas.

In Europe, the tick *Ixodes simplex* Neumann, 1906 is highly specialized to *M. schreibersii* (see Hornok *et al.*, 2014: 1).

In Spain, Estrada-Peña and Serra-Cobo (1991: 346) found the following Acari: *Ixodes (Pomerantzevella) simplex* Neumann, 1906, *Ixodes (Eschatocephalus) vespertilionis* Koch, 1844, *Macronyssus longimanus* (Kolenati, 1856), *Macronyssus granulosus* (Kolenati, 1856),

Macronyssus cyclaspis (Oudemans, 1906), *Macronyssus rhinolophi* (Oudemans, 1902), *Macronyssus diversipilis* (Vitzthum, 1920), *Macronyssus ellipticus* (Kolenati, 1857), *Spinturnix psi* (Kolenati, 1856), *Eyndhovenia euryalis euryalis* (Canestrini, 1884); and the bat flies *Nycteribia schmidlii* Schiner, 1853 and *Penicillidia dufouri* (Westwood, 1835).

VIRUSES:

Astroviridae

Luis *et al.* (2013: suppl.) mention the presence of an unassigned bat astrovirus.

Coronaviridae - Coronaviruses

Luis *et al.* (2013: suppl.) report the occurrence of various Coronaviruses (e.g. BatCoV HKU7, Miniopterus bat coronavirus 1, Miniopterus bat coronavirus HKU8).

Alphacoronavirus

Kohl and Kurth (2014: 3112) report this virus from Spain and Germany.

Betacoronavirus

Kohl and Kurth (2014: 3112) report this virus from Bulgaria and Germany.

Filoviridae - Filoviruses

Cuevavirus - Reported from Spain by Kohl and Kurth (2014: 3113).

Negredo *et al.* (2011: 1) described a new virus (Lloviu virus [LLOV]) from *M. schreibersii* in Spain.

Flaviviridae

Flavivirus

de Jong *et al.* (2011: 10), Luis *et al.* (2013: suppl.) report Japanese encephalitis virus. Luis *et al.* (2013) also mentions Kyasanur Forest disease virus and Yokose virus.

Orthomyxoviridae

Despite sampling and testing of 2 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

Papillomaviridae

Dyolambda

A new papillomavirus (*Miniopterus schreibersii* papillomavirus type 1 [MscPV1]) was described by Tse *et al.* (2012: 5) from Hong Kong as the first member of the novel Dyolambda-papillomavirus genus.

Phenuiviridae

Phlebovirus - Rift Valley fever virus:

de Jong *et al.* (2011: 11), Luis *et al.* (2013: suppl.) report the occurrence of Rift Valley fever virus.

Rhabdoviridae

Lyssavirus - Rabies related viruses

de Jong *et al.* (2011: 9) report the presence of West Caucasian bat virus.

van Eeden *et al.* (2011: 67) report an unconfirmed, but possible occurrence of Duvenhage virus in a specimen from the Limpopo province, South Africa.

In Algeria, Serra-Cobo *et al.* (2018: 2) found seven bats out of 63 testing seropositive for European bat lyssavirus 1.

"Various European bat lyssaviruses" were reported by Kohl and Kurth (2014: 3114) from a variety of European countries.

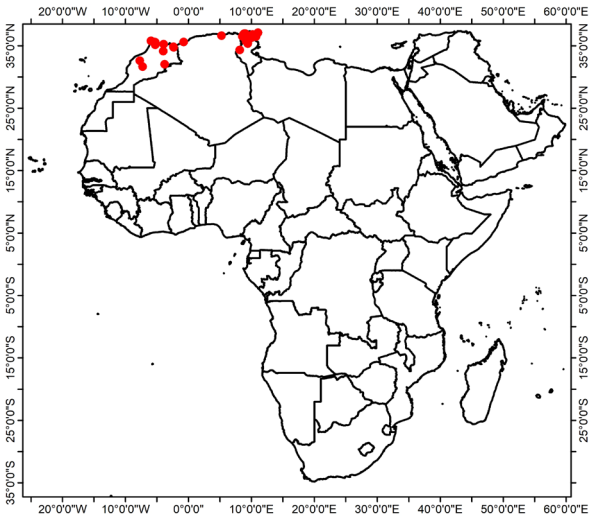


Figure 227. Distribution of *Miniopterus schreibersii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, Morocco, Tunisia.

Miniopterus sororculus Goodman, Ryan, Maminirina, Fahr, Christidis and Appleton, 2007

*2007. *Miniopterus sororculus* Goodman, Ryan, Maminirina, Fahr, Christidis and Appleton, J. Mamm., 88 (5): 1219, figs 2 - 6. Type locality: Madagascar: Province de Fianarantsoa: unnamed cave: Ambatofinandrahana, 3 km S [2034.321S 4648.530E, 1450 m] [Goto Description]. Holotype: FMNH 177259: ad ♀, skull and alcoholic. Collected by: Steven M. Goodman; collection date: 23 March 2003; original number: SMG 13560. Paratype: FMNH 177255: Collected by: Steven M. Goodman; collection date: 23 March 2003. Paratype: FMNH 177256: Collected by: Steven M. Goodman; collection date: 23 March 2003. Paratype: FMNH 177257: Collected by: Steven M. Goodman; collection date: 23 March 2003. Paratype: FMNH 177258: Collected by: Steven M. Goodman; collection date: 23

March 2003. Paratype: FMNH 177260: Collected by: Steven M. Goodman; collection date: 23 March 2003. - Etymology: The name *sororculus* is derived from the Latin ("*sororcula*") and means "small sister" (Goodman *et al.*, 2007b: 1222). This epithet was chosen to contrast this taxon with its African counterpart *fraterculus*, which means "little brother", as well as this animal being slightly smaller than *M. majori* (Goodman *et al.*, 2007b: 1222). (Current Combination)

2018. *Miniopterus soroculus:* Kemp, López-Baucells, Rocha, Wangensteen, Andriatafika, Nair and Cabeza, Agric. Ecosyst. Environ., 369: 90 (for 2019). Publication date: 1 October 2018. (Lapsus)

? *Miniopterus sororculus fraterculus:* (Name Combination)

TAXONOMY:
Specimens from Madagascar assigned to *M. fraterculus* by Peterson *et al.* (1995) and Simmons (2005) are now considered to be a distinct species (Goodman *et al.*, 2007b).

COMMON NAMES:
Czech: létavec sesterský. English: Sororculus Longfingered Bat, Sororcula Long-fingered Bat. German: Madagaskar-Langflügelfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) as the species appears to have a broad distribution in the central highlands with a relatively wide elevational range. There are no obvious major threats, and based on current records seems to be at least somewhat adaptable to disturbed habitats (Jenkins *et al.*, 2008f; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jenkins *et al.*, 2008f; IUCN, 2009).

MAJOR THREATS:
There are no known threats to this species and it exists in areas some distance from native forest (Goodman *et al.*, 2007b; Jenkins *et al.*, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Jenkins *et al.* (2008f) [in IUCN (2009)] report that at present, there are no known records from protected areas. This is a recently described taxon that does not appear to rely on large tracts of intact forest for its survival (Goodman *et al.*, 2007b). Further studies are needed to understand its adaptation to high elevations and extreme climate (Goodman *et al.*, 2007b).

GENERAL DISTRIBUTION:
Miniopterus sororculus is endemic to Madagascar where it has mainly been recorded from sites above 900 m elevation (Goodman *et al.*, 2007b) although there are a few records from sites at elevations < 50 m (Goodman *et al.*, 2008a). It is known from < 10 m confirmed localities ranging in elevation from 40 to 2,200 m above sea level. It is presumed to have a broad distribution spanning various portions of the central highlands (Goodman *et al.*, 2007b).

Schoeman *et al.* (2014: 28; 31) found the most suitable area for this species to be located in the central highland part of the island (higher elevations of the Central Highlands - sub-humid region).

Native: Madagascar (Goodman *et al.*, 2007b; Goodman *et al.*, 2008a).

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls as *Miniopterus majori/sororculus*, which produced broadband FM/QCF echolocation calls at low duty cycle, but with a lower maximum energy, at about 48.5 kHz. The fundamenetal being most intense with short duration pulses of about 4.5 ms.
Ramasindrazana *et al.* (2011: 294) recorded 20 calls from 7 *Miniopterus sororculus* specimens, and found the following echolocation call values: Frequency of maximum energy: 55.3 ± 0.92 (53.9 - 56.6) kHz, Maximum frequency: 103.2 ± 9.04 (83.0 - 121.0) kHz, Minimum frequency: 51.7 ± 1.08 (50.0 - 53.0) kHz, Call duration: 3.3 ± 0.29 (2.7 - 3.9) ms, Inter pulse interval: 79.3 ± 13.06 (50.8 - 99.8) ms.

HABITAT:
The holotype of *M. sororculus* was collected in a small limestone cave surrounded by pseudosteppe at 1,450 m (Goodman *et al.*, 2007b). This species is known to use rock crevices and deeper caves as day roosts (Goodman *et al.*, 2007b). At Antsampandrano, this species was found occupying a day roost in the attic of a building occupied by people. Further, it has been obtained in open dry savanna in the central west of Madagascar (Goodman *et al.*, 2007b).

ROOST:
Wilkinson *et al.* (2012: 160) mention that caves are the typical roosting sites for this species on Madagascar.

POPULATION:
Structure and Density - There is no information available on the population status of this recently described endemic species (Jenkins *et al.*, 2008f; IUCN, 2009).
Trend - 2008 - Unknown (Jenkins *et al.*, 2008f; IUCN, 2009).

PARASITES:
Dietrich *et al.* (2014: Suppl.) and Gomard *et al.* (2016: 5) report the presence of spirochaetes of the genus *Leptospira*, which Dietrich *et al.* (2018a: 3) identified as *L. borgpetersenii*.

Ramasindrazana *et al.* (2016: 6) recovered *Litomosa* Clade 1 and 2 (Nematoda: Onchocercidae) from this species.

Tortosa *et al.* (2013: 4) reported the presence of *Penicillidia leptothrinax*, a Nycteribiid bat fly. Ramasindrazana *et al.* (2017: Suppl.) mentioned the bat fly *Nycteribia stylidiopsis* (but the specimen on which this was found - UADBA 43264 - is here considered to be a *M. majori*).

VIRUSES:
Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 1 individuals from the Mauritius using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 1 positive results for viral nucleic acids.

2 out of 22 Madagascan specimens tested by Mélade *et al.* (2016b: 4) were positive for paramyxoviruses.

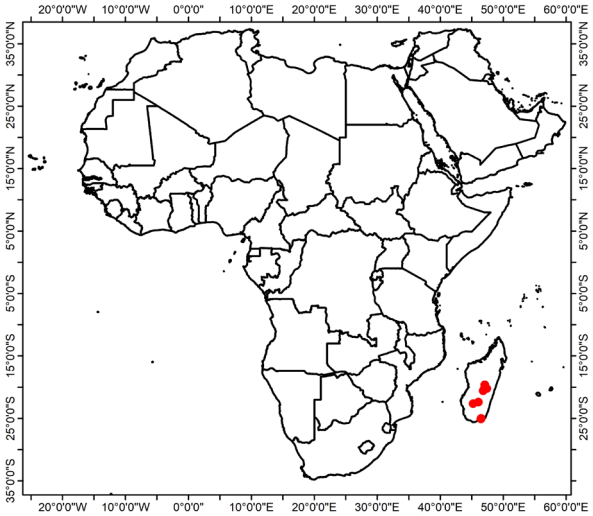


Figure 228. Distribution of *Miniopterus sororculus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Miniopterus villiersi Aellen, 1956

1956. *Miniopterus inflatus villiersi* Aellen, Bull. IFAN, (A) 18: 890. Type locality: Guinea: Dalaba: Grotte du Marché [10 42 N 12 15 W] [Goto Description]. Holotype: MHNG IFAN 54-1-1: ad ♂. Collected by: A. Villiers; collection date: 16 April 1954; original number: 2839. Former number IFAN: 54-1-1. - Comments: Considered a valid subspecies by Fahr and Ebigbo (2003: 128; 2004: 73), Fahr (2007a: 104). Aellen (1956a: 891) mentions 2 ♂♂ and 5 ♀♀ paratypes.
1965. *Miniopterus schreibersii villiersi:* Koopman, Am. Mus. Novit., 2219: 19. Publication date: 22 June 1965. (Name Combination)
2006. *Miniopterus (schreibersii) villiersi:* Fahr, Djossa and Vierhaus, Rapid assessment of bats (Chiroptera) in Déré, Diécké and Mt. Béro classified forests, southeastern Guinea; including a review of the distribution of bats in Guinée Forestière., 40: 74. (Name Combination)
2006. *Miniopterus villiersi:* Fahr, Djossa and Vierhaus, Rapid assessment of bats (Chiroptera) in Déré, Diécké and Mt. Béro classified forests, southeastern Guinea; including a review of the distribution of bats in Guinée Forestière: 74.. (Current Combination)
2017. *Miniopterus screibersii villiersi:* Reardon and Schoeman, Acta Chiropt., 19 (2): Suppl.. Publication date: December 2017. (Lapsus)
? *Miniopterus fraterculus villiersi:*

TAXONOMY:
For a long time, *villiersi* was considered to be a synonym or a subspecies of either *M. inflatus*, *M. schreibersii* or *M. natalensis*. Fahr *et al.* (2006a: 74), Weber and Fahr (2006: "4"), Jacobs *et al.* (2008x: 74) and Monadjem *et al.* (2016y: 371) indicated that *villiersi* represents a separate species (restricted to the Upper-Guinea forest zone), a view which is currently gaining support as detailed genetic analyses indicate the presence of multiple taxa in West Africa.

COMMON NAMES:
German: Lanflügelfledermaus.

GENERAL DISTRIBUTION:
Probably restricted to the Upper-Guinea forest zone, including Guinea (Decher *et al.*, 2016: 274).

HABITAT:
Monadjem *et al.* (2016y: 371) recorded *M. (schreibersii) villiersi* from altitudes between 460 and 900m in the Mount Nimba area.

ROOST:
Monadjem *et al.* (2016y: 371) found *Miniopterus (schreibersii) villiersi* roosting in old mine adits in the Mount Nimba area.

PARASITES:
HAEMOSPORIDA
Schaer *et al.* (2013a: 17416) report the presence of hemosporidian parasites of the genus *Polychromophilus* in three out of 12 investigated *M. villiersi* specimens from West Africa. Rosskopf *et al.* (2018: Suppl.) also found *Polychromophilus* sp. in bats from Guinea.

ACARI
Uchikawa (1985a: 19) indicates that *Miniopterus villiersi* is one of the true hosts of "typical" *Calcarmyobia congoensis* Uchikawa, 1982 (Acari: Myobiidae).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Guinea, Nigeria.

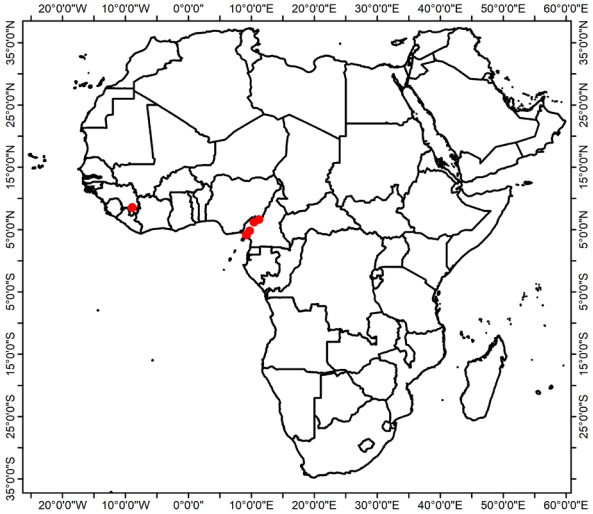


Figure 229. Distribution of *Miniopterus villiersi*

†Family PHILISIDAE Sigé, 1985

1985. *Philisidae* Sigé, Geol. Palaeontol., 19: 161-189. - Comments: Described as a distinct Family level.

TAXONOMY:
Ravel *et al.* (2014) confirmed the family status of the Philisidae within the superfamily Vespertilionoidae based on a cladistic assesment of the dental data, and that they represent the earliest offshoot of this superfamily (p. 698).

Sigé (1985) [in Ravel *et al.* (2014: 696)] concluded that the Philisidae could have originated in Late or Middle Eocene from a generalized Vespertilionidae after the divergence between the Molossidae and the Vespertilionidae sensu lato.

Ravel *et al.* (2012) suggested that *Philisis* and *Dizzya* were probably split of from the third genus of the family (*Witwatia*) in the Early Eocene. Ravel *et al.* (2012: 699), however, doubt the close relationship between the two former genera.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
According to Ravel *et al.* (2014: 691), Philisids were among the most common African bats in the Palaeogene (66 to 23.03 mya). They were found in the Late Eocene - Early Oligocene deposits of the Fayum Depression in Egypt, together with extant bat families, such as Rhinopomatidae, Megadermatidae, Emballonuridae and Myzopodidae (Sigé, 1985; Gunnell *et al.*, 2008, 2014).

†Genus ***Dizzya*** Sigé, 1991

*1991. *Dizzya* Sigé, N. Jb. Geol. Paläont. Abh., 182: ?. - Comments: Type species - *Dizzya exultans* Sigé, 1991. (Current Combination)

TAXONOMY:
Currently recognized species of *Dizzya*: ***†exsultans*** Sigé 1991.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Early. Eocene.

DENTAL FORMULA:
Ravel *et al.* (2011: 402) indicate that *Dizzya* differs from the other Philisidae in showing a nyctalodont molar structure.

†***Dizzya exsultans*** Sigé, 1991

*1991. *Dizzya exsultans* Sigé, N. Jb. Geol. Paläont. Abh., 182: ?. Type locality: Tunisia: Chambi. - Comments: Marandat (1994: 62) mentions the holotype to consist of a right M^1 or M^2.

. (Current Combination)

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Time frame - Early Eocene (Ypresian).

DETAILED MORPHOLOGY:
Ravel *et al.* (2014: 694) indicate that *Dizzya exsultans* is the smallest representative of the Philisidae. Together with *Witwatia sigei*, it is also the oldest. Based on data from Gunnell *et al.* (2009), Ravel *et al.* (2014: 702) estimated the body weight for this bat to be about 8.6 to 9.1 g.

†Genus ***Philisis*** Sigé, 1985

*1985. *Philisis* Sigé, Geol. Palaeontol., 19: ?. - Comments: Type species - *Philisis sphingis* Sigé, 1985. (Current Combination)

TAXONOMY:
May be a junior synonym of *Provampyrus*.

Ravel *et al.* (2014: 699) indicate that the genus might be paraphyletic.

Known species of *Philisis*: †*sevketi* Sigé, Thomas, Sen, Gheerbrant, Roger & Al-Sulaimani 1994 (Oman), †***sphingis*** Sigé 1985.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Ravel *et al.* (2014: 699) indicate that fossils of this genus were only found in deposits dating from the Early Oligocene.

†***Philisis sphingis*** Sigé, 1985

*1985. *Philisis sphingis* Sigé, Geologica et Palaeontologica, 19: ?. Holotype: YPM MAM 034488:. Right maxilla (P^4-M^3): see Gunnell *et al.* (2008: 2). (Current Combination)

DETAILED MORPHOLOGY:
Based on data from Gunnell *et al.* (2009), Ravel *et al.* (2014: 702) estimated the body weight for this bat to be between 36 to 74 g.

†Genus ***Witwatia*** Gunnell, Simons and Seiffert, 2008

*2008. *Witwatia* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 2. - Comments: Type species - *Witwatia schlosseri* Gunnell, Simons and Seiffert, 2008. - Etymology: *Wit Wat*, Egyptian Arabic for large, flapping wings (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

Ravel *et al.* (2014: 702) mention that the differences between *W. schlosseri* and *W. eremicus* (both found in the same locality: BQ2, Fayum, Egypt), might be attributed to the presence of a sexual dimorphism, where the former might represent the larger female and he latter the smaller male. But they also indicate that this is currently speculative.

Known species of the genus *Witwatia*: †***eremicus*** Gunnell, Simons and Seiffert, 2008; †***schlosseri*** Gunnell, Simons and Seiffert, 2008; †***sigei*** Ravel, Marivaux, Tabuce, Bel Haj Ali, Essid, and Vianey-Liaud, 2012.

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Timeframe - Ravel *et al.* (2014: 699) indicate that fossils were found dating back between the early and latest Eocene.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

†***Witwatia eremicus*** Gunnell, Simons and Seiffert, 2008

*2008. *Witwatia eremicus* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 3, 4, 5. Type locality: Egypt: Fayum Depression: Quarry BQ-2: Umm Rigl Member of the Birket Qurun Formation. - Etymology: *Eremikos*, Greek for solitude, in reference to the vast solitude of the Egyptian Western Desert (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Time frame - Earliest Late Eocene (Priabonian), Umm Rigl Member of the Birket Qarum formation.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

DETAILED MORPHOLOGY:
Based on data from Gunnell *et al.* (2009), Ravel *et al.* (2014: 702) estimated the body weight for this bat to be about 40 to 98 g.

†***Witwatia schlosseri*** Gunnell, Simons and Seiffert, 2008

*2008. *Witwatia schlosseri* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 2, 3, fig. 3D. Type locality: Egypt: Fayum Depression: Quarry BQ-2: Umm Rigl Member of the Birket Qarun Formation. Holotype: CGM 83668:. Left dentary (c1-m3): see Gunnell *et al.* (2008: 3). - Etymology: Specific name for Max Schlosser who described the first fossil bat from the Fayum (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Time frame - Earliest Late Eocene (Priabonian), Umm Rigl Member of the Birket Qarum formation.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

DETAILED MORPHOLOGY:
Based on data from Gunnell *et al.* (2009), Ravel *et al.* (2014: 702) estimated the body weight for this bat to be between 57 and 116 g.

†***Witwatia sigei*** Ravel, Marivaux, Tabuce, Bel Haj Ali, Essid, and Vianey-Liaud, 2012

*2012. *Witwatia sigei* Ravel, Marivaux, Tabuce, Bel Haj Ali, Essid, and Vianey-Liaud, Palaeontology, 55 (5): 1035, 1036, fig. 2. Publication date: 18 September 2012. Type locality: Tunisia: Kasserine

area: Chambi [Goto Description]. Holotype: ONM CB1-230: unknown / no information. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Left upper molar (M2), see Ravel *et al.* (2012: 1036). - Etymology: In honour of Bernard Sigé, who first extensively described Paleogene bats remains, including those from Chambi (see Ravel *et al.*, 2012: 1036). (Current Combination)

DETAILED MORPHOLOGY:
Based on data from Gunnell *et al.* (2009), Ravel *et al.* (2014: 702) estimated the body weight for this bat to be about 100 g.

Family VESPERTILIONIDAE Gray, 1821

1815. *Vespertilia* Rafinesque, Analyse de la Nature, 54. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Conserved by Direction 98 (IUCN , 1958), which also corrected the name to Vespertilionidae. Originally included the subfamilies Lophinia (Rafinesque, 1815) [including the genera *Rhinolophus* Lacépède, 1799; *Phyllostoma* G. Cuvier, 1800 [= *Phyllostomus* Lacépède, 1799]; *Vampyrum* Rafinesque, 1815; and *Megaderma* É. Geoffroy, 1810]; and Nycteria (Rafinesque, 1815) [including the genera *Pteropus* Brisson, 1762; *Eidolon* Rafinesque, 1815; *Pteronotus* Rafinesque, 1815; *Cephalotes* É. Geoffroy, 1810 [= *Nyctimene* Borkhausen, 1797]; *Tadaris* [sic = *Tadarida*] Rafinesque, 1814; *Vespertilio* Linnaeus, 1758; *Nycterus* [sic = *Nycteris*] É. Geoffroy and G. Cuvier, 1795; *Noctilio* Linnaeus,
1766; *Molossus* É. Geoffroy, 1805; and *Atalapha* Rafinesque, 1814 [= *Nyctalus* Bowdich, 1825: 36]] (see Jackson and Groves, 2015: 264).

*1821. *Vespertilionidæ* Gray, London Med. Repos., 15: 299. Publication date: 1 April 1821. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Dobson (1878: 167) refers to Dobson, 1875 (p. 347), indicating that Gray's (1866) definition includes genera beloning to very distinct families. Originally included the genera *Megadermes* [sic = *Megaderma*] É. Geoffroy, 1810; *Rhynolophus* [sic = *Rhinolophus*] Lacépède, 1799; *Nycterus* [sic = *Nycteris*] É. Geoffroy and G. Cuvier, 1795; *Rhynopoma* [sic = *Rhinopoma*] É. Geoffroy, 1818; *Thaphosores* [sic = *Taphozous*] É. Geoffroy, 1818; *Vespertilio* Linnaeus, 1758; *Pecotus* [sic = *Plecotus*] É. Geoffroy, 1818; and *Barbastella* J. Gray, 1821 (see Jackson and Groves, 2015: 264). The name was conserved by Direction 98 (ICZN, 1958: 131). (Current Combination)

1825. *Vespertilionina* Gray, Ann. Philos., 10 (5): 339. Publication date: November 1825. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Originally include the genera *Vespertilio* Linnaeus, 1758; *Plecotus* É. Geoffroy, 1818; *Barbastellus* J. Gray, 1825 [= *Barbastella* J. Gray, 1821]; *Proboscidea* Spix, 1823 [= *Rhynchonycteris* Peters, 1867; *Thyroptera* Spix, 1823; and *Caelano* [sic = *Celaeno*] Leach, 1821 [= *Noctilio* Linnaeus, 1766: 88] (see Jackson and Groves, 2015: 264).

1843. *Gymnorhina* Wagner.

1855. *Nycticeina* Gervais, in: F. Comte de Castelnau, Exped. Partes Cen. Am. Sud., Zool, ???. Publication date: 23 July 1856.

1866. *Nyctophilina* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 91. Publication date: 1 February 1866.

1866. *Plecotina* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 91. Publication date: 1 February 1866.

1866. *Romiciana* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 90. Publication date: 1 February 1866.

1866. *Vespertiliones* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1865: 524. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Originally included the genera *Synotus* Keyserling & Blasius, 1839 [= *Barbastella* J. Gray, 1821]; *Plecotus* É. Geoffroy, 1818; *Histiotus* Gervais, 1855; *Otonycteris* Peters, 1859; *Miniopterus* Bonaparte, 1837; *Vespertilio* Linnaeus, 1758; *Vesperugo* Keyserling and Blasius, 1839 [= *Vespertilio* Linnaeus, 1758]; *Vesperus* Keyserling and Blasius, 1839 [= *Vespertilio* Linnaeus, 1758]; *Murina* J. Gray, 1842; *Harpiocephalus* J. Gray, 1842; *Nycticejus* [sic = *Nycticeius*] Rafinesque, 1819]; *Atalapha* Rafinesque, 1814 [= *Nyctalus* Bowdich, 1825]; *Thyroptera* Spix, 1823; and *Antrozous* H. Allen, 1862 (see Jackson and Groves, 2015: 265). Jackson

and Groves (2015: 227) consider this (family) name a homonym of Vespertiliones Pallas, 1767, and indicated that it covers the Vespertionidae family, rather than the Vespertilioninae subfamily. Not Vespertiliones Dobson, 1878, a group name for the subfamily Vespertilioninae.

1869. *Gymnorhinida* Fatio, Faune des Vertébrés de la Suisse.

1872. *Vespertilionidae:* Gill, Smiths. Misc. Coll., 11 (1): 17. Publication date: November 1872. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Originally included the subfamilies Vespertilioninae J. Gray, 1821 and Nycticejinae Gill, 1872 (see Jackson and Groves, 2015: 265).

1893. *Nycteridae:* Schulze. - Comments: Not of Van der Hoeven, 1855. Not of Dobson, 1875 (see Pavlinov *et al.*, 1995: 93).

1893. *Vespertilionini* Winge, Samling af Afhandlinger. E Museo Lundii, 2 (1): 24. - Comments: Introduced as tribe (?). Jackson and Groves (2015: 265) (erroneously?) mention *Emballonura* Temminck, 1838 as type genus. Originally included the genera *Vespertilio* Linnaeus, 1758 [including the subgenera *Kerivoula* J. Gray, 1842; *Natalus* J. Gray, 1838; and *Nyctiellus* Gervais, 1855]; *Plecotus* É. Geoffroy, 1818; *Minyopterus* Agassiz, 1846 [= *Miniopterus* Bonaparte, 1837]; *Lasionycteris* Peters, 1865; *Vesperugo* Keyserling and Blasius, 1839 [= *Vespertilio* Linnaeus, 1758]; *Harpyiocephalus* J. Gray, 1866 [= *Harpiocephalus* J. Gray, 1842]; *Synotus* Keyserling & Blasius, 1839 [= *Barbastella* Gray, 1821]; *Chalinolobus* Peters, 1865; *Otonycteris* Peters, 1859; *Nyctophilus* Leach, 1821; *Atalapha* Rafinesque, 1814 [= *Nyctalus* Bowdich, 1825]; and *Antrozous* H. Allen, 1862 (see Jackson and Groves, 2015: 265).

1907. *Nyctophilinæ* Miller, Bull. U.S. natl. Mus., 57: xi, *234*. Publication date: 29 June 1907. - Comments: Type genus: *Nyctophilus* Leach, 1821. Originally included the genera *Antrozous* H. Allen, 1862 and *Nyctophilus* Leach (see Jackson and Groves, 2015: 270).

1942. *Myotini* Tate, Bull. Am. Mus. Nat. Hist., 80 (7): 221, 229. Publication date: 27 November 1942. - Comments: Type genus: *Myotis* Kaup, 1829. Introduced as tribe, and originally included the genera *Myotis* Kaup, 1829; *Lasionycteris* Peters, 1865; *Plecotus* É. Geoffroy, 1818; *Corynorhinus* H. Allen, 1865; *Idionycteris* Anthony, 1923; and *Euderma* H. Allen, 1891 (see Jackson and Groves, 2015: 280).

2008. *Vespertolionidae:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 247. (Lapsus)

2018. *Vespertilionnidae:* Malekani, Musaba, Gembu, Bugentho, Toengaho, Badjedjea, Ngabu, Mutombo, Laudisoit, Ewango, Van Cakenberghe, Verheyen, Asimonyo, Masudi, Bongo and Ngbolua, Nat. Conserv. Res., 3 (1): 67.. Publication date: January 2018. (Lapsus)

? *Vespertilioninae sp.:*

TAXONOMY:

Systematicians have long recognized that Vespertilionidae as so defined, is diagnosed by few if any apomorphies, and some data have been cited as evidence that the family is not monophyletic. For example, *Tomopeas ravus* (the only member of the subfamily Tomopeatinae) shares immunological affinities and several derived morphological and molecular traits with molossidis (Miller, 1907; Davis, 1970; Barkley, 1984; Pierson, 1986; Sudman *et al.* (1994). Miniopterines, which differ from other vespertilionids in several aspects of fetal development and adult morphology, show immunological affinity with molossids (Mein and Tupinier, 1977; Gopalakrishna and Chari, 1983; Pierson, 1986). Kerivoulines share derived morphological traits with Natalidae, Thyropteridae, Furipteridae, and Myzopodidae (Sigé, 1974; Van Valen, 1979). These patterns have lead various workers to suggest removal of one or more subfamilies from Vespertilionidae (Davis, 1970; Sigé, 1974; Mein and Tupinier, 1977; Van Valen, 1979; Gopalakrishna and Chari, 1983; Barkley, 1984; Sudman *et al.*, 1994). Each of the eight vespertilionid subfamilies just listed appears to be monophyletic, with the exception of Vespertilioninae, which may be paraphyletic. In morphology, Vespertilioninae is "perhaps best characterized by absence of the special modifications that distinguish the other groups" (Miller, 1907: 197). Volleth and Heller, 1994) describe several derived karyotype features that diagnose Vespertilioninae (including Nyctophilinae but exclude Myotinae), but their study did not include any members of Antrozoinae or Lasiurini.

Molecular phylogenetics reviewed by Hoofer and Van Den Bussche (2003).

Roehrs *et al.* (2011: 24) suggest the following subdivision in tribes/groups:
Vespertilionini (*Nyctalus, Pipistrellus, Scotoecus, Vespertilio*)

Hypsugine group (*Chalinolobus, Vespadelus, Hypsugo, Nycticeinops, Neoromicia, Laephotis, Tylonycteris*)
Eptesicini / Nycticeiini (*Arielulus, Lasionycteris, Glauconycteris, Nycticeius, Eptesicus, Scotomanes*)
Perimyotine group (*Parastrellus, Perimytois*)
Scotophilini (*Scotophilus*)
Antrozini (*Antrozous, Rhogeessa, Baeodon*)
Lasiurini (*Lasiurus*)
Plecotini (*Corynorhinus, Otonycteris, Barbastella, Plecotus, Idionycteris*).

Known genera in the subfamily Vespertilioninae:
Tribe Eptesicini Volleth and Heller, 1994 - *Arielulus* Hill and Harrison, 1987; ***Eptesicus*** Rafinesque, 1820; *Hesperoptenus* Peters, 1868.
Tribe Lasiurini Tate, 1942 - *Lasiurus* Gray, 1831.
Tribe Nycticeiini Gervais, 1855 - ***Nycticeinops*** Hill and Harrison, 1987; *Nycticeius* Rafinesque, 1819; *Rhogeessa* H. Allen, 1866; *Scoteanax* Troughton, 1943; ***Scotoecus*** Thomas, 1901; *Scotomanes* Dobson, 1875; ***Scotophilus*** Leach, 1821; *Scotorepens* Troughton,1943.
Tribe Nyctophilini Peters,1865 - *Nyctophilus* Leach, 1821; *Pharotis* Thomas, 1914.
Tribe Pipistrellini Tate, 1942 - *Glischropus* Dobson, 1875; *Nyctalus* Bowditch, 1825; ***Pipistrellus*** Kaup, 1829; *Scotozous* Dobson, 1875.
Tribe Plecotini Gray, 1866 - *Barbastella* Gray, 1821; *Corynorhinus* H. Allen, 1865; *Euderma* H. Allen, 1892; *Idionycteris* Anthony, 1923; ***Otonycteris*** Peters, 1859; ***Plecotus*** E. Geoffroy Saint-Hilaire, 1818.
Tribe Vespertilionini Gray, 1821 - *Chalinolobus* Peters, 1867; *Eudiscopus* Conisbee, 1953; *Falsistrellus* Troughton, 1943; ***Glauconycteris*** Dobson, 1875; *Histiotus* Gervais, 1856; ***Hypsugo*** Kolenati, 1856; *Ia* Thomas, 1902; ***Laephotis*** Thomas, 1901; ***Mimetillus*** Thomas, 1904; ***Neoromicia*** Roberts, 1926; *Philetor* Thomas, 1902; *Tylonycteris* Peters, 1872; *Vespadelus* Troughton, 1943; *Vespertilio* Linnaeus, 1758.

COMMON NAMES:
Czech: netopýrovití, netopýři holonosí. Dutch: Gladneusvleermuizen. English: Evening bats, Vespertilionid bats, Vesper Bats, Plain-faced Bats, Simple-nosed Bats. Finnish: Siipat. French: Vespertilionidés. German: Glattnasen, Glattnasen-Fledermäuse. Italian: Vespertiliònidi. Norwegian: Glattneser, Glattneseflaggermus. Polish: mroczkowate. Romanian: Lilieci cu tragus. Russian: Гладконосые. Spanish (Castillian): Murcielagos chicos, Murciélagos de cola envainada. Vietnamese: Họ dơi muỗi

ETYMOLOGY OF COMMON NAME:
Rosevear (1965) uses the colloquial name vesper bats, borrowing it from the name for the family, which is derived from the Latin for a bat, *vespertilio*. They are sometimes called 'evening bats' because of their time of activity (Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Shi and Rabosky (2015: 1537) report the family-level stem ages/crown ages for the Vespertilionidae (including Miniopteridae and Cistugidae) to be 52.1 and 51.1 million years ago, respectively.

The oldest African fossil assigned to this family is *Khonsunycteris aegypticus* from the late Eocene (ca. 34 MYA) of the Fayum, Egypt (Hand *et al.*, 2016: 7).

GENERAL DISTRIBUTION:
Luo *et al.* (2019) investigated the geographic range of 126 vespertilionid bat species (including 20 African) in relation to their wing morphology and found that species with higher wing loading have larger distribution ranges than those with lower wing loading, and that the size of geographic ranges was associated with wing aspect ratio.

ROOST:
López-Baucells *et al.* (2018: 30) examined the roost selection by synanthropic bats in rural Madagascar and found that small colonies of vespertilionid bats had a preference for small, traditional houses made of mud and wood, especially if the roof was made from leaves.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention a Vespertiliondae bat taken as prey by a Swamp boubou (*Laniarius bicolor* (Verreaux, 1857)) in Botswana.

PARASITES:
Fain (1994: 1280) reports that three genera of Myobiidae (Acari) are occurring on members of the Vespertilionidae: *Acanthophthirius*, with 4 subgenera (*Acanthophtirius, Myotimyobia, Chiromyobia, Mimetillobia*) and 47 species, *Pteracarus* with 21 species, and *Calcarmyobia* with 18 species and 8 subspecies. The latter genus is restricted to bats of the genus *Miniopterus*, and since this genus is currently included in a family of its own, this implies that only two genera of Myobiidae parasite on Vespertilionidae.

VIRUSES:
A paramyxovirus was detected in one out of nine Vespertilionidae bats sampled in Kirindy in Madagascar (Wilkinson *et al.*, 2014).

Subfamily Kerivoulinae Miller, 1907

*1907. *Kerivoulinae* Miller, Bull. U.S. natl. Mus., 57: 232. Publication date: 29 June 1907. - Comments: Type genus: *Kerivoula* Gray, 1842. Originally included the genera *Kerivoula* J. Gray, 1842 and *Phoniscus* Miller, 1905 (see Caron *et al.*, 2018: 265). (Current Combination)

TAXONOMY:
Known genera in the Kerivoulinae: †***Chamtwaria*** Butler, 1884; ***Kerivoula*** Gray, 1842; *Phoniscus* Miller, 1905.

COMMON NAMES:
Czech: vlnouškové, kerivuly. English: Forest Bats, Woolly bats.

†Genus ***Chamtwaria*** Butler, 1984

*1984. *Chamtwaria* Butler, Palaeovert., 14 (3): 117, 187. Publication date: 15 November 1984 [Goto Description]. (Current Combination)

TAXONOMY:
Was assigned to the Vespertilionidae by Beard *et al.* (1992).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe- Early Miocene (Burdigalian).

Known species in the genus *Chamtwaria*: †***pickfordi*** Butler, 1984.

†***Chamtwaria pickfordi*** Butler, 1984

*1984. *Chamtwaria pickfordi* Butler, Palaeovert., 14 (3): 118, 187, figs 25 A, A'. Publication date: 15 November 1984. Type locality: Kenya: Tinderet (volcano) Region, Songhor, Kapurtay agglomeration: Chamtwara [Goto Description]. - Etymology: Named after Dr. Martin Pickford. (Current Combination)

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola.

Genus ***Kerivoula*** Gray, 1842

*1842. *Kerivoula* Gray, Ann. Mag. nat. Hist., [ser. 1], 10 (65): 258. Publication date: 1 December 1842. - Comments: Type species: *Vespertilio pictus* Pallas, 1767. Gray (1842: 258) mentions *Vesp. Hardwickii Horsfield, V. picta* Pallas, *V. tenuis*, G. Gärtneri [and *Kerivoula griseus, Kerivoula Poensis*]. Type species by subsequent designation (Peters, 1867c) (see Corbet and Hill, 1992: 153). Allen (1939a: 100) mentioned *Vespertilio hardwickii* Horsfield as genotype. - Etymology: Rosevear suggested that *Kerivoula* was derived from the Cingalese name for the Painted Bat, kehel vuhla. Flannery (1995a: 369) indicates that it was derived from the Ceylonese for plantain (banana) bat. (Current Combination)

1849. *Kirivoula* Gervais, Dictionnaire Universelle d'Histoire naturelle, 13: 213. Publication date: 1849. - Comments: Emendation (see Meester *et al.*, 1986: 63). (Emendation)

1861. *Nyctophylax* Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 42: 390 (for 1860). Publication date: 1861. - Comments: "Apparently based on *Vespertilio tralatitius*, Temminck, 1840 =*V. tralatitius* Horsfield, 1824, an indeterminable name according to Laurie and Hill (1954: 66). According to Palmer (1904), *Nyctophylax* was 'a new name for

the barbaric *Kerivoula* Gray, 1842'" (see Corbet and Hill, 1992: 153). Mentioned as a possible synonym (question mark) by Pavlinov *et al.* (1995: 93). - Etymology: From the Greek "*νύξ*" or "*νυκτός*", meaning night and "*φύλαξ*", meaning watcher (see Palmer, 1904: 467).

1870. *Nyctophilax:* Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 62 (1): 544. Publication date: November 1870. (Lapsus)

1891. *Cerivoula* Blanford, The fauna of British India, including Ceylon and Burma. Part II, 338. Publication date: 1891. - Comments: Emendation (see Meester *et al.*, 1986: 63). (Emendation)

1904. *Kehelvoulha* Jentink, Notes Leyden Mus., 24 (4): 175 (for 1902). Publication date: 15 Jul 1904. - Comments: *Nomen nudum*. Jentink (1904: 175) suggests that this should be the etymologically correct name, but adds immediately that this name has no taxonomical value whatsoever.

2005. *Keivoula:* Struebig, Rossiter, Bates, Kingston, Sai Sein Lin Oo, Aye Aye Nwe, Moe Moe Aung, Sein Sein Win and Khin Mya Mya, Acta Chiropt., 7 (1): 14. (Lapsus)

? *Kerivoula sp.:*

TAXONOMY:

Phoniscus Miller, 1906, has been included in *Kerivoula* as either a subgenus (Ellerman and Morrison-Scott, 1951; Ellerman *et al.*, 1953) or a synonym (Ryan, 1965). Hill (1965) argues for the generic separation of *Phoniscus* from *Kerivoula*, and this view appears to be widely accepted (Rosevear, 1965; Hayman and Hill, 1971; Corbet and Hill, 1992), but see Koopman (1982).

The species *aerosa* Tomes, 1858, was described from the east coast of South Africa, but Roberts (1951: 76) questions whether the description is not that of an immature *argentata*, although the colour is reminiscent of *lanosa*; Ellerman *et al.* (1953) point out that the type specimen resembles the Oriental species of *Kerivoula* (in which they include *Phoniscus*) rather than *argentata* or *lanosa*; Hill (1965: 553) has shown that *aerosa* should be transferred to the Asiatic *Phoniscus*. Hayman and Hill (1971) question the African origin of *aerosa*, and Corbet and Hill (1980) dubiously place it in Southeast Asia, while Koopman (1982) cite the provenance as 'possibly Africa'. In view of the considerable doubt about the status and origin of this species it is not treated as a member of the southern African fauna.

Known species of the genus *Kerivoula*: ***africana*** Dobson, 1878; *agnella* Thomas, 1908 – Louisiade Arch., Woodlark and D'Entrecasteaux Isls (Papua New Guinea) (Simmons, 2005: 526); ***argentata*** Tomes, 1861; ***cuprosa*** Thomas, 1912; ***eriophora*** (Heuglin, 1877); *flora* Thomas, 1914 – Borneo, Lesser Sunda Isls, Bali, Sumbawa and Sumba (Indonesia), Vietnam and Thailand (Simmons, 2005: 526); *hardwickii* (Horsfield, 1824) – India and Sri Lanka, Burma, Laos, Cambodia, Vietnam, Thailand, China, western Malaysia, Borneo, Java, Sumatra, Nusa Penida, Mentawai Isls, Sulawesi, Bali, Lesser Sundas, Kangean Isl and Talaud Isl (Indonesia), Philippines (Simmons, 2005: 526); *intermedia* Hill and Francis, 1984 – Borneo, western Malaysia (Simmons, 2005: 527); ***lanosa*** (A. Smith, 1847); *lenis* Thomas, 1916 – northeastern and southern India, western Malaysia, Sabah (Simmons, 2005: 527); *minuta* Miller, 1898 – western Malaysia, southern Thailand, Borneo (Simmons, 2005: 527); *muscina* Tate, 1941 – central New Guinea (Simmons, 2005: 527); *myrella* Thomas, 1914 – Bismarck Arch. (Simmons, 2005: 527); *papillosa* (Temminck, 1840) – Thailand, Cambodia, Vietnam, western Malaysia, Sumatra, Java, Sulawesi, Borneo (Simmons, 2005: 527); *pellucid* (Waterhouse, 1845) – Borneo, Philippines, Java and Sumatra, western Malaysia (Simmons, 2005: 528); ***phalaena*** Thomas, 1912; *picta* (Pallas, 1767) – Sri Lanka; India and Nepal to Vietnam, western Malaysia and southern China, Borneo, Sumatra, Java, Bali, Lombok and Molucca Isls (Simmons, 2005: 528); ***smithii*** Thomas, 1880; *whiteheadi* Thomas, 1894 – Philippines, Borneo, southern Thailand, western Malaysia (Simmons, 2005: 528).

COMMON NAMES:

Czech: praví vlnouškové. English: Woolly Bats, Trumpet-eared Bats. French: Chauves-souris peintes. German: Wollfledermäuse. Italian: Cherìvoule.

ECHOLOCATION:

Keeley *et al.* (2018: 13) indicate that some *Kerivoula* species have fundamental frequencies up to 295 kHz and bandwidths up to 155 kHz, which they link to the absence of grooves in the external ear.

Kerivoula africana Dobson, 1878

*1878. *Kerivoula africana* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, p. xl, 331, ul 335. Publication date: June 1878. Type locality: Tanzania: Coast opposite Zanzibar Island [Goto Description]. - Comments: Type specimen: MNHN ???, ad ♂, alcoholic. (Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: vlnoušek východoafrický, netopýr vlnatý, kerivula africká. English: African Woolly Bat, Tanzanian Woolly Bat. French: Kérivoule de Tanzanie, Chauve-souris peinte de Tanzanie. German: Tanzania-Wollfledermaus.

CONSERVATION STATUS:
Global - MacPhee and Flemming, 1999) considered this species to be extinct, followed by Simmons, 2005), but it was recently rediscovered, see (Burgess *et al.*, 2000). Listed as Endangered (EN B2ab(iii) ver 3.1 (2001)) because its area of occupancy is probably less than 500 km^2, with all individuals in fewer than five locations, and the extent of its forest habitat is continuing to decline (Fahr and Jacobs, 2008; IUCN, 2009).

Assessment History -
2008 - EN B2ab(iii) ver 3.1 (2001) (Fahr and Jacobs, 2008; IUCN, 2009). 2004 - EN B2ab(iii) ver 3.1 (2001) (Fahr and Jacobs, 2004; IUCN, 2004). 1996 - DD (Baillie and Groombridge, 1996). 1994 - Ex (Groombridge, 1994). 1993 - Ex (World Conservation Monitoring Centre, 1993). 1990 - Ex (IUCN 1990). 1988 - Ex (IUCN Conservation Monitoring Centre 1988).

MAJOR THREATS:
It is threatened by the loss of coastal forests, largely through conversion of land to subsistence agriculture and harvesting of timber and firewood for local use (Fahr and Jacobs, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr and Jacobs (2008) [in IUCN (2009)] report that it has been recorded from Morogoro (presumably within the Morogoro State Forest Reserve) and Genda Genda (possibly in a Forest Reserve). There is a need to prevent further loss of coastal forest habitat. Further studies are needed into the distribution of this species to locate additional populations.

GENERAL DISTRIBUTION:
Endemic to eastern Tanzania, where it has only been recorded from Morogoro; the Genda Genda coastal forest; and the Tong'omba coastal forest.

Native: Tanzania (Matschie, 1895; Swynnerton and Hayman, 1951; Cockle *et al.*, 1998; Burgess *et al.*, 2000).

POPULATION:
Structure and Density - Very little is known about the population of this rarely recorded species (Fahr and Jacobs, 2008; IUCN, 2009).
Trend - 2008 - Decreasing (Fahr and Jacobs, 2008; IUCN, 2009).

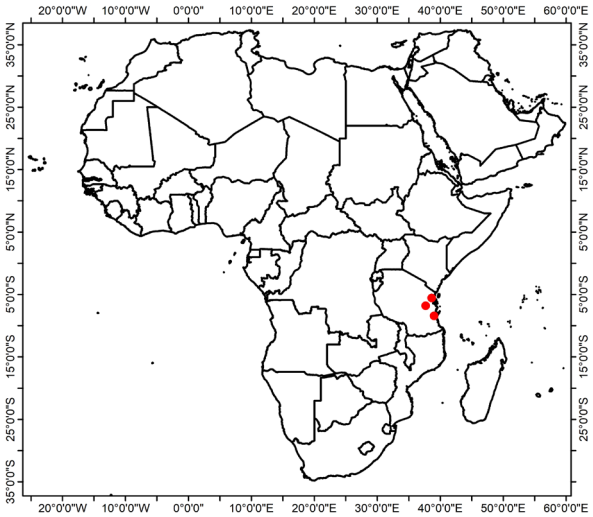


Figure 230. Distribution of *Kerivoula africana*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Tanzania.

Kerivoula argentata Tomes, 1861

*1861. *Kerivoula argentata* Tomes, Proc. zool. Soc. Lond., 1861, I: 31, 32. Publication date: May 1861. Type locality: Namibia: Ovamboland: Otjoro [=Otjihoro] [ca. 17 54 S 15 38 E] [Goto Description]. Holotype: [Unknown] ♀. Collection date: 1 December 1859. See Tomes (1861b: 33). Holotype: BMNH 1907.1.1.540: ♀. Collection date: 1 December 1859. Presented/Donated by: ?: Collector Unknown. - Comments: Ansell and Dowsett (1988: 44) indicate the type locality is probably Otjihoro, according to Shortridge (1934: 70). (Current Combination)

1865. *Nycticejus nidicola* Kirk, Proc. zool. Soc. Lond., 1864, III: 651. Publication date: May 1865. Type locality: Mozambique: Zambesi River: Shupanga [=Chupanga] [18 02 S 35 37 E] [Goto Description]. Syntype: BMNH 1864.1.9.37: ad. Collected by: Dr. Kirk. Syntype: BMNH 1864.1.9.38: ad. Collected by: Dr. Kirk. Syntype: BMNH 1864.1.9.39: ad. Collected by: Dr. Kirk. - Comments: (1 ad ♂ + 2 ad ♀♀). Considered a valid subspecies by Ansell and Dowsett (1988: 44.

1924. *Kerivoula nidicola zuluensis* Roberts, Ann. Transv. Mus., 10: 61. Publication date: 31 January 1924. Type locality: South Africa: KwaZulu-Natal: White Umfolosi River [28 19 S 31 50 E] [Goto Description]. Holotype: TM 3025: ad ♂, skin and skull. Collected by: Austin Roberts; collection date: 17 July 1922. Note: In weaver nest with two others. - Comments: Considered a valid subspecies by Taylor (1998: 57).

? *Kerivoula argentata argentata:* (Name Combination)

? *Kerivoula argentata zuluensis:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Afrikaans: Damara-wolhaarvlermuis, Damaralandse Wolhaarvlermuis. Chinese: 银彩蝠. Czech: vlnoušek damarský. English: Silvery Woolly Bat, Silvered Woolly Bat, Silver Woolly Bat, Damara Woolly Bat. French: Chauve-souris peinte argentée, Chauve-souris laineuse du Damara. German: Bunte Wollfledermaus. Kiluba (DRC): Kasusu. Portuguese: Morcego lanoso da Damaralandia.

ETYMOLOGY OF COMMON NAME:
This species was originally described from a specimen from Damaraland, Namibia (Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
K. argentata may be represented in the late Holocene at Nkupe, South Africa (Avery, 1991: 6).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008k; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008k; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004h; IUCN, 2004). 1996 - Lower Risk/least concern (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT C2a(i) ver 3.1 (2001) (Monadjem *et al.*, 2016f). 2004 - EN B1ab(iii)+2ab(iii) ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Jacobs *et al.*, 2008k; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008k) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It has been recorded from the Kambai Forest Reserve in Tanzania by Cunneyworth (1996b), and seems likely to be present in a number of protected areas within its range. Further studies are needed to determine if the species is truly present in Angola.

GENERAL DISTRIBUTION:
Kerivoula argentata is distributed in East Africa and southern Africa, with some records in southern parts of the Democratic Republic of the Congo and possibly northern Angola in Central Africa (records are uncertain from this country). In East Africa it has been recorded from Kenya and Tanzania in the north, through Zambia, Malawi and Mozambique. In southern Africa, it appears to be widespread in Zimbabwe, with additional scattered records from northeastern South Africa and central Namibia.

For southern Africa, Cooper-Bohannon *et al.* (2016: "5") calculated a potential distribution area of 752,853 km^2.

Native: Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 563); Kenya (Aggundey and Schlitter, 1984); Malawi (Happold and Happold, 1997b: 822; Monadjem *et al.*, 2010d: 563); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 563; Monadjem *et al.*, 2010c: 383); Namibia (Monadjem *et al.*, 2010d: 563); South Africa (Roberts, 1951; Smithers, 1983; Skinner and Smithers, 1990; Taylor, 2000; Skinner and Chimimba, 2005; Monadjem *et al.*, 2010d: 563); Tanzania, United Republic of (Cunneyworth, 1996b); Zambia (Ansell, 1974; Monadjem *et al.*,

2010d: 563); Zimbabwe (Smithers and Wilson, 1979; Monadjem *et al.*, 2010d: 563).

Presence uncertain: Angola (Hill and Carter, 1941), although Taylor *et al.* (2018b: 63) predict it might occur in that country.

ECHOLOCATION:
See Taylor (1999b).

Schoeman and Waddington (2011: 291) mention a peak frequency of 99 kHz and a duration of 1.7 msec for a specimen from the Mkuze Game Reserve, South Africa.

POPULATION:
Structure and Density - Although this species is rarely encountered, it is not thought to be especially uncommon (Jacobs *et al.*, 2008k; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008k; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Trentin and Rovero (2011: 51) reported two lactating females, captured at Uzungwa Scarp Forest Reserve, Tanzania, at the end of November 2005.

VIRUSES:
Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that the one specimen they examined from South Africa tested positive for *Paramyxovirus* sequences.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Kenya, Malawi, Mozambique, Namibia, Senegal, South Africa, Tanzania, Zambia, Zimbabwe.

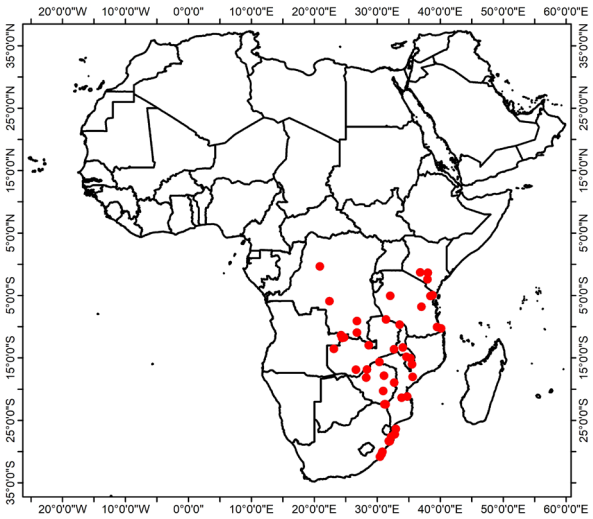


Figure 231. Distribution of *Kerivoula argentata*

Kerivoula cuprosa Thomas, 1912

*1912. *Kerivoula cuprosa* Thomas, Ann. Mag. nat. Hist., ser. 8, 10 (55): 41. Publication date: 1 July 1912. Type locality: Cameroon: Ja River: Bitye [03 13 N 12 22 E, 2 000 ft] [Goto Description]. Holotype: BMNH 1912.10.25.1: ad ♂. Collected by: George Latimer Bates Esq. Collection date: 17 October 1911; original number: 564. (Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: vlnoušek bronzový. English: Copper Woolly Bat. French: Chauve-souris laineuse cuivrée, Chauve-souris peinte cuivrée. German: Kupferfarbene Wollfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing problems with its taxonomy as well as absence of recent information on its extent of occurrence, ecological requirements and threats (Fahr, 2008b; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Fahr, 2008b; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Fahr, 2004m; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not well known. In parts of its range it is presumably threatened to some degree by habitat loss resulting from conversion of land to agricultural use, and harvesting of timber and firewood (Fahr, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008b) [in IUCN (2009)] reports that jt is unclear if this species is present in any protected areas. Additional studies are needed into the taxonomy, distribution, natural history and threats to this little known bat.

GENERAL DISTRIBUTION:
Scattered records from West and Central Africa. It has apparently been reported from Guinea, Côte

d'Ivoire, Liberia, possibly Ghana (see Koopman *et al.*, 1995; Grubb *et al.*, 1998), Cameroon and the Democratic Republic of the Congo (see Hayman and Hill, 1971). It is found up to 600 m asl.

Grubb *et al.* (1998: 92) indicate that records west of Cameroon are erroneous and probably refer to a specimen from Oda, Ghana in the FMNH that was re-identified as *K. lanosa muscilla*. A record of this species from Kenya was based on a specimen subsequently reidentified as *Kerivoula smithii* (J. Fahr *pers. Comm.,* in Simmons, 2005: 526; and also in Fahr (2008b) [in IUCN (2009)]).

Native: Cameroon; Congo (The Democratic Republic of the); Côte d'Ivoire; Guinea (Fahr and Ebigbo, 2004: 69); Kenya (Harrison, 1957b); Liberia (Koopman, 1989b; Koopman *et al.*, 1995); Uganda (Kityo *et al.*, 2009: 135).
Presence uncertain: Ghana.

POPULATION:
Structure and Density - It appears to be a rare, or rarely recorded, species (Fahr, 2008b; IUCN, 2009).

Trend - 2008 - Unknown (Fahr, 2008b; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Côte d'Ivoire.

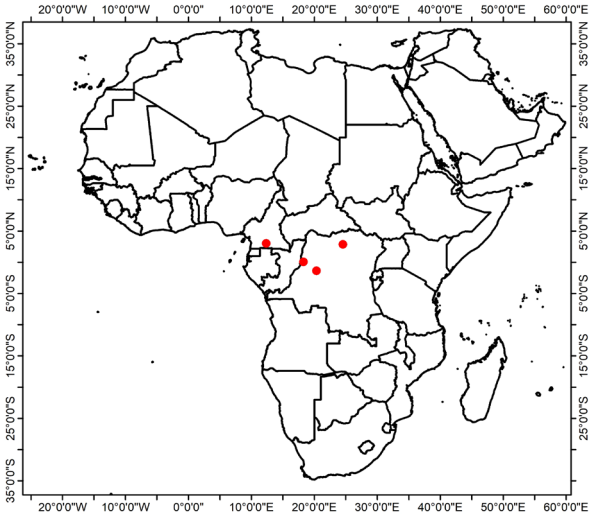


Figure 232. Distribution of *Kerivoula cuprosa*

Kerivoula eriophora (Heuglin, 1877)

*1877. *Nycticejus eriophorus* Heuglin, Reise in Nordost Afrika, 2: 34. Publication date: 1877. Type locality: Ethiopia: Begemdir province: Belegaz Valley: Semian and Wogara, between [ca. 12 50 N 38 20 E] [Goto Description]. - Etymology: From the Greek "*eriophora*" meaning wool-bearing.
? *Kerivoula eriophora:* (Name Combination, Current Combination)

TAXONOMY:
May be conspecific with *africana* which it antedates; see Hayman and Hill (1971: 53) and Simmons (2005: 526).

COMMON NAMES:
Czech: vlnoušek habešský. English: Ethiopian Woolly Bat. French: Chauve-souris laineuse d'Ethiopie, Chauve-souris peinte d'Ethiopie. German: Heuglins Wollfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing problems with its taxonomy as well as absence of recent information on its extent of occurrence, ecological requirements and threats (Fahr, 2008c; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Fahr, 2008c; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Fahr, 2004p; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not known (Fahr, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008c) [in IUCN (2009)] reports that it is not known if the species is present in any protected areas. Further research is needed into the systematic status, distribution, natural history and possible threats to this species.

GENERAL DISTRIBUTION:
Kerivoula eriophora has only been recorded at the type locality of 'between Semian and Wogara, Belegaz Valley, Ethiopia'.

Native: Ethiopia (Heuglin, 1877: 34).

POPULATION:
Structure and Density - It is known only from the holotype (Fahr, 2008c; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008c; IUCN, 2009).

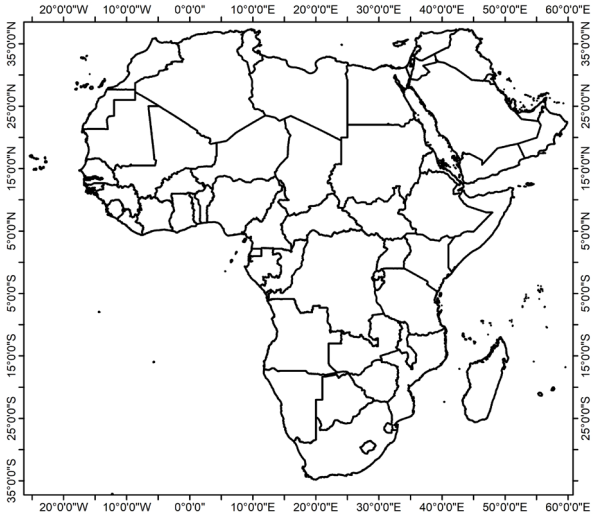


Figure 233. Distribution of *Kerivoula eriophora*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: South Sudan.

Kerivoula lanosa (A. Smith, 1847)

*1847. *Vespertilio lanosus* A. Smith, Illustrated Zoology of South African Mammals, pl. 50 and text. Publication date: December 1847. Type locality: South Africa: Cape province: Cape Town, 200 mi (332 km) E. Syntype: BMNH 1907.1.1.538: ♂. Syntype: BMNH 1907.1.1.539:. - Comments: Thorn *et al.* (2009: 50) indicate that Roberts (1951: 75) designated Knysna as type locality. - Etymology: From the Greek "*lanosa*" meaning woolly.

1878. *Kerivoula brunnea* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, xl, 331, 334. Publication date: June 1878. Type locality: South Africa: "South Africa or Madras" [Goto Description]. Holotype: BMNH 1852.8.12.9: sad ♂, alcoholic (skull not removed). Presented/Donated by: Sir Andrew Smith. - Comments: Roberts (1951: 75) mentioned "Madras or South Africa as type locality. Sir A. Smith (Obviously the type of Smith's *V. Lanosus*, cf. Roberts, 1913: Knysna)". Meester *et al.* (1986: 64) mention "South Africa or Madras").

1901. *Kerivoula harrisoni* Thomas, Proc. zool. Soc. Lond., 1900, IV: 802, footnote. Publication date: April 1901. Type locality: Ethiopia: between Lakes Zwai and Margherita [=Lake Abaya]: Walamo [c. 07 00 N 38 00 E,, 6 700 ft] [Goto Description]. Holotype: BMNH 1900.11.4.1: Collected by: J.J. Harrison; collection date: 21 February 1900. Presented/Donated by: J.J. Harrison.

1906. *Kerivoula muscilla* Thomas, Ann. Mag. nat. Hist., ser. 7, 18 (106): 294. Publication date: 1 October 1906. Type locality: Cameroon: Ja River [ca. 03 00 N 13 00 E] [Goto Description]. Holotype: BMNH 1908.6.23.10: ad ♂. Collected by: George Latimer Bates Esq. Collection date: 22 December 1905. Presented/Donated by: ?: Collector Unknown. - Comments: Considered a valid subspecies by Fahr and Ebigbo (2003: 128; 2004: 73).

1920. *Kerivoula lucia* Hinton, Ann. Mag. nat. Hist., ser. 9, 6 (32): 240. Publication date: 1 August 1920. Type locality: Zimbabwe: N'dola. [12 50 S 28 40 E] [Goto Description]. Holotype: BMNH 1920.11.3.27: ad ♂. Collected by: Captain Guy Chester Shortridge; collection date: 26 September 1919; original number: 472.

1922. *Kerivoula lueia* Kershaw, Ann. Mag. nat. Hist., ser. 9, 10 (55): 99. Publication date: 1 July 1922. - Comments: Erratum (see Meester *et al.*, 1986: 64).

1959. *Kerivoula harrisoni bellula* Aellen, Archs Sci. Genève, 12 (2): 221. Type locality: Côte d'Ivoire: NW of Abidjan: Adiopodoumé [05 19 N 04 08 W, 0 - 30 m] [Goto Description]. Holotype: MHNG 965.038: ad ♂, alcoholic (skull not removed). Collected by: Dr. Villy Aellen; collection date: 20 July 1953; original number: 622.

? *Kerivoula harrisoni lucia:* (Name Combination)

? *Kerivoula lanosa harrisoni:* (Name Combination)

? *Kerivoula lanosa lucia:* (Name Combination)

? *Kerivoula lanosa muscilla:* (Name Combination)

? *Kerivoula lanosa:* (Name Combination, Current Combination)

TAXONOMY:
Includes *harrisoni* and *muscilla*; see Hill (1977b), but see Fahr and Ebigbo (2003: 128; 2004: 73).

COMMON NAMES:
Afrikaans: Klein wolhaarvlermuis. Chinese: 小彩蝠. Czech: vlnoušek malý. English: Lesser Woolly Bat. French: Petite Chauve-souris laineuse, Chauve-souris laineuse. German: Kleine Wollfledermaus. Portuguese: Morcego lamoso Harrison.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008l; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004a; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016g). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species (Jacobs *et al.*, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008l) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Further studies are needed to better understand the taxonomic status of *Kerivoula lanosa*.

GENERAL DISTRIBUTION:
Kerivoula lanosa has been recorded across sub-Saharan Africa, from Liberia and Guinea in the west, to Ethiopia and Kenya in the east, and ranging as far south as southern South Africa. In the latter country, its distribution is mainly affected by temperature seasonality (Babiker Salata, 2012: 49).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 636,522 km^2.

Native: Angola (Monadjem *et al.*, 2010d: 563; Taylor *et al.*, 2018b: 63); Botswana (Monadjem *et al.*, 2010d: 563); Central African Republic; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 563); Côte d'Ivoire; Ethiopia (Kruskop and Lavrenchenko, 2009: 72 - first record in over a 100 years); Gabon; Ghana; Guinea (Fahr and Ebigbo, 2003: 128); Kenya; Liberia; Malawi (Ansell and Dowsett, 1988; Monadjem *et al.*, 2010d: 563); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 563; Monadjem *et al.*, 2010c: 383); Nigeria (Happold, 1987); South Africa (Roberts, 1951; Smithers, 1983; Skinner and Smithers, 1990; Taylor, 1998; Skinner and Chimimba, 2005; Monadjem *et al.*, 2010d: 563); Swaziland (Monadjem *et al.*, 2010d: 563); Tanzania; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 563); Zimbabwe (Cotterill, 1996a; Monadjem *et al.*, 2010d: 563).
Presence uncertain: Namibia (Cotterill, 2004a: 262; Monadjem *et al.*, 2010d: 563).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 28, FN = 50, BA = 24, a metacentric X chromosome, and an acrocentric Y chromosome, for specimens from South Africa.
Protein / allozyme - Unknown.

ROOST:
In the southern part of the Kruger Park, Pienaar (1964: 12) indicated that it is said that it often used disused nests of weaver birds, but he could not confirm this without doubt.

POPULATION:
Structure and Density - There appears to be little information available on the population abundance of this species (Jacobs *et al.*, 2008l; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008l; IUCN, 2009).

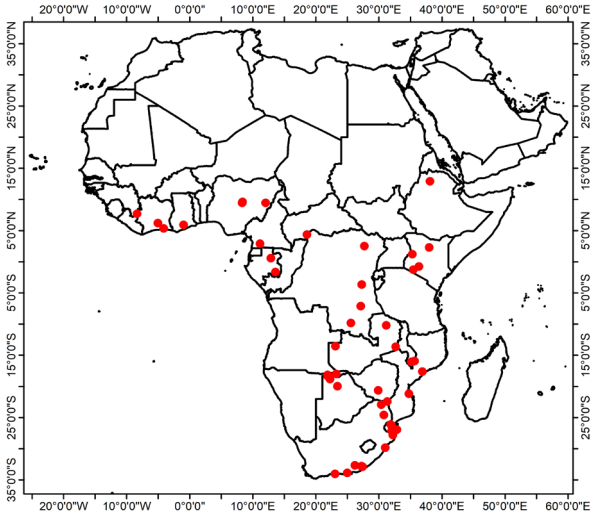


Figure 234. Distribution of *Kerivoula lanosa*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Botswana, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Mozambique, Namibia, Nigeria, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe.

Kerivoula phalaena Thomas, 1912

*1912. *Kerivoula phalæna* Thomas, Ann. Mag. nat. Hist., ser. 8, 10 (57): 281. Publication date: 1 September 1912. Type locality: Ghana: Western province: Inland from Denkwa: Bibianaha [=Bibiani] [06 28 N 02 20 W, 720 ft] [Goto Description]. Holotype: BMNH 1912.6.20.3: ad ♀. Collected by: Dr. H.G.F. Spurrell; collection date: 24 April 1912; original number: 224. Presented/Donated by: Dr. H.G.F. Spurrell. - Etymology: From the Greek "*phalaena*" meaning whale. (Current Combination)
1973. *Kerivoula phalaema:* Eisentraut, Bonn. zool. Monogr., 3: 46. (Lapsus)
2010. *Kerivoula cf. phalaena:* Monadjem, Schoeman, Reside, Pio, Stoffberg, Bayliss, Cotterill, Curran, Kopp and Taylor, Acta Chiropt., 12(2): 383.
? *Kerivoula phalaena:* (Current Spelling)

TAXONOMY:
See Simmons (2005: 528).

COMMON NAMES:
Czech: vlnoušek západoafrický. English: Spurrell's Woolly Bat, Spurell trumpet-eared bat. French: Chauve-souris à oreilles en trompette de Spurell, Chauve-souris peinte phalène, Chauve-souris à oreilles en trompette de Spurell. German: Spurrells Wollfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr, 2008d; Fahr, 2008d).

Assessment History -
2008 - LC ver 3.1 (2001) (Fahr, 2008d; Fahr, 2008d). 2004 - NT ver 3.1 (2001) (Fahr, 2004l; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are poorly known. Koopman *et al.* (1995) mention that this one of seven bat species from Liberia that have not been recorded from the lowland since 1965, and that it might have declined because of deforestation, although this may instead just indicate vagaries of collection within this country (Fahr, 2008d; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008d) [in IUCN (2009)] reports that it is not known if the species is present within any protected areas. Additional studies are needed into the distribution, abundance, natural history and threats to this little known species.

GENERAL DISTRIBUTION:
Recorded from Guinea, Liberia, Côte d'Ivoire and Ghana in West Africa; and from Cameroon, the Democratic Republic of the Congo to western Uganda in Central Africa.

Native: Cameroon; Congo (The Democratic Republic of the); Côte d'Ivoire; Ghana; Guinea

(Fahr and Ebigbo, 2004: 69); Liberia (Kuhn, 1965; Koopman *et al.*, 1995; Rwanda; Uganda.
Presence uncertain: Mozambique (Monadjem *et al.*, 2010c: 383, recorded as *K.* cf. *phalaena*).

HABITAT:
Monadjem *et al.* (2016y: 368) collected this bat in forested habitats in the Mount Nimba area, at altitudes between 450 and 700 m.

POPULATION:
Structure and Density - It appears to be a rare species that is known only from 14 localities (Fahr, 2008d; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008d; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Gabon, Ghana, Liberia, Uganda.

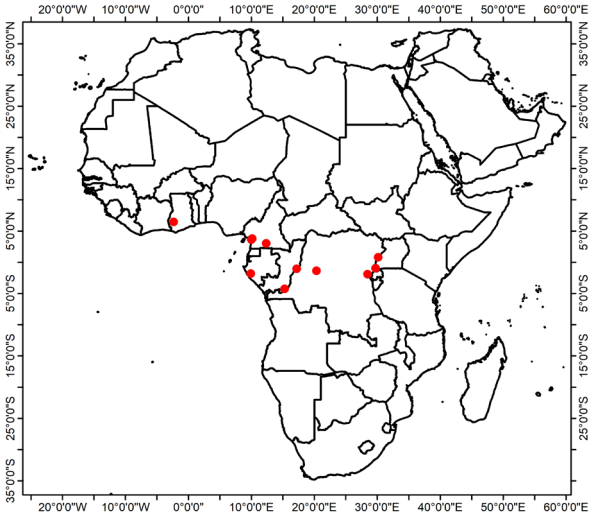


Figure 235. Distribution of *Kerivoula phalaena*

Kerivoula smithii Thomas, 1880

*1880. *Kerivoula Smithii* Thomas, Ann. Mag. nat. Hist., ser. 5, 6 (32): 166, text-fig. Publication date: 1 August 1880. Type locality: Nigeria: Eastern region: Old Calabar [04 56 N 08 22 E]. Holotype: BMNH 1880.7.21.9: Collected by: Dr. A. Robb. Presented/Donated by: Dr. J.A. Smith. - Etymology: In honour of Dr. J.A. Smith, who presented to the type specimen to the British Museum of Natural History. (Current Combination)
? *Kerivoula smithi:* (Alternate Spelling)
? *Kerivoula smithii:* (Current Spelling)

TAXONOMY:
See Simmons (2005: 528).

COMMON NAMES:
Chinese: 史密斯彩蝠. Czech: vlnoušek guinejský. English: Smith's Woolly Bat. French: Chauve-souris peinte de Smith. German: Smith's Wollfledermaus. Italian: Cherìvoula di Smith.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Fahr, 2008e; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Fahr, 2004a; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species (Fahr, 2008e; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008e) [in IUCN (2009)] reports that it is not known if the species is present within any protected areas. Further studies are needed into the distribution, abundance, and general ecology of this apparently rare species.

GENERAL DISTRIBUTION:
Kerivoula smithii is known from scattered records in a distribution band ranging from Nigeria and Cameroon in the west, through the Democratic Republic of the Congo, to Uganda and Kenya in the east. It has been recorded at elevations of 900 to 2,800 m asl.

Fahr (2007a: 105) indicates that the specimens from Liberia mentioned by Happold (1987: 349) and Koopman *et al.* (1995) are actually representatives of *K. phalaena*. J. Fahr *pers. comm.* [in Simmons (2005: 528)] also suggests that records from Côte d'Ivoire (Happold, 1987: 349) appear to be in error.

Native: Cameroon; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966); Kenya (Harrison, 1963c; Aggundey and Schlitter, 1984) ; Nigeria (Happold, 1987: 77); Uganda.

Presence uncertain: Côte d'Ivoire (Happold, 1987: 349).

ECHOLOCATION:
Eisenring *et al.* (2016: SI 2) reported the following values for 14 calls from the Aberdares Range in Kenya: PF: 95.9 ± 6.2 (81.5 - 104.9), HF: 126.3 ± 7.2 (115.6 - 137.2), LF: 65.3 ± 13.2 (44.9 - 91.8), DT: 0.0 ± 0.0 (0.0 - 0.1), DF: 61.0 ± 16.5 (25.1 - 85.5), IPI: 0.2 ± 0.1 (0.1 - 0.6).

POPULATION:
Structure and Density - This species has been very rarely recorded (Happold, 1987: 77; Fahr, 2008e; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008e; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Central African Republic, Congo (Democratic Republic of the), Kenya, Nigeria, Tanzania, Uganda.

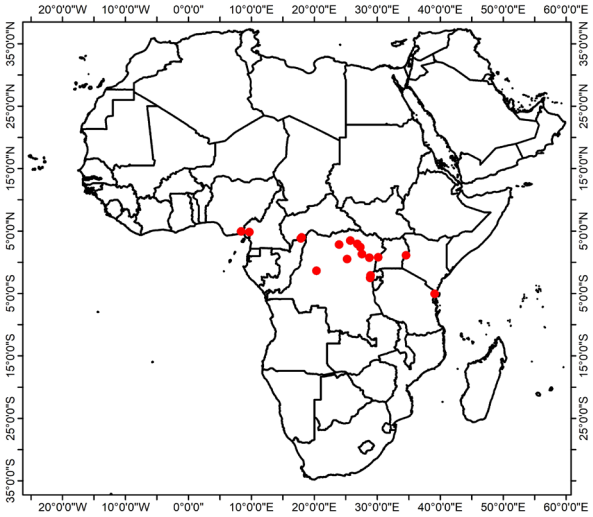


Figure 236. Distribution of *Kerivoula smithii*

Subfamily Myotinae Tate, 1942

*1942. *Myotinae* Tate, Bull. Am. Mus. Nat. Hist., 80 (7): 221, 229. Publication date: 27 November 1942. - Comments: Type genus: *Myotis* Kaup, 1829. (Current Combination)

1942. *Myotini* Tate, Bull. Am. Mus. Nat. Hist., 80 (7): 221, 229. Publication date: 27 November 1942. - Comments: Type genus: *Myotis* Kaup, 1829. Introduced as tribe, and originally included the genera *Myotis* Kaup, 1829; *Lasionycteris* Peters, 1865; *Plecotus* É. Geoffroy, 1818; *Corynorhinus* H. Allen, 1865; *Idionycteris* Anthony, 1923; and *Euderma* H. Allen, 1891 (see Jackson and Groves, 2015: 280).

1987. *Leuconoformes* Menu, Palaeovert., 17 (3): 77, 5992, 133. Publication date: 31 March 1987. - Comments: Type genus: *Leuconöe* Boie, 1830. Introduced with unclear rank, and originally included the genera *Leuconöe* Boie, 1830 [= *Myotis* Kaup, 1829]; *Pizonyx* Miller, 1906 [= *Myotis* Kaup, 1829]; and *Perimyotis* Menu, 1984 (see Jackson and Groves, 2015: 280).

1998. *Myotinae:* Simmons, in: Kunz, T. H.; Racey, P. A., A reappraisal of interfamilial relationships of bats., 12. - Comments: Type genus: *Myotis* Kaup, 1829.

2005. *Myotiinae:* Ramírez-Pulido, Arroyo-Cabrales, and Castro-Campillo, Acta Zool. Mex. (ns), 21 (1): 31. - Comments: Ramírez-Pulido *et al.* (2005) refer to Simmons (1998) for Myotiinae, but Simmons (1998: 5) uses the correct spelling (Myotinae). (Lapsus)

TAXONOMY:
Tate (1942: 229) originally named Myotini as a tribe within Vespertilioninae, in which he included the genera *Myotis*, *Lasionycteris*, *Plecotus*, *Corynorhinus*, *Idionycteris* and *Euderma*. Although Tate (1942: 230) noted that the latter four genera might alternatively be referred to their own tribe Plecotini. This suggestion was followed by subsequent authors, and Myotini has been restricted to *Myotis* and *Lasionycteris* in recent classifications (e.g. Hill and Harrison, 1987; Koopman, 1994). Volleth and Heller (1994) described karyological data which indicate that Myotini represents a lineage distinct from Vespertilioninae, and therefore they suggested that Myotini be raised to the rank of subfamily. Despite their suggestion, Volleth and Heller (1994) did not use the name Myotinae in their publication, so formal usage of the name at the subfamily rank dates from Simmons (1998: 3, 5), who raised it to the subfamily level, and followed in recent classifications (e.g., Bannikova *et al.*, 2002: 722; Hoofer and Van Den Bussche, 2003: 21).
May not be monophyletlic; see Hoofer and Van Den Bussche (2001), and Simmons (2005). Hoofer and Van Den Bussche (2003: 21) and Roehrs *et al.* (2010: 1081) only include the members of the genus *Myotis*, (not *Lasionycteris* nor *Cistugo*).

Known genera of the subfamily Myotinae: †***Khonsunycteris*** Gunnell, Simons and Seiffert, 2008; ***Myotis*** Kaup, 1829.

COMMON NAMES:
Czech: netopýrcové.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Ruedi *et al.* (2013: 446-447) doubt the African origin of the Myotinae as proposed by Gunnell *et al.* (2012), and their molecular phylogeny points to eastern Asia as the cradle of *Myotis* evolution.

Gunnell *et al.* (2017: 14) suggest that the basal myotines (e.g. *Khonsunycteris*) originated in northern Africa in the Late Eocene, followed by the appearance of *Myotis* in the early Oligocene of Europe. The fact that they found a plecotine bat (*Quinetia misonnei*) in the same Belgian location, furthermore suggests that the vespertilionid subfamilies Vespertilioninae and Myotinae had already diverged by 33.5 MYA.

The discovery of the southernmost and oldest record of *Myotis podlesicensis* Kowalski, 1956 in Europe (Spain; Late Miocene) by Crespo *et al.* (2017: 324) provides support for an African origin of this taxon.

†Genus ***Khonsunycteris*** Gunnell, Simons and Seiffert, 2008

*2008. *Khonsunycteris* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 3, 8. - Comments: Type species - *Khonsunycteris aegypticus* Gunnell, Simons and Seiffert, 2008. - Etymology: Khonsu, Egyptian God of the Moon, in reference to the nocturnal habits of vesper bats (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

Gunnell *et al.* (2017: 9) indicate that *Khonsunycteris* might be the earliest known myotine bat.

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

†***Khonsunycteris aegypticus*** Gunnell, Simons and Seiffert, 2008

*2008. *Khonsunycteris aegypticus* Gunnell, Simons and Seiffert, J. Vert. Paleont., 28 (1): 3, 8, fig. 8. Type locality: Egypt: Fayum Depression: Quarry L-41: Lower Sequence, Jebel Qatrani Formation. Holotype: CGM 83673: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Left dentary c1-m2. - Comments: latest Eocene, Priabonian. - Etymology: Name for Egypt (Gunnell *et al.*, 2008). (Current Combination)

TAXONOMY:
See Gunnell *et al.* (2008).

SIMILAR SPECIES:
See Gunnell *et al.* (2008).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
See Gunnell *et al.* (2008).

GENERAL DISTRIBUTION:
Egypt (Gunnell *et al.*, 2008).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Gunnell *et al.* (2008).

Genus ***Myotis*** Kaup, 1829

*1829. *Myotis* Kaup, Skizzierte Entwicklungs-Geschichte Natürliche Systematik der Europäische Thierwelt, 1: 106. Publication date: 1829. - Comments: Type species: *Vespertilio myotis* Borkhausen, 1797, by subsequent designation by Miller (1912: 167). Kaup (1829: 106) mentioned *Vespertilio murinus*, but for a discussion on the type species, see Jackson and Groves (2015: 280). - Etymology: From the Greek "*μύς*" or "*μυός*", meaning mouse and

"*ούς*" or "*ώτός*" meaning ear (see Palmer, 1904: 442). Gardner (2005:184) considers the name to be masculine (My = mouse + ot = ear(ed) + is (Latin third declension ending)).

1829. *Nystactes* Kaup, Skizzirte Entwicklungs-Geschichte Natürliche Systematik der Europäische Thierwelt, 1: 108. Publication date: 1829. - Comments: Type species: *Vespertilio bechsteini* Kuhl, 1819. Jackson and Groves (2015: 281) indicate that this name is an objective synonym of *Paramyotis* Bianchi. Not *Nystactes* Gloger, 1827 (Aves, Piciformes, Bucconidae). - Etymology: From the Greek "*νυστακτής*", meaning the one who nods, a sleeper (see Palmer, 1904: 467).

1830. *Leuconoe* Boie, Isis oder Encyclopädische Zeitung von Oken, 256. Publication date: 1830. - Comments: Type species: *Vespertilio daubentonii* Kuhl, 1817. Considered a valid genus based on tooth morphology: see Menu (1985, 1987) in Menu *et al.* (2002: 320).

1841. *Capaccinius* Bonaparte, Iconografia Fauna italiana, 1: Indice Distributivo: 1. - Comments: Type species: *Vespertilio megapodius* Temminck, 1840 [=*Vespertilio capaccinii* Bonaparte, 1837], by tautonomy (see Jackson and Groves, 2015: 281). - Etymology: In honour of Francesco Capaccini, under secretary of state of Rome about 1833-34, and a patron of Bonaparte's "Iconografia della Fauna Italica," published in 1832-1841 (see Palmer, 1904: 49).

1841. *Selysius* Bonaparte, Iconografia Fauna italiana, 1: Mamm., Introd.: 3. Publication date: 1841 [Goto Description]. - Comments: Type species: *Vespertilio mystacinus* Kuhl, 1817, by monotypy (see Jackson and Groves, 2015: 281). - Etymology: In honour of Baron Edmond de Selys-Longchamps, 1813 - 1900, an eminent naturalist and statesman, some time president of the Belgian Senate; author of "Etudes de Micromammalogie," 1839, and "Faune Belge," 1844 (see Palmer, 1904: 51).

1842. *Trilatitus* Gray, Ann. Mag. nat. Hist., [ser. 1], 10 (65): 258. Publication date: 1 December 1842. - Comments: type species: *Vespertilio hasseltii* Temminck, 1840, by subsequent designation (see Jackson and Groves, 2015: 281). Included *Vespertilio hasselti* Temminck, *M. macellus* Temminck, and *V. blepotis* Temminck (a *Miniopterus*) (see Hall and Kelson, 1959: 159; Hall, 1981: 183; Corbet and Hill, 1992: 119).

1843. *Vespertilio* Gray, Cat. specs mamm., xix, 26. Publication date: 13 May 1843. - Comments: Type species: *Vespertilio mystacinus* Kuhl, 1817, by monotypy according to Jackson and Groves (2015: 281). Not Linnaeus, 1758, nor *Vespertilio* Mörch, 1852 (Mollusca, Neogastropoda, Volutidae) (see Jackson and Groves, 2015: 281).

1849. *Tralatitus:* Gervais, Dictionnaire Universelle d'Histoire naturelle, 13: 213. - Comments: A lapsus for *Trilatitus* (see Hall, 1981: 183). Modification of *Trilatitus* (see Ellerman and Morrison-Scott, 1951: 137; Meester *et al.*, 1986: 47). Incorrect subsequent spelling (see Jackson and Groves, 2015: 281). (Lapsus)

1856. *Brachyotus* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Type species: *Vespertilio mystacinus* Kuhl, 1817, by subsequent designation by Ellerman and Morrison-Scott (1951: 137) (see Jackson and Groves, 2015: 281). Preoccupied by *Brachyotus* Gould, 1837 (Aves, Strigiformes, Strigidae) (see Allen, 1939a: 89; Hall, 1981: 183; Corbet and Hill, 1992: 119; Pavlinov *et al.*, 1995: 95; Jackson and Groves, 2015: 281). Based on *V. mystacinus*, *daubentonii* and *dascyneme* (see Allen, 1939a: 89).

1856. *Isotus* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Type species: *Vespertilio nattereri* Kuhl, 1817. Considered a valid subgenus by Pavlinov *et al.* (1995: 95). - Etymology: From the Greek "*ίσος*", meaning equal and "*ούς*" or "*ώτός*", meaning ear (see Palmer, 1904: 354).

1856. *Myotus:* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Incorrect subsequent spelling (see Palmer, 1904: 442; Jackson and Groves, 2015: 282). (Lapsus)

1866. *Tralatitius:* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 90. Publication date: 1 February 1866. - Comments: Lapsus for *Trilatitus* Gray (seeHall, 1981: 183). Modification of *Trilatitus* (see Ellerman and Morrison-Scott, 1951: 137; Meester *et al.*, 1986: 47). (Lapsus)

1867. *Vespertilio (Pternopterus)* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 706. Publication date: 1867. - Comments: Type species: *Vespertilio (Pternopterus) lobipes* Peters, 1867 (=*Vespertilio muricola* Gray, 1846).

1868. *Pternopterus* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1867: 706. - Comments: Type species: *Vespertilio (Pternopterus) lobipes* Peters, 1867 [= *Myotis muricola* (J. Gray, 1846)] by monotypy (see Jackson and Groves, 2015: 282).

1870. *Aëorestes* Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 62 (1): 427. Publication date: October 1870. - Comments: Based upon *Vespertilio villosissimus* E. Geoffroy, 1806, *albescens* E. Geoffroy, 1806, *laevis* I. Geoffroy, 1824 and *nigricans* Schinz, 1821 (see Allen, 1939a: 90; Hall, 1981: 183 [who excludes *laevis*]). Hill (in litt. In Meester *et al.*, 1986: 48) pointed out that *villosissimus* is a member of *Lasiurus* Gray, 1831, but all others are indeed *Myotis* representatives. If *villosissimus* can be regarded as the type species of *Aeorestes*, it should instead be included in *Lasiurus* (Meester *et al.*, 1986: 48). Hoofer and Van Den Bussche (2003: 25) consider *Aeorestes* a valid subgenus, including all of the New World species.

1870. *Comastes* Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 62 (1) 9: 565. Publication date: 1870. - Comments: Type species: *Vespertilio capaccinii* Bonaparte, 1837, by subsequent designation (see Jackson and Groves, 2015: 282). Based upon *Vespertilio capaccinii* Bonaparte, *megapodius*, *dasycneme* Boie, *limnophilus* (see Allen, 1939a: 90). Based upon *Vespertilio capaccinii* and *dasycneme* according to Hall and Kelson (1959: 159) and Hall (1981: 183). Not *Comastes* Jan, 1863 (Reptilia, Squamata, Colubridae) (see Jackson and Groves, 2015: 282). - Etymology: From the Greek "*κωμαστής*", meaning reveler, probably referring to the animal's nocturnal habits (see Palmer, 1904: 197).

1870. *Exochurus* Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 62 (1) 6: 75. Publication date: 1870. - Comments: Type species: *Vespertilio macrodactylus* Temminck, 1840, by subsequent designation (see Jackson and Groves, 2015: 282). Not of Kolenati (1858). Based upon *Vespertilio macrodactylus* Temminck, *V. horsfieldii* Temminck, and *V. macrotarsus* Waterhouse (see Hall, 1981: 183; Corbet and Hill, 1992: 119). Not of Kolenati, 1858: see Cabrera (1914: 91). - Etymology: From the Greek "*εξοχος*", meaning standing out and "*ούρά*", meaning tail (see Palmer, 1904: 284).

1899. *Euvespertilio* Acloque, Faune de France, Mammifères, 38. - Comments: Includes *Vespertilio emarginatus* Geoffroy, *murinus* Schreber =*myotis* Borkhausen, *mystacinus* Kuhl, *nattereri* Kuhl, and *bechsteinii* Kuhl. Hall and Kelson (1959: 159) and Hall (1981: 183) state that *Euvespertilio* includes *emarginatus* and *murinus* in a composite sense.

1906. *Pizonyx* Miller, Proc. Biol. Soc. Wash., 19: 85. Publication date: 4 June 1906. - Comments: Type species: *Myotis vivesi* Menegaux, 1901, by original designation (see Jackson and Groves, 2015: 282). Considered a valid genus by Hall and Kelson (1959), but only as a subgenus of *Myotis* by Hall (1981: 183).

*1910. *Chrysopteron* Jentink, Notes Leyden Mus., 32: 74. Publication date: January 1910 [Goto Description]. - Comments: Type species: *Chryopteron bartelsii* Jentink, 1910 [=*Vespertilio formosa* Hodgson, 1835]. Considered a valid subgenus by Hall and Kelson (1959: 159), Hall (1981: 183), Corbet and Hill (1992: 121) and Pavlinov *et al.* (1995: 95).

1917. *Dichromyotis* Bianchi, Ann. Mus. zool. Acad. Impér. Sci. St. Petersbourg, 21: lxxviii (for 2016). Publication date: 14 May - 13 Jun 1917. - Comments: Type species: *Vespertilio formosus* Hodgson, 1835, by original designation according to Csorba *et al.* (2014: 668), by monotypy according to Jackson and Groves (2015: 283).

1917. *Megapipistrellus* Bianchi, Ann. Mus. zool. Acad. Impér. Sci. St. Petersbourg, 21: lxxvii (for 2016). Publication date: 14 May - 13 June 1917. - Comments: Type species: *Pipistrellus annectans* Dobson, 1871, by monotypy (see Jackson and Groves, 2015: 282). Considered a valid subgenus by Pavlinov *et al.* (1995: 95).

1917. *Paramyotis* Bianchi, Ann. Mus. zool. Acad. Impér. Sci. St. Petersbourg, 21: lxxix (for 2016). Publication date: 14 May - 13 Jun 1917. - Comments: Type species: *Vespertilio bechsteinii* Kuhl, 1817. New name for *Nystactes* Kaup, 1829, preoccupied (see Hall and Kelson, 1959: 159; Hall, 1981: 183). Considered a valid subgenus by Pavlinov *et al.* (1995: 95).

1917. *Rickettia* Bianchi, Ann. Mus. zool. Acad. Impér. Sci. St. Petersbourg, 21: lxxvii (for 2016). Publication date: 14 May - 13 Jun 1917. - Comments: Type species: *Vespertilio (Leuconoe) ricketti* Thomas, 1894, by monotypy (see Jackson and Groves, 2015: 282). Valid as a subgenus (see Hall and Kelson, 1959: 159; Hall, 1981: 183).

1929. *Anamygdon* Troughton, Rec. Austr. Mus., 17 (2): 87. Publication date: 26 Jun 1929. - Comments: Type species: *Anamygdon solomonis* Troughton, by original designation (see Jackson and Groves, 2015: 283) [=*Vespertilio adversus* Horsfield, 1824 or *Leuconoe moluccarum* Thomas, 1915 ?].

1934. *Brachyotis:* Taylor, Monographs of the Bureau of Science, Manila, 30: 278. (Lapsus)

1958. *Hesperomyotis* Cabrera, Rev. Mus. Arg. Cienc. Nat., Zool., 4: 103. - Comments: Type species: *Myotis simus* Thomas, 1901, by original designation (see Jackson and Groves, 2015: 283).
1982. *Myottis:* Alberico and Orejuela, Cespedesia, 3 (suppl.): 103. (Lapsus)
1995. *Capaccinus:* Pavlinov, Borissenko, Kruskop and Jahonton, Arch. Zool. Mus., Moscow State Univ., 133: 95. (Lapsus)
1995. *Exochirus:* Pavlinov, Borissenko, Kruskop and Jahonton, Arch. Zool. Mus., Moscow State Univ., 133: 95. (Lapsus)
1995. *Selisius:* Pavlinov, Borissenko, Kruskop and Jahonton, Arch. Zool. Mus., Moscow State Univ., 133: 99. (Lapsus)
1996. *Myotiz:* Spiewak, Johansson and Wüthrich, Allergologie, 19 (11): 510 - 511. (Lapsus)
? *Loeconoe:* (Alternate Spelling)
? *Myotis sp.:*

TAXONOMY:
Woodman (1993) indicated that the genus name ending on -otis" is female, and therefore the species name should also be female. Benda and Tsytsulina (2000: 335) agree with Woodman (1993), but continue to understand *Myotis* as a masculine name, because it has been used for over 170 years, and hence was conserved in this way. Simmons (2005) follows Pritchard (1994) and retains the masculin names too. See also Gardner (2005: 184) where *Myotis* = My (mouse) + ot (ear[ed]) + is (Latin third declension ending) = masculine (Mammalia).

Bronner *et al.* (2003) state that the genus *Myotis* has been considered to include several subgenera, but the number thereof, and placement of species, varied considerably. Meester *et al.* (1986) listed three subgenera from the Southern African subregion, namely *Cistugo* Thomas, 1912 (for *seabrai* and *lesueuri*), *Chrysopteron* Jentink, 1910 (for *welwitschii*) and *Selysius* Bonaparte, 1841 (for *tricolor* and *bocagei*). Menu (1987) proposed synonymising *Selysius* under the subgenus *Leuconoe* Boie, 1830 on the basis of dental characters. This was endorsed by Koopman (1993a, 1994) who transferred *M. bocagei* to *Leuconoe* but included other *Selysius* and *Chrysopteron* in the subgenus *Myotis*, and also by Godawa-Stormark (1998)'s phenetic analysis of dental variation in the genus. Phylogenetic analysis of mitochondrial DNA sequences, however, do not support the monophyly of the three subgenera (*Selysius, Leuconoe* and *Myotis*) analysed (Ruedi and Mayer, 2001), but *Cistugo* warrants generic separation (N. Simmons in litt.) owing to the distinct wing glands and unique karyotypes (see Rautenbach *et al.*, 1993) found in *seabrai* and *lesueuri* from southern Africa.

Meester *et al.* (1986) state that their synonymy is slightly modified from Ellerman and Morrison-Scott (1951), who include also *Aeorestes* Fitzinger, 1870, a South American group, in the synonymy of *Myotis*, as does Hall (1981). However, J.E. Hill points out (in litt) that of the species included in this genus, the first, *Vespertilio villosissimus* E. Geoffroy, 1806, is a *Lasiurus* Gray, 1831, although the others, *albescens* E. Geoffroy, 1806, *nigricans* Schinz, 1821, and *levis* I. Geoffroy, 1824, belong in *Myotis*. If, as Hill suggests, *villosissimus* can be regarded as the type species of *Aeorestes*, it should instead be included in *Lasiurus*.

Phylogenetic analyses performed by Ruedi *et al.* (2013: 441) confirm that the Ethiopian clade within *Myotis* is highly supported with all methods of reconstruction (see also Stadelmann *et al.*, 2004b). This clade contains all of the sub-Saharan species, the species inhabiting the islands in the Western Indian Ocean, as well as *M. emarginatus* (which occurs circum-Mediterranean) and two Asian forms (*M.* cf. *formosus* and *M. formosus flavus*).

Patterson *et al.* (2019: "4') made an extensive phylogenetic analysis on the Afrotropical *Myotis* species and found that they were not monophyletic as *M. welwitschii* formed a sister clade with the east Asian *M. rufoniger*, which was separate from all other African species. All African species, together with *M. rufoniger, M. formosus* and *M. emarginatus* appeared to be grouping on a higher level.

Ghazali *et al.* (2016: 475) state that phylogenetic relationships within *Myotis* reflect biogeographic affinities rather than phenotypes. They also suggest that *Myotis* diverged from other bats in the early Miocene, with a subsequent split between Old and New World lineages about 19 MYA, and that ecomorphs ('Leuconoe' [near-water hunters], 'Myotis' [gleaners], 'Selysius' [aerial hawkers]) emerged independently in different lineages of *Myotis*. Their analyses indicate the ancestor of the African (Ethiopian) clade was most likely a *Myotis*, which diverged from the Eurasian clade about 17.0 MYA.

Bogdanowicz *et al.* (2015: Fig. 2, p. 640) mention Moroccan data for *Myotis nattereri*, but in the supplementary information, these are mentioned as *Myotis* cf. *nattereri*. They also include the Mediterranean coastal areas of Morocco and Algeria in the distribution area of *M. capaccinii*.

Known species of the genus *Myotis*: *abei* Yoshikura, 1944 – southern Sakhalin, Russia (Simmons, 2005: 500); *adversus* (Horsfield, 1824) – islands in Indonesia, New South Wales, Taiwan, possibly Vietnam and peninsular Malaysia (Simmons, 2005: 500); *aelleni* Baud, 1979 – southwestern Argentina (Simmons, 2005: 501); *albescens* (E. Geoffroy, 1806) – southern Veracruz (Mexico), Guatemala, Honduras, Nicaragua, Panama, Colombia, Venezuela, Guyana, Surinam, Equador, Peru, Brazil, Uruguay, northern Argentina, Paraguay and Bolivia (Simmons, 2005: 501); *alcathoe* von Helversen and Heller, 2001 – Greece, Hungary, France (Simmons, 2005: 501); *altarium* Thomas, 1911 – Szechwan, Kweichow (China), Thailand (Simmons, 2005: 501); ***anjouanensis*** Dorst, 1960; *annamiticus* Kruskop and Tsytsulina, 2001 – Vietnam (Simmons, 2005: 501); *annectans* (Dobson, 1871) – northeastern India to Burma, Thailand, Laos, Cambodia and Vietnam (Simmons, 2005: 502); *atacamensis* (Lataste, 1892) – southern Peru, northern Chile (Simmons, 2005: 502); *ater* (Peters, 1866) – Vietnam, western Sumatra, Peninsular Malaysia, Sulawesi, Togian Isl, northern Borneo, Moluccas, Papua New Guinea (Simmons, 2005: 502); *auriculus* Baker and Stains, 1955 – Arizona and New Mexico (USA) to Jalisco and Veracruz (Mexico); Guatemala (Simmons, 2005: 502); *australis* Dobson, 1878) – New South Wales (Simmons, 2005: 502); *austroriparius* (Rhoads, 1897) – southeastern USA including Florida, north to Indiana and North Carolina, west to Texas and southeastern Oklahoma (Simmons, 2005: 502); *bechsteinii* (Kuhl, 1817) – Europe to Caucasus and Iran; Bulgaria; England; southern Sweden (Simmons, 2005: 503); *blythii* (Tomes, 1857) – Turkey and Israel to Iraq and Iran; northwestern India and the Himalayas; northwestern Altai Mtns; Inner Mongolia and Shensi (China) (Simmons, 2005: 503); ***bocagii*** (Peters, 1870); *bombinus* Thomas, 1906 – Japan, Korea, southeastern Siberia, northeastern China (Simmons, 2005: 503); *brandtii* (Eversmann, 1845) – Britain south to Italy, Greece and Bulgaria, east to Kazakhstan and Mongolia, eastern Siberia, Kamchatka Peninsula and Kurile Isls; Ussuri region (Russia), Korea (Simmons, 2005: 503); *bucharensis* Kuzyakin, 1950 – Uzbekistan, Tajikistan and Afghanistan (Simmons, 2005: 504); *californicus* (Audubon and Bachman, 1842) – southern Alaska Panhandle (USA) to Baja California and higher elevations in the Sonoran and Chihuahuan deserts (Mexico); Guatemala (Simmons, 2005: 504); *capaccinii* (Bonaparte, 1837) – Mediterranean zone and islands of Europe; Bulgaria; Turkey; Israel; Iraq; Iran; Uzbekistan (Simmons, 2005: 504); *chiloensis* (Waterhouse, 1840) – central and southern Chile; Argentina (Simmons, 2005: 504); *chinensis* (Tomes, 1857) – Szechwan and Yunnan to Kiangsu (China); Hong Kong; northern Thailand; Burma; Vietnam (Simmons, 2005: 505); *ciliolabrum* Merriam, 1886 – southern Alberta and Saskatchewan (Canada) south through eastern Colorado and western Kansas (USA) (Simmons, 2005: 505); *cobanensis* Goodwin, 1955 – central Guatemala (Simmons, 2005: 505); *csorbai* Topál, 1997 – Nepal (Simmons, 2005: 505); *dasycneme* (Boie, 1825) – France and Sweden east to Yenisei River (Russia), south to Ukraine, northwestern Kazakhstan, China (Simmons, 2005: 505); *daubentonii* (Kuhl, 1817) – Europe (including Britain and Ireland; Scandinavia) east to Kamtschatka, Vladivostok, Sakhalin and Kurile Isls (Russia), Japan, Korea, Manchuria, northern and eastern China (including Tibet), Vietnam (Simmons, 2005: 505); *davidii* Peters, 1869 – northern China (Simmons, 2005: 506); ***dieteri*** M. Happold, 2005; *dominicensis* Miller, 1902 – Dominica, Guadeloupe (Simmons, 2005: 506); *elegans* Hall, 1962 – Mexico to Costa Rica (Simmons, 2005: 506); ***emarginatus*** (E. Geoffroy, 1806); *evotis* (H. Allen, 1864) – southern British Columbia, southern Alberta, southern Saskatchewan (Canada) to New Mexico (USA) and Baja California (Mexico) (Simmons, 2005: 506); *fimbriatus* (Peters, 1871) – southeastern China (Simmons, 2005: 507); *findleyi* Bogan, 1978 – Trés Marías Isls (Mexico) (Simmons, 2005: 507); *formosus* (Hodgson, 1835) – Afghanistan to northern India, Nepal, Tibet, Kweichow, Kwangsi, Kiangsu and Fukien (China), Taiwan, Korea, Tsushima Isl (Japan), Malaysia, Philippines, Sumatra, Java, Sulawesi and Bali (Simmons, 2005: 507); *fortidens* Miller and Allen, 1928 – Sonora and Veracruz (Mexico) to Guatemala (Simmons, 2005: 507); *frater* G. M. Allen, 1923 – eastern Siberia, Ussuri Region, Krasnoyarsk Region (Russia) to Korea, Heilungkiang (China), southeastern China; Japan (Simmons, 2005: 507); *gomantongensis* Francis and Hill, 1998 – Sabah (Borneo, Malaysia) (Simmons, 2005: 508); ***goudoti*** (A.Smith, 1834); *grisescens* A. H. Howell, 1909 – Florida Panhandle to Kentucky, Indiana, Illinois, eastern Kansas and northeastern Oklahoma (USA) (Simmons, 2005: 508); *hajastanicus* Argyropulo, 1939 – Sevan Lake basin in Armenia (Simmons, 2005: 508); *hasseltii* (Temminck, 1840) – eastern India, Sri Lanka, Burma, Thailand, Cambodia, Vietnam, western Malaysia, Sumatra, Mentawai Isls, Riau Arch., Java, Borneo (Simmons, 2005: 508); *hermani*

Thomas, 1923 – Sumatra (Indonesia) (Simmons, 2005: 508); *horsfieldii* (Temminck, 1840) – India, Andaman Isls, southeastern China, Thailand, Burma, Laos, Vietnam, western Malaysia, Java, Bali, Sulawesi, Borneo, Philippines (Simmons, 2005: 508); *hosonoi* Imaizumi, 1954 – Honshu (Japan) (Simmons, 2005: 509); *ikonnikovi* Ognev, 1912 – Ussuri region and North Korea to Lake Baikal (Russia), the Altai Mtns and Mongolia, northeastern China; Sakhalin Isl (Russia) and Honshû and Hokkaido Isls (Japan) (Simmons, 2005: 509); *insularum* (Dobson, 1878) – Samoa (Simmons, 2005: 509); *keaysi* J. A. Allen, 1914 – Tamaulipas (Mexico) to Bolivia, northern Argentina, Peru, Ecuador, Venezuela and Trinidad (Simmons, 2005: 509); *keenii* (Merriam, 1895) – Alaska Panhandle to western Washington (USA) (Simmons, 2005: 509); *laniger* Peters, 1871 – southern China including Tibet, Vietnam, eastern India (Simmons, 2005: 509); *leibii* (Audubon and Bachman, 1842) – eastern North America from southern Ontario, southern Quebec (Canada) and southern Maine (USA) to southwards to Georgia and western to eastern Oklahoma (USA) (Simmons, 2005: 509); *levis* (I. Geoffroy, 1824) – Bolivia, Argentina, southeastern Brazil, Uruguay (Simmons, 2005: 510); *longipes* (Dobson, 1873) – Afghanistan, northeastern India, Nepal (Simmons, 2005: 510); *lucifugus* (Le Conte, 1831) – Alaska (USA) to Labrador and Newfoundland (Canada), south to southern California, northern Arizona, northern New Mexico (USA) (Simmons, 2005: 510); *macrodactylus* (Temminck, 1840) – Japan, Kunashir Isl and Kurile Isls (Russia), southeastern Siberia, Korea (Simmons, 2005: 510); *macropus* (Gould, 1854) – southern Australia (Simmons, 2005: 511); *macrotarsus* (Waterhouse, 1845) – Philippines, northern Borneo (Simmons, 2005: 511); *martiniquensis* LaVal, 1973 – Martinique, Barbados (Lesser Antilles) (Simmons, 2005: 511); *melanorhinus* Merriam, 1890 – British Columbia (Canada) south to central Mexico and east to western Oklahoma (USA) (Simmons, 2005: 511); *moluccarum* (Thomas, 1915) – Ambon and Kai Isls (Moluccas), northern and western Australia, Seram, Waigeo Isl (West Palua, Indonesia), Papua New Guinea, Bismarck Arch., Solomon Isls (Simmons, 2005: 511); *montivagus* (Dobson, 1874) – Yunnan to Fukien and Chihil (China), northeastern India, Burma, Vietnam, Laos, northeastern Thailand, western Malaysia, Borneo (Simmons, 2005: 511); ***morrisi*** Hill, 1971. *muricola* (Gray, 1846) – Afghanistan through northern India and Nepal to Taiwan, Vietnam, Malaysia, Indonesia and New Guinea (Simmons, 2005: 512); *myotis* (Borkhausen, 1797) – central and southern Europe, east to Ukraine; southern England, most Mediterranean islands; Asia Minor; Lebanon, Syria and Israel (Simmons, 2005: 512); ***mystacinus*** (Kuhl, 1817); *nattereri* (Kuhl, 1817) – Ireland, Great Britain, Europe (except northern Scandinavia), Morocco, northern Algeria, Turkey, Israel, Jorden, Lebanon, Iraq, Iran, Bulgaria, Crimea and Caucasus to Turkmenistan (Simmons, 2005: 513); *nesopolus* Miller, 1900 – northeastern Venezuela; Curaçao and Bonaire (Netherlands Antilles) (Simmons, 2005: 513); *nigricans* (Schinz, 1821) – Nayarit and Tamaulipas (Mexico) to Peru, Bolivia, northern Argentina, Paraguay and southern Brazil; Trinidad and Tobago; St. Martin, Montserrat, Grenada (Lesser Antilles) (Simmons, 2005: 513); *nipalensis* Dobson, 1871 – Iran, Turkey and Uzbekistan to Nepal, Mongolia, Tibet and northwestern China, Siberia (Simmons, 2005: 513); *occultus* Hollister, 1909 – southern California to Arizona, New Mexico and Colorado (USA), south to Distrito Federal (Mexico) (Simmons, 2005: 514); *oreias* (Temminck, 1840) – Singapore (Simmons, 2005: 514); *oxygnathus* Monticelli, 1885 – Mediterranean region from Spain to Italy and Greece; Bulgaria to Turkmenistan, Kyrgyztan and Afghanistan (Simmons, 2005: 514); *oxyotus* (Peters, 1867) – Venezuela to Bolivia; Panama; Costa Rica (Simmons, 2005: 514); *ozensis* Imaizumi, 1954 – Honshu (Japan) (Simmons, 2005: 514); *peninsularis* Miller, 1898 – southern Baja California (Mexico) (Simmons, 2005: 514); *pequinius* Thomas, 1908 – Hong Kong, Hopeh, Shantung, Honan and Kiangsu (China) (Simmons, 2005: 514); *planiceps* Baker, 1955 – Coahuila, Nuevo León and Zacatecas (Mexico) (Simmons, 2005: 515); *pruinosus* Yoshiyuki, 1971 – Honshu and Shikoku (Japan) (Simmons, 2005: 515); ***punicus*** Felten, Spitzenberger and Storch, 1977; *ricketti* (Thomas, 1894) – Fukien, Anhwei, Kiangsu, Shantung, Yunnan (China); Hong Kong; Vietnam and Laos (Simmons, 2005: 515); *ridleyi* Thomas, 1898 – western Malaysia, Sumatra, Borneo (Simmons, 2005: 515); *riparius* Handley, 1960 – Honduras south to Uruguay, eastern Brazil, Argentina, Paraguay and Bolivia; Trinidad (Simmons, 2005: 515); *rosseti* (Oey, 1951) – Cambodia, Thailand (Simmons, 2005: 516); *ruber* (E. Geoffroy, 1806) – southeastern Brazil, southeastern Paraguay, northeastern Argentina (Simmons, 2005: 516); *schaubi* Komos, 1934 – Arminia and western Iran (Simmons, 2005: 516); ***scotti*** Thomas, 1927; *septentrionalis* (Trouessart, 1897) – eastern USA and Canada west to British Columbia, eastern Montana, eastern Wyoming; south to Alabama, Georgia, and Florida Panhandle (Simmons, 2005: 516); *sicarius* Thomas, 1915 – northeastern India and Nepal (Simmons, 2005: 516); *siligorensis* (Horsfield, 1855) – northern India to southern China, Burma, Vietnam and Laos; south to western Malaysia; Borneo (Simmons, 2005: 516); *simus* Thomas, 1901 – Colombia, Ecuador, Peru, northern Brazil, Bolivia, northeastern Argentina and Paraguay (Simmons, 2005: 517); *sodalis* Miller and Allen, 1928 – New

Hampshire to Florida Panhandle, west to Wisconsin and Oklahoma (USA) (Simmons, 2005: 517); *stalkeri* Thomas, 1910 – Kai and Gebe Isls (Molucca Isls), Waigeo Isl. (Prov. of Papua, Indonesia) (Simmons, 2005: 517); *thysanodes* Miller, 1897 – Chiapas (Mexico) to southwestern South Dekota (USA) and south-central British Columbia (Canada) (Simmons, 2005: 517); ***tricolor*** (Temminck, 1832); *velifer* (J. A. Allen, 1890) – Honduras to Kansas and southeastern California (USA) (Simmons, 2005: 517); *vivesi* Menegaux, 1901 – coast of Sonora and Baja California (Mexico), mainly on small islands (Simmons, 2005: 518); *volans* (H. Allen, 1866) – Jalisco to Veracruz (Mexico); Alaska Panhandle (USA) to Baja California (Mexico), east to northern Nuevo León (Mexico), South Dekota (USA) and central Alberta (Canada) (Simmons, 2005: 518); ***welwitschii*** (Gray, 1866); *yanbarensis* Maeda and Matsumura, 1998 – Northern Okinawa Isl (Japan) (Simmons, 2005: 518); *yesoensis* Yoshiyuki, 1984 – Hokkaido (Japan) (Simmons, 2005: 518); *yumanensis* (H. Allen, 1864) – Hidalgo, Morelos and Baja California (Mexico) north to British Columbia (Canada), east to Montana and western Texas (USA) (Simmons, 2005: 518).

COMMON NAMES:
Czech: netopýři myší, ouška myší, netopýrcové. English: Mouse-eared Bats, Little Brown Bats, Hairy Bats, Large-footed Bats. French: Murins. German: Mausohr, Mausohren. Polish: nocki.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
In Africa *Myotis* sp. have been found deposits of the Plio-Pleistocene, at Bolt's Farm, South Africa (Broom, 1948). Early Pleistocene, at Olduvai (Butler, 1978). Geraads *et al.* (2010: 279) reported the presence of *Myotis* in Late Cenozoic (ca. 2.5 MYA) deposits in Ahl al Oughlam, Morocco.

Molecular dating performed by Ruedi *et al.* (2013: 437-441) suggest an origin of all recent *Myotis* in the early Miocene (about 21 MYA with 95 % highest posterior density interval 23 - 20 MYA).

Shi and Rabosky (2015: 1532) report the approximate fossil date for crown Myotinae to be 27 MYA.

However, a recent study by Gunnell *et al.* (2017) reported on a fossil *Myotis* found in a Belgian Oligocene locality, dating 33 MYA.

The Ethiopian clade (see Taxonomy) would have been separated about 12.33 (15 - 10) MYA.

MOLECULAR BIOLOGY:
Baker *et al.* (1974) recorded the karyotype of *Myotis* as 2*n* = 44, AA = 50, but Dippenaar *et al.* (1983) give it as 2*n* = 50, AA = 48 in both *seabrai* and *lesueuri*.

PREDATORS:
In Algeria, Djilali *et al.* (2016: 159) found the Short-eared owl (*Asio flammeus*) to feed primarily on bats of the genus *Myotis*. They made up 37.8 % of all prey items (195 specimens on 516 prey items). The second one was *Gerbillus nanus* with only 5.4 % of all preys.

PARASITES:
From non-specified *Myotis* specimens, the following nycteribiids were reported by Vermeil (1960) from Tunisia: *Penicillidia conspicua* Speiser, 1900, *Nycteribia vexata vexata* Westwood, 1835, *Nycteribia biarticulata* Hermann, 1804, *Nycteribia latreillii* Leach, 1817, and *Nycteribia schmidlii* Schiner, 1853.

†***Myotis darelbeidensis*** Gunnell, Eiting, and Geraads, 2011

*2011. *Myotis darelbeidensis* Gunnell, Eiting, and Geraads, N. Jb. Geol. Paläont. Abh., 260 (1): 59, figs 3C, 5A-C, 8A-C. Publication date: January 2011. Type locality: Morocco: Ahl al Oughlam [ca. 33 35 N 07 30 W] [Goto Description]. Holotype: INSAP AaO 4571: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Right dentary fragment with p2-m3. Paratype: INSAP AaO 4589: Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. Left maxilla P4-M1. - Etymology: Name taken from Dar el Beida ("white house"), the Arabic name for Casablanca (see Gunnell *et al.*, 2011: 60). (Current Combination)

TAXONOMY:
Gunnell *et al.* (2011: 60) describe it as a large species of *Myotis*, similar in size to *M. blythii* and *M. myotis*, much larger than most other extant Mediterranean *Myotis* species (including *M. capaccinii, M. bechsteinii, M. emarginatus*).

Myotis anjouanensis (Dorst, 1960)

*1960. *? anjouanensis* Dorst, Bull. Mus. natn. Hist. nat., Paris, sér. 2, 31: 476 (for 1959). Type locality: Comoros: Anjouan Island. - Etymology: The specific name refers to the island where the type specimen was collected.
? *Myotis anjouanensis* (Name Combination, Current Combination)

TAXONOMY:
Considered a synonym of *goudoti* by Koopman (1993a: 211), and a subspecies of *goudoti* by Peterson *et al.* (1995: 89), but a valid species by Simmons (2005).

Csorba *et al.* (2014: 667) include *anjouanensis* in the subgenus *Chrysopteron*.

COMMON NAMES:
Czech: netopýr anžuánský. English: Anjouan Myotis, Anjouan Mouse-eared Bat. French: Murin d'Anjouan, Vespertilion de l'Ile d'Anjouan. German: Anjouan-Mausohr.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since it has only recently been recognised as a distinct species, and there is still very little information on its extent of occurrence, status, threats and ecological requirements (Jacobs, 2008c; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs, 2008c; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs, 2004k; IUCN, 2004).

MAJOR THREATS:
The threats to this species are not known (Jacobs, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs (2008c) [in IUCN (2009)] reports that it is not known if the species is present in any protected areas. Further studies are needed into the natural history and possible threats to this little-known species.

GENERAL DISTRIBUTION:
Myotis anjouanensis is endemic to the island of Anjouan in the Comoros Islands.

Native: Comoros.

POPULATION:
Structure and Density - There is currently little information on the abundance of this species (Jacobs, 2008c; IUCN, 2009). Specimens were collected by Goodman, 2007) from Anjouan in 2007.

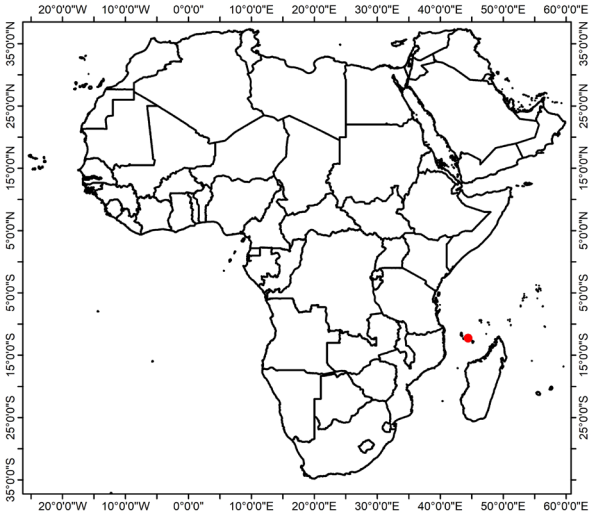


Figure 237. Distribution of *Myotis anjouanensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Comoros.

Myotis bocagii (Peters, 1870)

*1870. *Vespertilio Bocagii* Peters, J. Sci. mat. phys. nat., ser. 1, 3 (10): 125. Publication date: December 1870. Type locality: Angola: Duque de Bragança [08 55 S 16 10 E]. Lectotype: ZMB 3973: ad ♂, skull and alcoholic. Presented/Donated by: José Vicente Barboza du Bocage. Lectotype designated by Turni and Kock (2008: 57). - Comments: Turni and Kock (2008: 57) also indicate that Peters did not mention the number of specimens he examined, therefore it might be possible that additional syntypes might have existed in the Lisbon museum, but were destroyed by the fire in 1978. Thorn *et al.* (2009: 51) situate the type locality at 09 23 S 15 53 E. - Etymology: In honour of J.V. Barbosa du Bocage, an eminent Portuguese zoologist, who worked during the nineteenth century, and who named material from the Congo and Angola collected by his Portuguese colleague Snr. M. Jose d'Anchieta (Smithers, 1983: 93).
1976. *Myotis boccagei:* Brosset, Z. Tierpsychol., 42 (1): 50. (Lapsus)

1996. *Myotis bocagi:* Kityo and Kerbis, J. East Afr. Nat. Hist., 85: 63. (Lapsus)
? *Myotis (Selysius) bocagei:* (Name Combination, Alternate Spelling)
? *Myotis bocagei:* (Alternate Spelling)
? *Myotis bocagii:* (Name Combination, Current Combination)

TAXONOMY:

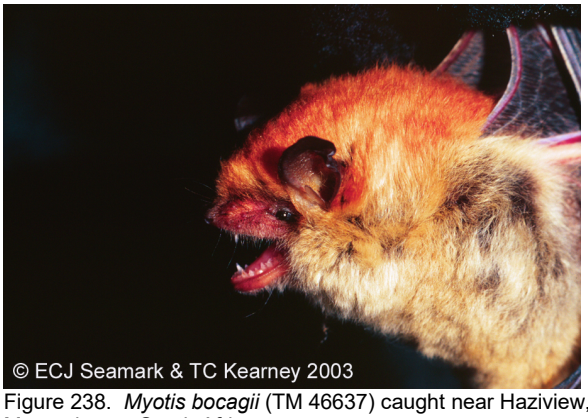


Figure 238. *Myotis bocagii* (TM 46637) caught near Haziview, Mpumalanga, South Africa.

Mentioned as *bocagei* by Corbet (1978: 49), Smithers (1983: 93), Meester *et al.* (1986: 49), Koopman (1993a: 209), Horácek *et al.* (2000: 121) Wilson and Cole (2000: 58), Hutson *et al.* (2001: 28), Fenton and Bogdanowicz (2002: 1008) but as *bocagii* by Ansell and Dowsett (1988: 37), Harrison and Bates (1991: 76), Grubb *et al.* (1998: 82), Stadelmann *et al.* (2004b: 178); and as *bocagi* by Kityo and Kerbis (1996: 63).

Csorba *et al.* (2014: 667) include *bocagii* in the subgenus *Chrysopteron*, but see Ruedi and Mayer (2001: 436), Ghazali *et al.* (2016: 476) and Patterson *et al.* (2019: "2") who reject the subgeneric division.

The phylogenetic analyses by Patterson *et al.* (2019: "5") revealed the presence of two groups within *M. bocagii*: one including a single Senegalese specimen and two all the remainder, including material from Ghana, DRC, Kenya, and Tanzania. These findings do not support the currently accepted division into two subspecies: *bocagii* and *cupreolus*, although the authors stress that no material from Angola (where the type of *bocagii* was collected) was included in the analyses (p. "9"). As such, it might be possible that two subspecies might still be present, with *bocagii* restricted to Angola. Until this has been resolved, we do retain the two traditionally recognized subspecies. Patterson *et al.* (2019) also indicated that *M. bocagii* forms a sister group with *M. goudoti* + *M. anjouanensis*, which in turn form a sister group to *M. tricolor* and *M. emarginatus* (based on nuclear genes).

COMMON NAMES:

Afrikaans: Rooi langhaarvlermuis. Chinese: 棕红鼠耳蝠. Czech: netopýr Bocageův. English: Rufous Mouse-eared bat, Bocage's Mouse-eared Bat, Rufous Mouse-eared Myotis, Rufous Hairy Bat, Bocage Banana Bat, Bocage's Hairy Bat. French: Murin roux, Murin de Du Bocage. German: Kupferfarbenes Mausohr, Bananen-Mausohr. Portuguese: Morcego lanudo de Bocage. Spanish (Castillian): Murciélago de Orejas de Ratón.

CONSERVATION STATUS:

Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs, 2008d; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs, 2008d; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs, 2004f; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016j). 2004 - DD ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:

There appear to be no major threats to this species as a whole (Jacobs, 2008d; IUCN, 2009).

CONSERVATION ACTIONS:

Jacobs (2008d) [in IUCN (2009)] reports that it has been recorded from Kruger National Park, South Africa (Skinner and Chimimba, 2005), Dzanga-Sangha Special Dense Forest Reserve in the Central African Republic (Lunde *et al.*, 2001), and from the Manga Forest Reserve in Tanzania (Doggart *et al.*, 1999b), and in view of the species wide range it is presumed to be present in many more protected areas. There are no direct conservation measures currently needed for this species as a whole.

GENERAL DISTRIBUTION:

Myotis bocagii is widespread throughout much of sub-Saharan Africa. It occurs from Sierra Leone and Senegal in West Africa, eastwards through Cameroon and Central Africa, to Ethiopia and East

Africa, being recorded as far south as northeastern South Africa. Outside of Africa it has been recorded from southern Yemen.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 594,469 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 564); Benin; Burkina Faso (Kangoyé *et al.*, 2015a: 618); Burundi; Cameroon; Central African Republic; Congo (The Democratic Republic of the) (Allen, 1917; Hayman *et al.*, 1966; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 564); Côte d'Ivoire; Equatorial Guinea; Ethiopia; Gabon; Ghana; Guinea (Fahr *et al.*, 2006a: 73); Kenya; Liberia (Monadjem and Fahr, 2007: 50); Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 564); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 564; Monadjem *et al.*, 2010c: 383); Nigeria; Rwanda; Senegal; Sierra Leone (Weber *et al.*, 2019: 25); South Africa (Monadjem *et al.*, 2010d: 564); Swaziland (Monadjem *et al.*, 2010d: 564; Shapiro and Monadjem, 2015: 353); Sudan; Tanzania (Stanley and Goodman, 2011: 43); Togo; Uganda; Yemen; Zambia (Monadjem *et al.*, 2010d: 564); Zimbabwe (Monadjem *et al.*, 2010d: 564).

Bates *et al.* (2013: 339) reject the occurrence of *M. bocagii* in the Republic of Congo as Happold (2013dn: 693) only provided a map without any supporting data.

ECHOLOCATION:
Schoeman and Waddington (2011: 291) mention a peak frequency of 43.2 ± 0.2 kHz and a duration of 2.0 ± 0.1 msec for specimens from Durban, South Africa. Monadjem *et al.* (2017c: 179) reported for one specimen the following parameters from Swaziland: F_{min}: 30.1 kHz, F_{knee}: 41.2 kHz, F_c: 36.6 kHz, and duration: 2.8 msec. They were also to capture the call up to a distance of 5 m.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 44, FN = 50, BA = 8, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from South Africa. These results are the same as those obtained for *M. tricolor* specimens from South Africa and Zimbabwe (Rautenbach *et al.*, 1993).
Protein / allozyme - Unknown.

HABITAT:
In southern Africa, this species primarily (82 %) occurs in Savanna habitats (Cooper-Bohannon *et al.*, 2016: Table S2).

In the Mount Nimba area, Monadjem *et al.* (2016y: 369) collected one specimen in old growth forest at 420 m.

HABITS:
Brosset (1976) found that harem groups of female *M. bocagii*'s remained very stable over a period of several years. The males in these groups were replaced more often.

DIET:
From the Umbilo River in KwaZulu Natal (RSA), Naidoo *et al.* (2011: 26) reported the following prey volume percentages: during summer: Lepidoptera (1.3 ± 1.9), Coleoptera (0.8 ± 1.0), Hemiptera (8.5 ± 13.1), Diptera (37.8 ± 25.8), and Trichoptera (51.8 ± 29.9); during winter: Lepidoptera (7.5 ± 10.6), Coleoptera (32.5 ± 46.1), Hemiptera (20.0 ± 28.3), Diptera (33.4 ± 33.0), and Trichoptera (6.7 ± 4.7).

Weier *et al.* (2019b: 6) investigated droppings from this species in the Levubu region (Limpopo, RSA) and found DNA sequences of *Bathycoelia distincta* Distant, 1878 (Hemiptera).

POPULATION:
Structure and Density - Although this species is difficult to catch it is possibly not very rare (Jacobs, 2008d; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs, 2008d; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Stanley and Goodman (2011: 43) report on a male with scrotal testes collected in the East Usambara Mountains (Tanzania) on 30 July 1992.

One female captured on 4 June in Sierra Leone by Weber *et al.* (2019: 25) was pregnant.

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibodies to SARS-CoV in serum of one individual from Limpopo Province, South Africa, which tested negative (0/1).

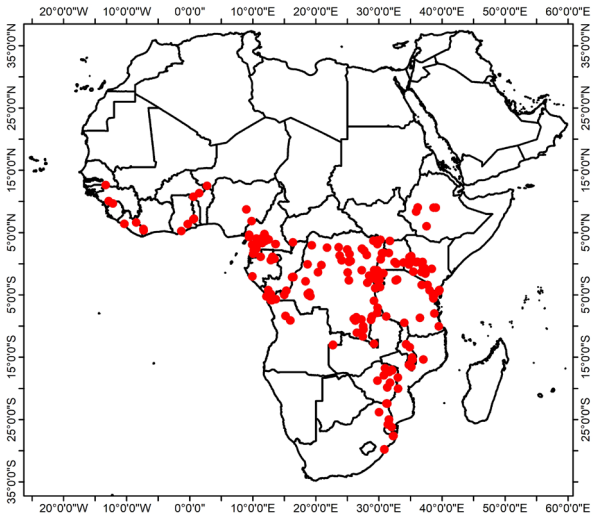


Figure 239. Distribution of *Myotis bocagii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Malawi, Mozambique, Niger, Rwanda, Senegal, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Myotis bocagii bocagii (Peters, 1870)

*1870. *Vespertilio Bocagii* Peters, J. Sci. mat. phys. nat., ser. 1, 3 (10): 125. Publication date: December 1870. Type locality: Angola: Duque de Bragança [08 55 S 16 10 E] [Goto Description].

1904. *Myotis Hildegardeæ* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (75): 209. Publication date: 1 March 1904. Type locality: Kenya: Fort Hall [=Muranga] [00 43 S 37 09 E, 4 000 ft] [Goto Description]. Holotype: BMNH 1903.3.2.2: ♂. Collected by: Mrs. Hildegarde Hinde; collection date: 17 October 1902; original number: 115.

? *Myotis bocagei bocagei:* (Alternate Spelling)

? *Myotis bocagei hildegardeae:* (Name Combination, Alternate Spelling)

? *Myotis bocagii bocagii:* (Name Combination, Current Combination)

GENERAL DISTRIBUTION:
Uganda to Ethiopia, south to Angola, Zambia, Malawi, and Transvaal (South Africa).

Myotis bocagii cupreolus Thomas, 1904

*1904. *Myotis Bocagei cupreolus* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (78): 407. Publication date: 1 June 1904. Type locality: Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. Holotype: BMNH 1903.2.4.6: ♂. Collected by: George Latimer Bates Esq. Collection date: 14 August 1901. - Comments: Evenhuis (2003: 36) states that pages 329 to 424 were included in part 77, which appeared on 1 May 1904. However, the title page of the publication indicates that the part is 78, which was published on 1 June 1904. (Current Combination)

? *Myotis bocagii cupreolus:* (Current Spelling)

GENERAL DISTRIBUTION:
West Africa.

Myotis capaccinii (Bonaparte, 1837)

*1837. *Vespertilio Capaccinii* Bonaparte, Iconografia Fauna italiana, 1, fasc. 20 and pl., fig. Publication date: 1837. Type locality: Italy: Sicily [Goto Description]. Holotype: BMNH 1907.1.1.734:. - Etymology: In honour of Francesco Capaccini, under secretary of state of

Rome about 1833-34, and a patron of Bonaparte's "Iconografia della Fauna Italica," published in 1832-1841 (Palmer, 1904: 49). (see Palmer, 1904: 49; Kozhurina, 2002: 15).

? *Myotis capaccinii capaccinii:* (Name Combination)

? *Myotis capaccinii:* (Name Combination, Current Combination)

TAXONOMY:
Most recent authors consider *M. capaccinii* as a monotypic species (Spitzenberger and von Helversen, 2001; Simmons, 2005).

COMMON NAMES:
Albanian: Lakuriq nate gishtgjatë. Arabian: Khaffash. Armenian: Միջերկրածովայիհն գիշերաչղջիկ. Azerbaijani: Uzunbarmaq gecəşə bpə rə si. Basque: Saguzar hatz-luze, Saguzar hankahandia. Belarusian: Начніца даўгапалая. Bosnian: Dugoprsti š iš miš. Breton: Gousperell Capaccini. Bulgarian: Дългопръст нощник. Castilian: Murciélago patudo, Murciélago ratonero patudo. Catalan: Ratpenat de peus grans, Rat penat de peus grans. Croatian: Dugonogi š iš miš. Czech: Netopý r dlouhonohý. Danish: Capaccinis flagermus. Dutch: Capaccini's vleermuis. English: Capaccinii's Mouse-eared Bat, Long-fingered Bat, Long-fingered Myotis. Estonian: Pikkjalg-lendlane. Finnish: Pitkäsormisiippa. French: Murin de Capaccini, Vespertilion de Capaccini, Vespertilion des montagnes. Frisian: Grutfuottige flearmûs. Galician: Morcego de pés grandes. Georgian: კაპაჩინის მღამიობი. German: Langfußfledermaus, Freischeinige Stelzfussfledermaus. Greek: Ποδαρομυωτίδα. Hebrew: Nishpon Gadot. Hungarian: Hosszúlábú denevér, Nycteris i macropus. Irish Gaelic: Ialtóg fhadmhéarach. Italian: Vespertilio di Capaccini. Latvian: Garpirkstu naktssikspā rnis. Lithuanian: Ilgapirštis pelė ausis. Luxembourgish: Laangfoussfliedermaus. Macedonian: Долгопрст ноќник [= Dolgoprst Nokjnik]. Maltese: Farfett il-Lejl tas-Swaba Twal. Montenegrin: Dugoprsti već ernjak. Norwegian: Langfotflaggermus. Polish: Nocek dł ugopalcy. Portuguese: Morcego de Capaccini. Rhaeto-Romance: Vespertil da Capaccini. Romanian: Liliacul cu picioare lungi, Liliac-cu-picioare-lungi. Russian: Ночница средиземная (итальянская). Serbian: Дугопрсти вечерњак [= Dugoprsti večernjak]. Scottish Gaelic: Ialtag fhad-mheurach. Slovak: Netopier dlhonohý. Slovenian: Dolgonogi netopir. Swedish: Storfotsfladdermus. Turkish: Uzunayaklı Yarasa. Ukrainian: Нічниця довгопала. Welsh: Ystlum hirfys.

CONSERVATION STATUS:
Global - The species occupies specialised habitat (caves and associated water systems). In the eastern part of the range it congregates in winter in a few sites which are threatened by human disturbance. It has declined between 30 and 50 % in Spain in the last 10 years, and there are indications of declines in other parts of the range. It only hunts in watercourses and is therefore threatened by water pollution and the development of tourist infrastructure, which is expected to continue in the future. It is suspected that population declines are underway that will exceed 30 % over 18 years (3 generations), and for that reason the species is considered Vulnerable (VU A4bce ver 3.1 (2001)) (Hutson *et al.*, 2008k; IUCN, 2009).

Assessment History -
2008 - VU A4bce ver 3.1 (2001) (Hutson *et al.*, 2008k; IUCN, 2009). 1996 - VU (Baillie and Groombridge, 1996). 1994 - VU (IUCN, 1994). 1990 - VU (IUCN, 1990). 1988 - VU (IUCN, 1988).

MAJOR THREATS:
Threats include changes in water quality through pollution and dam building, and loss of water bodies and watercourses. Damage or disturbance to caves (tourism, fires and vandalism) used as roosts may also be a problem, as the species is very dependent on caves. The species is collected for medicinal purposes in North Africa (Hutson *et al.*, 2008k; IUCN, 2009).

The species's small distribution range, cave or tree roosting, and aerial hawking feeding style are considered to be the most important risk factors related to climatic change (Sherwin *et al.*, 2012: 174). Bilgin *et al.* (2012: 434) predict that the range retraction for *M. capaccinii* as a result of climatic change may pose severe threats to its survival as this species has the bulk of its range in the Mediterranean region.

CONSERVATION ACTIONS:
Hutson *et al.* (2008k) [in IUCN (2009)] report that it is protected by national legislation in most range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention in the range states where these apply. It is included in Annex II (and IV) of EU Habitats and Species Directive, and hence requires special measures for conservation including designation of Special Areas for Conservation. Some habitat protection through Natura 2000. In Spain, fences are in place to protect several known colonies. Measures needed include protection of colonies (these measures should avoid the blocking of any cave

entrances with gates and control of tourist access) and improvement of water quality.

GENERAL DISTRIBUTION:
Myotis capaccinii is sparsely distributed from eastern Iberia, Spain through the northern Mediterranean to coastal Asia Minor and Israel, Lebanon and Jordan, and also in Mesopotamia from Turkey to Iran and in north-west Africa (limited to the Mediterranean fringe of western Maghreb: north Morocco and northwest Algeria). It occurs from sea level to 900 m.
Bilgin *et al.* (2012) examined climate change scenarios within the Asia Minor and Levant region, they predict that *M. capaccinii* will have a range contraction, which may pose severe threats to their survival of this species.

Native: Albania; Algeria (Kowalski and Rzebik-Kowalska, 1991: 91); Andorra; Austria; Bosnia and Herzegovina; Bulgaria; Croatia; Cyprus (Benda *et al.*, 2007: 71); France [Corse]; Greece [Kriti]; Holy See [Vatican City State]; Iran, Islamic Republic of; Iraq; Israel; Italy [Sardegna, Sicilia]; Jordan; Lebanon; Macedonia, the former Yugoslav Republic of; Montenegro; Morocco (Aulagnier and Thevenot, 1986: 44); Romania; Russian Federation; Serbia; Slovenia; Spain [Baleares]; Syrian Arab Republic; Tunisia; Turkey; Uzbekistan.
Regionally extinct: Switzerland.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Almenar *et al.* (2006: 158) indicate that the large hind feet and pointed wings of this species are well suited for capturing prey while trawling through the water surface.

DETAILED MORPHOLOGY:
In their study on take-off performance, Gardiner *et al.* (2014: 1059) determined a wing beat frequency of 12.96 ± 0.18 Hz.

FUNCTIONAL MORPHOLOGY:
Gardiner and Nudds (2011: 2187), in their study of flight-initiating jumps, found that *M. capaccinii* did not show a reduced jumping performance, which could have been expected due to the large feet, which leads to extra weight at the extremities.

ECHOLOCATION:
Highly variable depending on activity and habitat; these data refer to cruising calls in the main habitat. Search-phase call-shape (while hunting above water surface): hyperbolic FM. Start-frequency: 43 kHz; end-frequency: 22 kHz; frequencies with maximum energy: 28 - 35 kHz; call-duration: 6 - 9 msec, inter-call interval: 145 - 165 msec (Barataud, 2002, 2005).
The data for 56 animals from Greece were the following: F_{start}: 89.7 ± 7.35 kHz, F_{end}: 35.1 ± 2.18 kHz, F_{peak}: 48.9 ± 4.76 kHz, bandwidth: 14.2 ± 9.93 kHz, duration 4.6 ± 0.77 msec and interpulse interval: 75.4 ± 22.97 msec (Papadatou *et al.*, 2008b: 132).
Walters *et al.* (2012: suppl.) report the next figures for 30 calls of bats from France and Italy: duration: 3.62 ± 1.40 msec, F_{max}: 73.51 ± 9.28 kHz, F_{min}: 36.6 ± 3.18 kHz, bandwidth: 36.91 ± 10.73 kHz, F_{peak}: 52.2 ± 6.93 kHz.
The following data for 20 calls from Iran were reported by Benda *et al.* (2012a: 182): F_{start}: 66.0 ± 12.3 (53.1 - 87.1) kHz, F_{end}: 48.9 ± 2.0 (46.6 - 52.6) kHz, F_{peak}: 52.9 ± 1.9 (49.9 - 55.3) kHz, duration: 5.3 ± 0.7 (3.9 - 6.3) msec, and interpulse interval: 49.1 ± 20.4 (19.4 - 84.4) msec. Mehdizadeh *et al.* (2018: 1) reported that isolation calls of 1 to 4 day old Iranian *M. capaccinii* were FM shallow calls with longer duration (7.54 ± 1.83 ms) and lower F_{peak} (20.07 ± 0.89 kHz) as compared to adult female calls (2.35 ± 0.75 ms and 54.02 ± 4.34 kHz). Between days 12 and 16, the calls began to sounc more like these of the adults.

Aizpurua *et al.* (2013: 4) indicate that *M. capaccinii* is able to regulate the temporal component of the echolocation call so that they can modify their capturing technique depending on whether they are hunting for aquatic arthropods or fish.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Capanna *et al.* (1968) and Rushton (1970: 463) reported 2*n* = 44, aFN = 50, X = metacentric, Y = acrocentric for specimens from Italy, while Pérez-Suárez *et al.* (1991) reported 2*n* = 44, aFN = 52, X = submetacentric, Y = acrocentric for specimens from Spain.
From Italy, Capanna and Manfredi Romanini (1971: 474) mention 2*n* = 44, aFN =60, 3 metacentric pairs of chromosomes, 1 submetacentric and 17 acrocentric; with the X chromosome being metacentric and the Y chromosome acrocentric.

Karaman *et al.* (2017: 119) indicate that the ddRAD and mtDNA structure suggests that three lineages in the Mediterranean area could be considered different species, but this needs to be investigated further.

Protein / allozyme - Unknown.

HABITAT:
In the eastern Iberian peninsula, Almenar *et al.* (2006: 157) report that *M. capaccinii* only used aquatic habitats as foraging sites, and that most of their foraging activity was on rivers.

M. capaccinii preferentially used river stretches characterised by an open course and smooth water surfaces (Almenar *et al.*, 2012). They shifted foraging stretches seasonally, likely following the spatiotemporal dynamics of prey production over the watershed (Almenar *et al.*, 2012).

HABITS:
Aihartza *et al.* (2008: 287) describe the fishing behaviour of *M. capaccinii* as observed in a flight tent containing an artificial pool. They distinguished two patterns: "A) long series of circular flights, skimming along the water and dipping in softly twice or three times in each roundabout; B) long figure-eight loops with bats flying faster and higher, swooping down on the centre of the pond, where they snapped their hind feet hard into the water." They also suggest (p. 297) that the bats detect the presence of fish by touching them when they dip their feet into the water.

ROOST:
Within the Iberian Peninsula, within the lower basin of the Xúquer River, Almenar *et al.* (2012) reported a main roost within a limestone cave with a variable colony size through the season: 81 *M. capaccinii* during pre-breeding, 219 during lactation and 113 during weaning of 2004. More than 100 individuals inhabit the second roost during lactation, located 8.4 km from the first. Both roosts are shared with other bat species (*Rhinolophus euryale*, *Rhinolophus mehelyi*, *Myotis blythii*, *Myotis myotis*, *Myotis emarginatus*, *Myotis nattereri* and *Miniopterus schreibersii*) (Almenar *et al.*, 2012).

DIET:
Aihartza *et al.* (2008: 288) indicate that in the Mediterranean arean aquatic arthropods (e.g. Diptera: Culicidae and Chironomidae) form the main prey of this species, supplemented by Trichoptera, Neuroptera, Lepidoptera, Heteroptera and arachnids. But its diet also contains fish.
Although some *M. capaccinii* populations are known to eat fish in the wild Aihartza *et al.*, 2003; Levin *et al.*, 2006; Biscardi *et al.*, 2007), the diet of the surveyed individuals appeared to be exclusively arthropods (Almenar, 2008).
On the Iberian peninsula, Aizpurua *et al.* (2011: 48) examined 2600 guano samples and retrieved 97 otoliths, all from the mosquitofish (*Gambusia holbrooki*) which would have been between 1.5 and 3.6 cm in length (maximum size of fishes: 5 cm in males and 8 cm in females, see Aihartza *et al.*, 2003: 196). They also found that one of the bats was able to eat between 8 and 15 fishes in one or two nights.

POPULATION:
Structure and Density - See Hutson *et al.*, 2008k) [in IUCN (2009)].
Trend - 2008 - Decreasing (Hutson *et al.*, 2008k; IUCN, 2009). *Myotis capaccinii* populations within the Asia Minor and Levant region are predicted to have a declining population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

REPRODUCTION AND ONTOGENY:
In Greece, most females were pregnant by the second half of April and had given birth before the end of May. The first flying young were found by the end of June or the beginning of July (Papadatou *et al.*, 2008a 509).

In Iran, Mehdizadeh *et al.* (2018: 1) found the forearm length of neonates to be 19.59 ± 1.23 mm, with a linear growth of 0.74 mm/day until day 28. The weight at day one was 3.59 ± 0.23 g, and this increased linearly with 0.15 g/day until day 28.

PARASITES:
In Italy, Voyron *et al.* (2011: 193) reported the following fungal entities from carcasses: *Alternaria* sp., *Candida palmioleophila*, *Chrysosporium/Gymnoascus*, *Cladosporium cladosporioides*, Gimnoascacea, *Verticillium lecanii*, *Trichosporon chiropterorum*, *Mucor hiemalis f. hiemalis*, *Mucor racemosus*.

Ševcík *et al.* (2012: 35) report on the presence of the bat flies *Nycteribia pedicularia* Latreille, 1805, *Nycteribia schmidlii schmidlii* Schiner, 1853, and *Penicillidia dufourii* Westwood, 1835 on bats from Crete and Cyprus. *Nycteribia kolenati* Theodor & Moscona, 1954 and *Phthiridium biarticulatum* Hermann, 1804 were reported for the first time by Haelewaters *et al.* (2017: 1) from bats from Hungary.
From a non-specified area, Haelewaters *et al.* (2018: 794) added *Penicillidia conspicua* Speiser, 1901.

In Algeria, Bendjeddou *et al.* (2013: 325) reported two ectoparasites: *Cimex lectularius* (Linnaeus, 1758) (Hemiptera: Cimicidae) and *Rhipicephalus sanguineus* (Latreille, 1806) (Arachnidae: Ixodida: Ixodidae). Bendjeddou *et al.* (2017: 15) added the following species: *Nycteribia (Nycteribia) latreillii* (Leach, 1817) and *Phthiridium biarticulatum* Hermann, 1804 (Nycteribiidae); *Brachytarsina (Brachytarsina) flavipennis* Macquart, 1851 (Streblidae) and *Spinturnix myoti* (Kolenati, 1856) and *Ixodes vespertilionis* Koch, 1844 (Arachnida).

VIRUSES:
Paramyxoviridae
Morbillivirus

This virus was reported from Bulgaria, Germany and Romania by Kohl and Kurth (2014: 3113).

UTILISATION:
The species is collected for medicinal purposes in North Africa (Hutson *et al.*, 2008k; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Morocco, Tunisia.

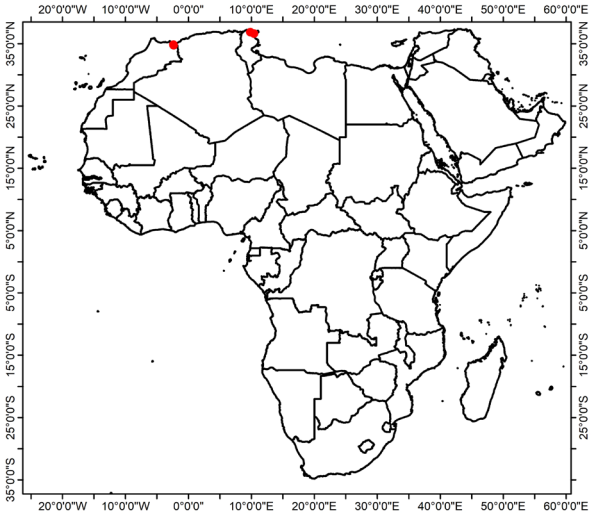


Figure 240. Distribution of *Myotis capaccinii*

Myotis dieteri M. Happold, 2005

*2005. *Myotis dieteri* M. Happold, Acta Chiropt., 7 (1): 11, figs 1 - 2. Type locality: Congo: Loudima: Grotte du Viaduc [04 15 S 13 00 E] [Goto Description]. Holotype: MNHN ZM-MO-1985-1925: ad ♀, alcoholic and cranium only (no mandibula). Collected by: Jean-Paul Adam; collection date: between 1961 and 1968. - Etymology: In honour of Dr. Dieter Kock of the Senkenberg Museum, Frankfurt, Germany, in recognition of the great contribution he made to the knowledge of African mammals, in recognition of the kindness and generosity with which he has helped so many others with their studies, and in gratitude for our long firendship (see Happold, 2005: 11). (Current Combination)

TAXONOMY:
Known only from the type specimen (Happold, 2005: 11).

Csorba *et al.* (2014: 668) indicate that *dieteri* is probably the only sub-Saharan *Myotis* that doesn't belong to the subgenus *Chrysopteron*, but molecular data are missing to confirm this.

COMMON NAMES:
Czech: netopýr Kockův. French: Murin de Kock. German: Kocks Mausohr.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since it has only recently been described, and there is still very little information on its extent of occurrence, status, threats and ecological requirements (Happold, 2008; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Happold, 2008; IUCN, 2009).

MAJOR THREATS:
The threats to this species remain unknown (Happold, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Happold (2008) [in IUCN (2009)] reports that it is not known if the species is present within any protected areas. Additional studies are needed into the distribution, abundance, breeding biology and general ecology of this species. There is a need to determine if the species is still present at Grotte du Viaduc à Loudima, and to locate additional populations through directed surveys.

GENERAL DISTRIBUTION:
Myotis dieteri has only been recorded from type locality of 'Grotte du Viaduc à Loudima, Republic of Congo (04º15'S, 13º00'E) (Happold, 2005: 11). Despite extensive surveys of other seemingly suitable localities, it has not been recorded from additional caves in the Loudima-Kimongo region, or from caves in the Mayombe and lower Kouilou regions of Congo, the Haut-Ivindo region of Gabon, or Kikwit in the Democratic Republic of Congo (Happold, 2005).

Native: Congo (Happold, 2005: 11; Bates *et al.*, 2013: 337).

POPULATION:
Structure and Density - It is known only from the holotype collected by Jean-Paul Adam sometime

between 1961 and 1968, from a small number of this species present in the cave (Happold, 2005). Trend - 2008 - Unknown (Happold, 2008; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo.

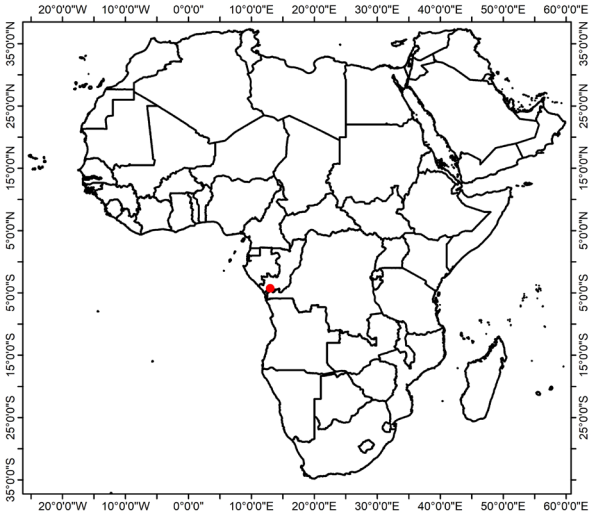


Figure 241. Distribution of *Myotis dieteri*

Myotis emarginatus (E. Geoffroy St.-Hilaire, 1806)

*1806. *Vespertilio emarginatus* E. Geoffroy Saint-Hilaire, Ann. Mus. Hist. nat. Paris, 8: 198. Type locality: France: Ardennes: Givet: Charlemont. Holotype: MNHN 819-202: ad, mounted skin (skull not removed). Additional skull A6953: see Rode (1941: 244), who mentions Abbeville as locality, and M. Baillon as collector.
? *Myotis emarginata:* - Comments: corrected gender for specifc name. (Alternate Spelling)
? *Myotis emarginatus emarginatus:* (Name Combination)
? *Myotis emarginatus:* (Name Combination, Current Combination)

TAXONOMY:
Assigned to the subgenus *Isotus* by Pavlinov *et al.* (1995: 97), but Csorba *et al.* (2014: 667) include it in the subgenus *Chrysopteron*.

Woodman (1993) notes that many mammalian generic names ending in *-otis* use the wrong gender for specific names therefore this name should be *M. emarginata*. However, see also Benda and Tsytsulina (2000: 335), and Simmons (2005).

COMMON NAMES:
Albanian: Lakuriq nate i Geoffroy-it. Arabian: Khaffash. Armenian: Եռագույն գիշերաչղջիկ. Azerbaijani: Üçrə ng gecəşə bpə rə si. Basque: Geoffroy saguzar. Belarusian: Начніца трохкаляровая. Bosnian: Trobojni šišmiš. Breton: Gousperell Geoffroy. Bulgarian: Трицветен нощник. Castilian: Murciélago orejirroto, Murciélago de Geoffroy, Murciélago ratonero pardo. Catalan: Ratpenat d'orelles dentades, Ratapinyada d'orella escapçada. Croatian: Riđi šišmiš. Czech: Netopýr brvitý, Netopýra brvitého, Nedopír wraubkowaný, N. brvitý, Stejnouš an zejkatý, Netopýrec brvitý). Danish: Geoffroys flagermus. Dutch: Ingekorven vleermuis. English: Geoffroy's Bat, Notch-eared Bat, Geoffroy's Myotis. Estonian: Ripslendlane. Finnish: Ruskosiippa. French: Murin à oreilles échancrées, Vespertilion à oreilles échancrées, Vespertilion échancré. Frisian: Ynsniene flearmûs. Galician: Morcego de orellas fendidas. Georgian: სამფერი მღამიობი. German: Wimperfledermaus, Kerbohrige Ohrenfledermaus, Fledermaus mit gerändelten Ohren. Greek: Πυρρομυωτίδα Hebrew: Nishpon Pgoom Ozen. Hungarian: Csonkafülű denevér, Nycteris i blephardoti. Irish Gaelic: Ialtóg Geoffroy. Italian: Vespertilio smarginato, Vespertilio smarginato. Latvian: Skropstainais naktssikspārnis. Lithuanian: Trispalvis pelė ausis. Luxembourgish: Wimperefliedermaus. Macedonian: Тробоен ноќник [= Troboen Nokjnik]. Maltese: Farfett il-Lejl ta' Widnejħ Imnaqqxa. Montenegrin: Riđi večernjak. Norwegian: Vinkeløreflaggermus, Geoffroyflaggermus. Polish: Nocek orzę siony. Portuguese: Morcego-lanudo. Rhaeto-Romance: Vespertil cun tschegls, Vespertil cun tscheglias. Romanian: Liliacul cărămiziu, Liliac-cu-gene-lungi. Russian: Ночница трёхцветная, Трехцветная ни1086\чница [= Tryokhtsvetnaya nochnitsa]. Serbian: Риђи вечерњак [= Riđi večernjak]. Scottish Gaelic: Ialtag Geoffroy. Slovak: Netopier brvitý. Slovenian: Vejicati netopir. Swedish: Flikörad fladdermus. Turkish: Kirpikli Yarasa. Ukrainian: Нічниця триколірна. Welsh: Ystlum Geoffroy.

CONSERVATION STATUS:
Global - The species experienced a significant decline in at least parts of its range from the 1960s to the 1990s, but now it is expanding in central Europe and is stable or not significantly declining elsewhere. The range is still large and the species is not specialized to restricted habitat, although it has a very specialized diet. Assessed as Least Concern (LC ver 3.1 (2001)) (Hutson *et al.*, 2008m; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Hutson *et al.*, 2008m; IUCN, 2009). 1996 - VU A2c ver 2.3 (1994) (Baillie and Groombridge, 1996).

MAJOR THREATS:
In Europe the species is mainly associated with agricultural landscapes, therefore all agricultural activities can affect populations of this species. Loss of and disturbance to roost sites in buildings (including remedial timber treatment in attics) and underground sites are also threats. In the African part of the range, cave habitats, where the species roosts, are being destroyed by fires and vandalism. The species is also collected for traditional medicine practices in North Africa (Hutson *et al.*, 2008m; IUCN, 2009).

CONSERVATION ACTIONS:
Hutson *et al.* (2008m) [in IUCN (2009)] report that it is protected by national legislation in most range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention in the range states where these apply. It is included in Annex IV of EU Habitats and Species Directive, and there is some habitat protection through Natura 2000.
Protection of roosts and promotion of awareness about the lack of medicinal value of the species is required.

GENERAL DISTRIBUTION:
Myotis emarginatus occurs in southern Europe from Portugal in the west to the Balkans in the east and southern part of western and central Europe and non-arid parts of southwestern Asia from Asia Minor, Caucasus region and Palestine to Oman, Uzbekistan and Tajikistan; also in north-west Africa (recorded from northern Maghreb (Algeria, Morocco and Tunisia)). In the eastern part of the Mediterranean it occurs in various parts of Turkey, Syria, Lebanon and Israel. It occurs from sea level to 1,800 m, highest records in the Alps are 812 m (maternity colony) and 1,505 m (hibernaculum) (Spitzenberger, 2002).

Native: Afghanistan; Albania; Algeria; Andorra; Armenia; Austria; Azerbaijan; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; Cyprus; Czech Republic; France [Corse]; Georgia; Germany; Gibraltar; Greece [Kriti] (Benda *et al.*, 2007: 71); Hungary; Iran, Islamic Republic of; Israel; Italy [Sardegna]; Jordan; Kazakhstan; Kyrgyzstan; Lebanon; Luxembourg; Macedonia, the former Yugoslav Republic of; Monaco; Montenegro; Morocco (El Ibrahimi and Rguibi Idrissi, 2015: 360); Netherlands; Oman; Poland; Portugal; Romania; Russian Federation; San Marino; Saudi Arabia; Serbia; Slovakia; Slovenia; Spain [Baleares]; Switzerland; Syrian Arab Republic; Tajikistan; Tunisia (Dalhoumi *et al.*, 2014: 53); Turkey; Turkmenistan; Ukraine; Uzbekistan.

ECHOLOCATION:
Highly variable depending on activity and habitat; these data refer to cruising calls in the main habitat. Search-phase call-shape (close to foliage): steep linear FM. Start-frequency: 110 kHz; end-frequency: 39 kHz; frequency with maximum energy: 65 kHz; call-duration: 2.6 msec; inter-call interval: 26-32 msec (Barataud, 2005).

The data for 42 animals from Greece were the following: F_{start}: 110.5 ± 10.90 kHz, F_{end}: 42.6 ± 5.57 kHz, F_{peak}: 72.8 ± 7.28 kHz, bandwidth: 43.4 ± 8.29 kHz, duration 3.3 ± 0.73 msec and interpulse interval: 79.4 ± 23.83 msec (Papadatou *et al.*, 2008b: 132).
Walters *et al.* (2012: suppl.) report the following figures for 26 calls (24 sequences) from France and Germany: duration: 2.29 ± 0.70 msec, F_{max}: 93.23 ± 20.18 kHz, F_{min}: 42.00 ± 3.47 kHz, bandwidth: 51.23 ± 17.78 kHz, F_{peak}: 60.23 ± 15.14 kHz.

MOLECULAR BIOLOGY:
DNA - See García-Mudarra *et al.* (2009).

Karyotype - Bovey (1949) and Pérez-Suárez *et al.*, 1991) reported 2*n* = 44, aFN = 50, X = submetacentric, Y = acrocentric, while Radjhabli *et al.* (1970) reported aFN = 56 and Zima (1978) aFN = 52 with X = metacentric. The autosomal component consists of three large metacentric, one small metacentric, 15 acrocentric and two dot-like pairs (with one being bi-armed) (Arslan and Zima, 2014: 10). The latter authors also refer to the X chromosome as being a medium-sized metacentric.

HABITAT:
In Spain, Goiti *et al.* (2011: 19) found that *M. emarginatus* flew on average 5 km to its foraging areas, with a maximum distance of almost 10 km. The foraging area covered between 120 and 371 ha, and consisted mainly of scrubland (35 % of mean individual foraging time) and pine plantations (34 % of mean individual foraging

locations), followed by isolated trees (oak, pine, or eucalyptus - on average 11 %), riparian woods (7 %), oak dehesas (6 %), and eucalyptus plantations (5 %).

DIET:
Goiti *et al.* (2011: 20) found that, in Spain, spiders made up the major part of the diet by both volume (mean 79 %) and frequency (in feces of all examined bats, and in 95 % of the feces). The next most important group was formed by moths, with a mean consumption of 7 % of the diet by volume; dipterans (flies and midges - 6.3 %), and lacewings (especially the family Hemerobiidae - 4.4 %). Earwings, harvestmen, wasps, and beetles all made up less than 2 % of the diet.
Benda *et al.* (2012a: 325) summarizes the European food groups as: Araneae, Lepidoptera, brachyceran Diptera, and Lepidoptera larvae. In the Middle East Diptera, Lepidoptera, Coleoptera, and Homoptera are prevailing in Azerbaijan, Araneae and Brachycera in Syria, and Hemiptera, Araneae, and Brachycera in Turkey. In Iran, there was a high proportion of Tipulidae, and in Jordan of scarabaeid beetles. This lead Benda *et al.* (2012a: 325) to conclude that a certain level of flexibility of the trophic niche in *M. emarginatus*.

POPULATION:
Structure and Density - Locally it can be rare or common. The species experienced a significant decline from the 1960s to the 1990s, but in recent time the numbers in several regions have increased and the species has spread into new areas. It lives in large colonies (up to 1,200 individuals in Austria in one maternity colony) (Hutson *et al.*, 2008m; IUCN, 2009).
Trend - 2008 - Stable (Hutson *et al.*, 2008m; IUCN, 2009). *M. emarginatus* populations within the Asia Minor and Levant region are predicted to have a stable population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

PARASITES:
Frank *et al.* (2015: 8) mention the following parasites for European *M. emarginatus*:
Arachnida: *Eyndhovenia euryalis* (G. Canestrini, 1885), *Macronyssus rhinolophi* (Oudemans, 1902), *Steatonyssus periblepharus* Kolenati, 1858, *Spinturnix emarginata* (Kolenati, 1856).

Insecta: *Basilia nana* Theodor & Moscona, 1954, *Basilia italica* Theodor, 1954, *Cimex pipistrelli* Jenyns, 1839, *Ischnopsyllus emarginatus*, *Ischnopsyllus simplex* Rothschild, 1906, *Penicillidia dufourii* (Westwood, 1835), *Phthiridium biarcticulatum*, *Rhinolophopsylla unipectinata* (Taschenberg, 1880).

Trematoda - Digenea: *Lecithodendrium linstowi* Dollfus, 1931, *Prosthodendrium aelleni* Dubois, 1956, *Prosthodendrium chilostomum* (Mehlis, 1831).

Cestoda: *Myotolepis grisea* (Beneden, 1873).

Bendjeddou *et al.* (2017: 15) mention the following parasites from bats from Algeria: Nycteribiidae: *Nycteribia (Nycteribia) latreillii* (Leach, 1817) and *Penicillidia (Penicillidia) dufourii* Westwood, 1835; Arachnida: *Spinturnix myoti* (Kolenati, 1856) and *Ixodes vespertilionis* Koch, 1844.

VIRUSES:
Orthomyxoviridae
Despite sampling and testing of 3 individuals of this species, no evidence of influenza A-like viruses (Orthomyxoviridae) were obtained (Fereidouni *et al.*, 2015).

UTILISATION:
The species is also collected for traditional medicine practices in North Africa (Hutson *et al.*, 2008m; IUCN, 2009).

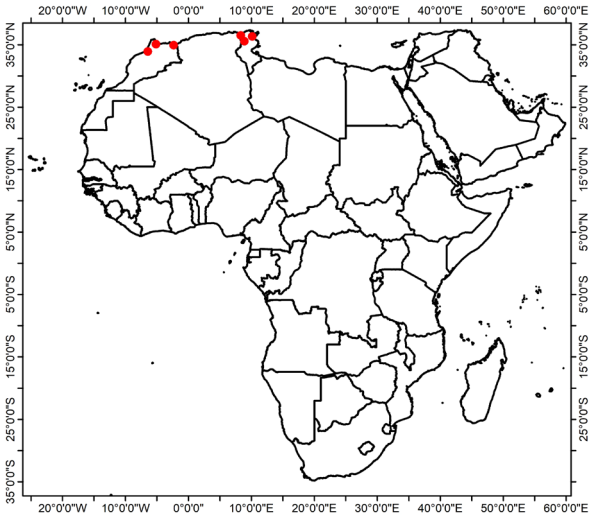


Figure 242. Distribution of *Myotis emarginatus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, France, Macedonia, Morocco, Tunisia.

Myotis goudoti (A. Smith, 1834)

*1834. *Vespertilio goudoti* A. Smith, S. Afr. Quart. J., ser. 2, 2: 244. Publication date: June 1834. Type locality: Madagascar: "Madagascar" [Goto Description].

1858. *Vespertilio Madagascariensis* Tomes, Proc. zool. Soc. Lond., 1858, XXVI (ccclii): 89. Publication date: 27 April 1858. Type locality: Madagascar: "Madagascar". Holotype: BMNH 1907.1.1.503:.
1870. *Vespertilio sylvicola* A. Grandidier, Rev. Mag. Zool., ser. 2, 22: 49. Publication date: February 1870. Type locality: Madagascar: Ambaravantao forest [Goto Description]. - Comments: The type locality was mentioned as "Forests of Ambaravaranvatou" by Allen (1939a: 91). Dobson (1878: 301, footnote) indicates that the type has been lost and that the description is insufficient. He, therefore, included it with a question mark.
? *Myotis goudoti goudoti:* (Name Combination)
? *Myotis goudoti:* (Name Combination, Current Combination)

TAXONOMY:
Simmons (2005) states that it does not appear to include *anjouanensis*; see Peterson *et al.* (1995).

Csorba *et al.* (2014: 667) include *goudoti* in the subgenus *Chrysopteron*, but Ruedi and Mayer (2001: 436), Ghazali *et al.* (2016: 476) and Patterson *et al.* (2019: "2") reject the division in subgenera.

COMMON NAMES:
Czech: netopýr madagaskarský. English: Malagasy Mouse-eared Bat. French: Murin de Madagascar, Chauve-souris malgache à oreille de souris, Vespertilion de Madagascar. German: Madagaskar-Mausohr.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Samonds (2007: 60) found samples in deposit (SS2), which was collected from the surface near the main cave entrance, dating attemps revealed this sample was contaminated, therefore no date is known for this locality in Anjohibe cave, Madagascar.

Weyeneth (2010) indicated that, during the Pleistocene, populations of this speciesi diverged into a southern and a northern component, with subsequent expansion and adaptation to all biomes.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) in view of its widespread distribution across Madagascar, and the absence of any major threats. Close monitoring of roosting colonies in areas where the forest is subject to disturbance is needed (Andriafidison *et al.*, 2008h; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Andriafidison *et al.*, 2008h; IUCN, 2009). 1996 - LR/nt ver 2.3 (1994) (Baillie and Groombridge, 1996).

MAJOR THREATS:
There are no known threats to this species although additional research is needed to determine the impact of forest degradation on its persistence in cave roosts (IUCN, 2009; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008h) [in IUCN (2009)] report that this is a widespread species that is found in many of Madagascar's protected areas, including those in the east and west of the island (Goodman, 1999; Russ *et al.*, 2003; Goodman *et al.*, 2005a).

GENERAL DISTRIBUTION:
Myotis goudoti is endemic to the island of Madagascar (Simmons, 2005) where it is widely distributed across a range of different vegetation types (Peterson *et al.*, 1995; Goodman, 1999; Eger and Mitchell, 2003; Russ *et al.*, 2003; Goodman *et al.*, 2005a), including Nosy Be and Nosy Komba (Rakotonandrasana and Goodman, 2007: 6).

Native: Madagascar (Peterson *et al.*, 1995; Goodman, 1999; Eger and Mitchell, 2003; Russ *et al.*, 2003; Goodman *et al.*, 2005a; Rakotonandrasana and Goodman, 2007: 6).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 64) reported the structure as being triangular, and in some cases, with a pronounced proximal indentation; length: 0.87 ± 0.111 (0.68 - 1.02) mm, width: 0.53 ± 0.081 (0.43 - 0.67) mm.

ECHOLOCATION:
Russ *et al.* (2003) describe the echolocation as a single frequency-modulated sweep from 75 kHz to 55 kHz. Kofoky *et al.* (2009: 382) reported the calls of 11 individuals, which were characterized by broadband FM sweeps produced at low duty cycle. The most energy always found in the fundamental at about 64.4 kHz, and the pulses were very short about 3 ms.

MOLECULAR BIOLOGY:
DNA.- Unknown.
Karyotype.- Richards *et al.* (2010) examined one female and one male having a 2*n*=44 and a FNa=

50, a submetacentric X and small acrocentric Y chromosome. In addition, Volleth and Eick (2012: 167) mention a segment number of 22.

HABITAT:
Dammhahn and Goodman (2013: 108) mention the lower portion of forest structure and partially open areas as the foraging habitat for this species.

ROOST:
Wilkinson *et al.* (2012: 160) indicate that caves are the typical roosting sites for these bats on Madagascar. Ravelomanantsoa *et al.* (2019: 110) added crevices and possibly tree holes.

DIET:
Razakarivony *et al.* (2005) found Araneae in 27 % of stomachs examined. Rakotoarivelo *et al.* (2007) in Madagascar found *M.goudoti* to mainly consumed Hymenoptera, Neuroptera, Araneae and fragments of spiders were present in 55 % of the fecal samples.

Rakotondramanana *et al.* (2015: 78) report the following diet items (volume percent, frequency percent): Coleoptera (34.0, 100.00); Hymenoptera (4.0, 60.0); Lepidoptera (62.0, 100.0). Rasoanoro *et al.* (2015: 64) found the following volume percentages for two specimens: Aranea (40.7), Coleoptera (43.7), Hymenoptera (8.4), Isoptera (4.6), Lepidoptera (2.5).

Kemp *et al.* (2018: Suppl.) used DNA metacarcoding to detect insect pest species in the diet of these bats and found the following prey orders (in descending order): Coleoptera, Hymenoptera, Lepidoptera (*Homona* sp., *Thaumatotibia batrachopa* (Meyrick, 1908)), Diptera (*Simulium lineatum* (Meigen, 1804), *Culex* sp., *Culex annulioris* Theobald, 1901, *Coquillettidia* sp., *Anopheles* sp.), Sarcoptiformes, Ephemeroptera, Hemiptera, Araneae, Blattodea, Trichoptera, Symphypleona, Mesostigmata, Trombidiformes.

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of one individual in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

POPULATION:
Structure and Density - Although widespread, there is a paucity of information on the population status of *M. goudoti*. It is frequently trapped in mist nets during bat surveys and appears to be at least locally abundant in west (Kofoky *et al.*, 2007; Rakotoarivelo and Randrianandrianina, 2007), but is more difficult to net, or is less abundant in the east (Russ *et al.*, 2003; Randrianandriananina *et al.*, 2006). There are few data available on roosting colonies but aggregations of up to 1,000 individuals have been recorded.
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008h; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Rakotoarivelo *et al.* (2007) suggest that *M. goudoti* is better adapted to forage in cluttered areas and may have a closer association with forest vegetation. They also suggest that *M. goudoti* may be a gleaner.

PARASITES:
BACTERIA
Lagadec *et al.* (2012: 1696), Dietrich *et al.* (2014: Suppl.) and Gomard *et al.* (2016: 5) report the presence of spirochaetes bacteria of the genus *Leptospira*, which are assigned to *L. borghpetersenii* by Dietrich *et al.* (2018a: 3). Lei and Olival (2014: Suppl.) mention *M. goudoti* as host for *Bartonella* bacteria.

HAEMOSPORIDA
Megali *et al.* (2010: 1042) and Duval *et al.* (2012: 1563) reported Genbank data for *Polychromophilus* sp. from *M. goudoti*. Ramasindrazana *et al.* (2018: Suppl.) identified this parasite as *Polychromophilus murinus* Dionisi, 1899.

Ramasindrazana *et al.* (2016: 6) reported the presence of an unnamed filariod in this bat species.

DIPTERA
Nycteribiidae: Ramasindrazana *et al.* (2017: Suppl.) found the bat flies *Nycteribia stylidiopsis* and *Penicillidia* sp. on specimens from this bat species.

ACARI
Trombiculidae: Stekolnikov (2018a: 116) reported *Trisetica aethiopica* (Hirst, 1926) from this bat species.

VIRUSES:
Astroviridae
Lebarbenchon *et al.* (2017 Suppl.) tested 14 animals and three of them was positive for Astroviruses.

Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 2 individuals from the Madagascar using RT-PCR specific for Respirovirus/Morbillivirus/Henipahvirus (RMH) and Paramyxovirinae (PMV) and found 0 positive results for viral nucleic acids. Wilkinson *et al.* (2014) tested 8 individuals from Anjohikinakia and Bekoaky in Madagascar with an RT-PCR specific

for the *Respiro-*, *Morbilli-* and *Henipavirus* genera, two of the 8 individuals tested positive for paramyxovirus RNA.
48 Madagascan *M. goudoti* specimens were tested by Mélade *et al.* (2016b: 4) and five of them were positive for paramyxoviruses.

Rhabdoviridae
Of the 11 bats tested by Mélade *et al.* (2016a: 6), four showed a seroreaction.

UTILISATION:
See Goodman *et al.* (2008d).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar.

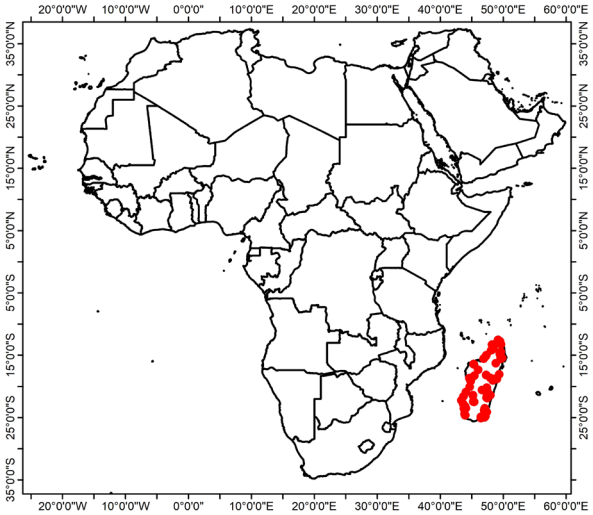


Figure 243. Distribution of *Myotis goudoti*

Myotis morrisi Hill, 1971

*1971. *Myotis morrisi* Hill, in: Hill and Morris, Bull. Br. Mus. (nat. Hist.) Zool., 21 (2): 43, pl. 1, 2 (a, b). Publication date: 28 April 1971. Type locality: Ethiopia: Walaga, Blue Nile Gorge: Didessa River mouth: "Forward Base Three" [10 05 N 35 38 E, ca. 1 000 m] [Goto Description]. Holotype: BMNH 1970.488: ad ♀, skin and skull. Collected by: The Great Abbai Expedition; collection date: 28 August 1968; original number: A107. (Largen, Yalden & King). Also see Hill and Morris (1971: 43). - Etymology: In honour of Dr. Pat Morris of Royal Holloway College, University of London, in recognition of his many services to the study of the Ethiopian fauna while with the Great Abbai Expedition (Hill in Hill and Morris, 1971: 44). (Current Combination)

TAXONOMY:
Known only from two specimens (see Stadelmann *et al.*, 2004b: 179).

COMMON NAMES:
Czech: netopýr Morrisův. English: Morris's Mouse-eared Bat, Morris's Bat, Morris's Myotis. French: Murin d'Ethiopie, Vespertilion de Morris. German: Morris' Mausohr.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, threats and conservation status (Jacobs *et al.*, 2008o; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008o; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Jacobs *et al.*, 2004b; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are unclear. It may be threatened by cave disturbance and subsistence harvesting for food (Jacobs *et al.*, 2008o; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008o) [in IUCN (2009)] report that it is not known if the species is present in any protected areas. Further studies are needed into the distribution, abundance, natural history, and threats to this poorly known species.

GENERAL DISTRIBUTION:
Myotis morrisi has only been recorded from two very disjunct sites, the type locality of 'Didessa River mouth, Walaga' in Ethiopia (Hill and Morris, 1971) and from Numan, Adamawa Province, in northeastern Nigeria (Hill *et al.*, 1988).

Native: Ethiopia (Hill and Morris, 1971); Nigeria (Hill *et al.*, 1988).

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Jacobs *et al.*, 2008o; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008o; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia, Nigeria.

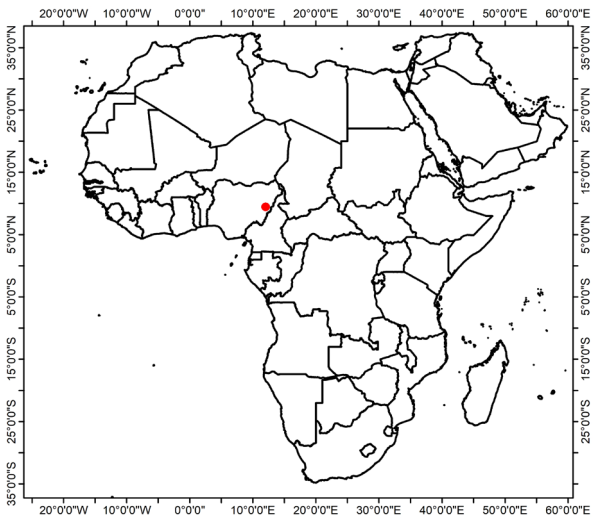


Figure 244. Distribution of *Myotis morrisi*

Myotis mystacinus (Kuhl, 1817)

*1817. *Vespertilio mystacinus* Kuhl, Die Deutsche Fledermäuse, 7, 58. Type locality: Germany. Syntype: ZMB 461: ♂, skin and skull. Unknown locality, presumably coll. Kuhl, purchased from Kuhl, 09.1818.: see Turni and Kock (2008: 60).
? *Myotis mystacinus:* (Name Combination, Current Combination)

TAXONOMY:
Despite the fact that numerous species have been recently recognized within this complex, the whiskered bats from Morocco are still included in the nominal form (von Helversen *et al.*, 2001; Mayer *et al.*, 2007; García-Mudarra *et al.*, 2009).

At present, this species includes three forms differing in morphological traits: *M. mystacinus mystacinus* (most of European range), *M. mystacinus occidentalis* (Iberia and Morocco) and *M. mystacinus caucasicus* (Caucasus region).

COMMON NAMES:
Albanian: Lakuriq nate me mustaqe. Armenian: Բեղավոր գիշերաչղջիկ. Azerbaijani: Bığ lı gecəşə bpə rə si. Basque: Saguzar biboteduna. Belarusian: Начніца вусатая. Bosnian: Mali brkati š iš miš. Breton: Gousperell varvek. Bulgarian: Мустакат нощник. Castilian: Murciélago bigotudo, Murciélago ratonero bigotudo. Catalan: Ratpenat de bigotis, Rat penat de bigotis. Croatian: Brkati šišmiš. Czech: Netopýr vousatý, nedopír walausatý, netopý rec vousatý. Danish: Skægflagermus. Dutch: Baardvleermuis, Gewone pisang blad vleermuis. English: Whiskered Mouse-eared Bat, Whiskered Bat, Whiskered Myotis, Mouse-eared bat. Estonian: Habelendlane. Finnish: Viiksisiippa. French: Murin à moustaches, Vespertilion à moustaches. Frisian: Burdflearmûs. Galician: Morcego bigotudo, Morcego de bigotes. Georgian: ულვაშა მღამიობი. German: Bartfledermaus, Kleine Bartfledermaus, Schnauzbärtige Fledermaus. Greek: Μουστακονυχτερίδα. Hungarian: Bajuszos denevér, Nycteris i mystakophoros. Indonesian: Kelelewar myotis pucuk. Irish Gaelic: Ialtóg ghiobach. Italian: Vespertilio mustacchino. Latvian: Bārdainais naktssikspārnis. Lithuanian: suotasis pelėausis. Luxembourgish: Kleng Baartfliedermaus. Macedonian: Мустаќест ноќник [= Mustakjest Nokjnik]. Maltese: Farfett il-Lejl Daqni. Montenegrin: Brkati večernjak. Norwegian: Skjeggflaggermus. Polish: Nocek wasatek. Portuguese: Morcego-de-bigodes. Rhaeto-Romance: Vespertil dal barbis, Vespertil pitschen dal barbis. Romanian: Liliacul mustăcio, Liliac-cu-mustăþi. Russian: Ночница усатая, Усатая ночница [= Usataya nochnitsa]. Serbian: Тамнолики бркати вечерњак [= Tamnoliki brkati več ernjak]. Scottish Gaelic: Ialtag ghibeach. Slovak: Netopier fúzatý. Slovenian: Brkati netopir, Skupina brkatih netopirjev. Swedish: Mustaschfladdermus. Turkish: Bıyıklı Siyah Yarasa. Ukrainian: Нічниця вусата. Welsh: Ystlum barfog.

CONSERVATION STATUS:
Global - *Myotis mystacinus* has a large population size and a wide distribution. No declines in population size have been detected, and there are no known widespread major threats. Assessed as Least Concern (LC ver 3.1 (2001)) (Hutson *et al.*, 2008r; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Hutson *et al.*, 2008r; IUCN, 2009).

MAJOR THREATS:
There are no major threats to this species overall, but the species is affected by loss of woodland and other aspects of land management and development. It is also affected by loss of and damage to roost sites in trees, buildings and underground habitats. In the African part of the species' range, cave habitats where the species roosts are being destroyed by fires and vandalism. This species is also collected for medicine, but not at a level that constitutes a threat to the species (Hutson *et al.*, 2008r; IUCN, 2009).

CONSERVATION ACTIONS:
Hutson *et al.* (2008r) [in IUCN (2009)] report that it is protected by national legislation in most range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention. It is included in Annex IV of EU Habitats and Species Directive, and there is some habitat protection through Natura 2000. It occurs in protected areas throughout its range. Protection of cave roost sites is required.

GENERAL DISTRIBUTION:
Myotis mystacinus is a western Palaearctic species, occurring in western and central Europe, southern parts of Scandinavia, the British Isles, Morocco, northern parts of eastern Europe, western parts of the Caucasus and the Urals. The occurrence in southeast Europe is questionable but likely. It is marginal in Africa, restricted to Moroccan mountains from the Rif in the north to the southern slope of High Atlas in the south. It has been recorded from sea level up to 1,920 m asl (Gerell, 1999).

Native: Andorra; Armenia; Austria; Azerbaijan; Belgium; Bosnia and Herzegovina; Bulgaria; China; Croatia; Czech Republic; Denmark; Estonia; Finland; France [Corse]; Georgia; Germany; Greece [Kriti]; Hungary; Ireland; Italy; Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Yugoslav Republic of; Montenegro; Morocco (Benda *et al.*, 2004d; El Ibrahimi and Rguibi Idrissi, 2015: 360); Netherlands; Norway; Poland; Romania; Russian Federation; Serbia; Slovakia; Slovenia; Spain; Sweden; Switzerland; Turkey; Ukraine; United Kingdom.
Regionally extinct: Portugal.
Presence uncertain: Albania; Lebanon.

ECHOLOCATION:
Papadatou *et al.* (2008b: 132) report the following data for 1 Greek specimen belonging to *M. mustacinus bulgaricus*: F_{start}: 104.0 kHz, F_{end}: 33.6 kHz, F_{peak}: 47.7 kHz, bandwidth: 9.1 kHz, duration 3.8 msec and interpulse interval: 72.7 msec.
Data for 51 calls from France, Greece, Switzerland, and the UK, presented by Walters *et al.* (2012: suppl.) include: duration: 2.36 ± 0.59 msec, F_{max}: 84.76 ± 14.10 kHz, F_{min}: 37.04 ± 3.24 kHz, bandwidth: 47.72 ± 14.14 kHz, F_{peak}: 51.55 ± 7.70 kHz.

MOLECULAR BIOLOGY:
DNA - See von Helversen *et al.* (2001), Mayer *et al.* (2007), García-Mudarra *et al.* (2009).

Karyotype - Bovey (1949) reported a 2*n* = 44, aFN = 50, X = metacentric, Y = acrocentric, while Zima (1978) found aFN = 52. Arslan and Zima (2014: 9) added an FN of 54 and that the autosomal component consists of three large metacentric, one small metacentric, 15 acrocentric and two dot-like pairs.

POPULATION:
Structure and Trend - In Europe, it is one of the more common species within the regular distribution area. It is very rare in North Africa, with only 25 specimens in 4 locations (Hutson *et al.*, 2008r; IUCN, 2009).
Trend - 2008 - Unknown (Hutson *et al.*, 2008r; IUCN, 2009).

PARASITES:
In Europe, Genov *et al.* (1992) reported the presence of the following Nematodes: *Molinostrongylus alatus* (Ortlepp, 1932), *M. skrjabini* Skarbilovitch, 1934, *M. spasskii* Andrejko, Pinchuk and Skvorzov, 1968, and *M. vespertilionis* Morosov and Spassky, 1961.

Frank *et al.* (2015: 8) provide the following overview for parasites in European *M. mystacinus*: Arachnida: *Argas vespertilionis* (Latreille, 1796, *Ixodes* sp., *Ixodes vespertilionis* Koch, 1844, *Macronyssus ellipticus* (Kolenati, 1857), *Macronyssus flavus* (Kolenati, 1856), *Spinturnix kolenatii* Oudemans, 1910, *Spinturnix myoti* (Kolenati, 1856), *Spinturnix mystacinus* (Kolenati, 1857), *Steatonyssus periblepharus* Kolenati, 1858, *Steatonyssus spinosus* Wilmann, 1936.

Insecta: *Basilia nana* Theodor & Moscona, 1954, *Basilia nattereri* Kolenati, 1857, *Basilia italica* Theodor, 1954, *Cimex pipistrelli* (Jenyns, 1839), *Ischnopsyllus hexactenus* (Kolenati, 1856), *Ischnopsyllus mysticus* Jordan, 1942, *Ischnopsyllus octactenus* (Kolenati, 1856), *Ischnopsyllus simplex* Rotschild, 1906, *Ischnopsyllus variabilis* (Wagner, 1898), *Myodopsylla trisellis* Jorda, 1929, *Nycteribia kolenatii* Theodor and Moscona, 1954, *Nycteribia pedicularia* Latreille, 1805, *Nycteridopsylla*

longiceps Rotschild, 1908, *Nycteridopsylla pentactena* (Kolenati, 1856).

Trematoda - Digenea: *Lecithodendrium linstowi* Dollfus, 1931, *Plagiorchis vespertilionis* (Muller, 1784), *Prosthodendrium chilostomum* (Mehlis, 1831).

Nematoda: *Molinostrongylus alatus* (Ortlepp, 1932), *Molinostrongylus spasskii* Andrejko, Pintschuk and Skvorzov, 1968, *Molinostrongylus vespertilionis* Morosov and Spassky, 1961.

Cestoda: *Vampirolepis balsaci* (Joyeux and Baer, 1934).

VIRUSES:
Orthomyxoviridae
Despite sampling and testing of 44 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

UTILISATION:
Species are also collected for medicine, but not at a level that constitutes a threat to the species (Hutson *et al.*, 2008r; IUCN, 2009).

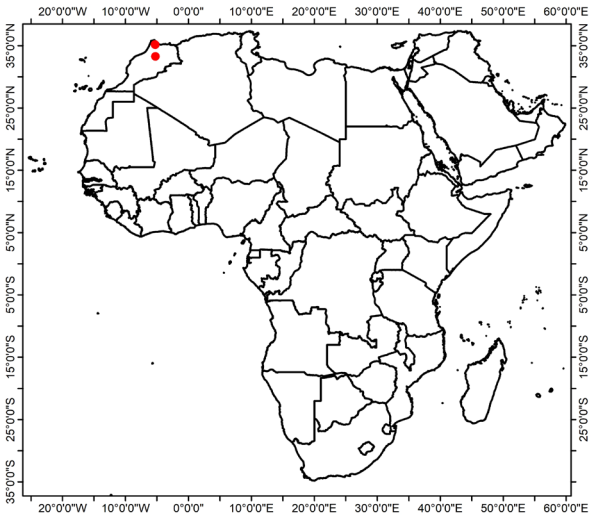


Figure 245. Distribution of *Myotis mystacinus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Morocco.

Myotis punicus Felten, 1977

1875. *Vespertilio murinus africanus* Dobson, Ann. Mag. nat. Hist., ser. 4, 16 (94): 260. Publication date: 1 October 1875. Type locality: Gabon: "Gaboon". Holotype: BMNH 1873.4.16.5:. . - Comments: The type locality was originally mentioned as 'Gaboon', but the specimen is more probably from Kashmir, see Blanford (1888-91) and Hayman and Hill (1971: 35) (in Corbet and Hill, 1992: 120). However, see also Grubb (2004: 92); who indicates that Gabon might not be rejected.

*1977. *Myotis blythii punicus* Felten, in: Felten, Spitzenberger and Storch, Senckenb. biol., 58 (1/2): 39. Publication date: 22 August 1977. Type locality: Tunisia: Cap Bon: El Haouaria cave [37 03 N 11 01 E] [Goto Description]. Holotype: SMF 44104: ad ♂, skull and alcoholic. Collected by: Nagel, Schubert and Indulis Evalds Vesmanis; collection date: 25 March 1971. See Felten *et al.* (1977: 39). Paratype: SMF 18946: ♂, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18947: ♂, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18948: ♂, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18949: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18950: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18951: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18952: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18955: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18956: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18957: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18958: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960.

Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18959: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18960: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18961: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18962: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18963: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 18964: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 15 May 1960. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 22214: ♂, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 12 March 1963. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 22217: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 12 March 1963. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 22218: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 12 March 1963. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 22219: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 12 March 1963. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 22220: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 12 March 1963. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43386: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43387: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43388: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43389: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43390: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43392: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43961: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43962: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43963: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43964: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43965: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43966: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43967: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 43968: ♂, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 28 August 1972. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44097: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44098: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44099: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44100: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44101: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971.

Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44102: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44103: ♂, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown. Paratype: SMF 44618: ♀, skull and alcoholic. Collected by: ?: Collector Unknown; collection date: 25 March 1971. Presented/Donated by: ?: Collector Unknown.

2000. *Myotis cf. punicus* Castella, Ruedi, Excoffier, Ibanez, Arlettaz and Hausser, Mol. Ecol., 9: 1761.

? *Myotis blythii oxygnathus:*

? *Myotis blythii:*

? *Myotis myotis myotis:*

? *Myotis myotis:*

? *Myotis oxygnathus:*

? *Myotis punicus:* (Name Combination, Current Combination)

TAXONOMY:

Originally described as a subspecies of *M. blythii*, but recently shown to lie outside a clade including *blythii*, *myotis* and *oxygnathus* (Ruedi and Mayer, 2001). Considered a valid species by Castella *et al.* (2000), Dietz and von Helversen (2004: 71), Benda *et al.* (2004d) and Evin *et al.* (2008). Biollaz *et al.* (2010) suggest that the Corsican and Sardinian populations are currently isolated from the continental gene pool and therefore should be considered as different evolutionary significant units. Baron (2012: 5) found that the population on Malta is a single panmitic unit with an tendency towards becoming isolated mating systems.

COMMON NAMES:

Albanian: Lakuriq nate maghrebian. Armenian: Փյունիկյան գիշերաչղջիկ. Azerbaijani: Siçanqulaq gecəşəbpərəsi. Basque: Saguzar arratoi-belarri mairutar. Belarusian: Начніца фінікійская, Начніца магрыбская. Bosnian: Punski šišmiš. Breton: Gousperell ar Magreb. Bulgarian: Магребски нощник. Castilian: Murciélago ratonero moruno. Catalan: Ratpenat rater africà. Croatian: Sjevernoafrički oš trouhi šišmiš. Czech: Netopýr punský. Danish: Mahgreb museøre. Dutch: Fenicische vale vleermuis. English: Maghrebian Mouse-eared Bat, Felten's Myotis. Estonian: Vahemere lendlane. Finnish: Tunisiansiippa. French: Murin du Maghreb. Frisian: Maghreb mûsearflearmûs. Galician: Morcego rateiro africano. Georgian: მაღრიბული მღამიობი. German: Punisches Mausohr, Maghreb-Mausohr. Greek: Τρανομυωτίδα της Καρχηδόνας. Hungarian: Magrebi denevér. Irish Gaelic: Ialtóg luch-chluasach Mhaigribeach. Italian: Vespertilio maghrebino. Latvian: Pūnijas naktssikspārnis. Lithuanian: Finikinis pelėausis. Luxembourgish: Maghreb-Mausouer. Macedonian: Магребски ноќник. Maltese: Farfett il-Lejl Widnet il-gurdien ta' Maghreb, Farfett il-Lejl Widnet il-Gurdien. Montenegrin: Punski večernjak. Norwegian: Mahgrebmusøre. Polish: Nocek punicki. Portuguese: Morcego-rato do Magrebe. Rhaeto-Romance: Vespertil ureglia-mieur punic. Romanian: Liliacul din Maghreb. Russian: Ночница финикийская. Serbian: Магребски велики вечерњак [= Magrebski veliki več ernjak]. Scottish Gaelic: Ialtag luch-chluasach Mhaigribeach. Slovak: Netopier magrebský. Slovenian: Punski netopir. Swedish: Medelhavsmusöra. Turkish: Mahrep Farekulaklı Yarasası. Ukrainian: Нічниця магрибська. Welsh: Ystlum clustlydan Maghreb.

CONSERVATION STATUS:

Global - The species is cave dwelling, only a small number of colonies are known, and these are in tourist areas subject to disturbance. There is evidence of decline in Corsica, and it is assumed that the population trend will be similar on Sardinia as the species faces the same threats there. On Malta, surveys have shown an estimated decline of 50 % or more in 3 generations, although this is a small part of the overall population and the trend has now stabilised. Given that it is a strict cave dweller, there are probably significant declines in North Africa due to exploitation and cave disturbance. Hence the species is listed as Near Threatened (NT ver 3.1 (2001)) almost meets VU under criteria A4cd (Aulagnier *et al.*, 2008c; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Aulagnier *et al.*, 2008c; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Aulagnier and Juste, 2004; IUCN, 2004).

MAJOR THREATS:

Human disturbance is a major threat, as colonies are located in tourist areas, in caves that are well known and popular. Changes in land management and agricultural pollution are also threats. In North Africa, the species is collected for traditional medicinal use (Aulagnier *et al.*, 2008c; IUCN, 2009).

The species is a cave or tree rooster, its water stress and long-distance dispersal were found to be the major risk factors related to climatic change (Sherwin *et al.*, 2012: 174).

CONSERVATION ACTIONS:
Aulagnier *et al.* (2008c) [in IUCN (2009)] report that it is protected by national legislation in its European range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention, in parts of its range where these apply. It is included in Annex IV of the EU Habitats and Species Directive, and some habitat protection may be provided through Natura 2000. There is an ongoing project for the conservation of this species. Appropriate conservation measures include fencing cave entrances (but not gating) and obtaining legal protection for the species.
In North Africa further research into population trends, establishment and management of protected areas, education, and implementation of national-scale legislation are needed.
Biollaz *et al.* (2010) suggest that special care is needed for the Sardinian population as an important source of genetic diversity.

GENERAL DISTRIBUTION:
Myotis punicus occurs in North-west Africa (Morocco, Algeria, Tunisia, and to western Libya) and on the Mediterranean islands of Corsica (to France), Sardinia (to Italy), and Malta (including Gozo [Baron and Borg, 2013: 407]).

Native: Algeria; Libyan Arab Jamahiriya; Malta; Morocco (Benda *et al.*, 2004d; 2010a: 157; El Ibrahimi and Rguibi Idrissi, 2015: 361); Tunisia (Dalhoumi *et al.*, 2014: 53; 2016b: 867).

BIOGEOGRAPHY:
Biollaz *et al.* (2010: 8)'s study suggests that the islands (Corsica and Sardinia) were colonized by *M. punicus* in a stepping-stone manner and predates human colonization. Mitochondrial analysis revealed that the insular populations were well differentiated from the mainland, with mean haplotypes and nucleotide diversities decreading from Tunisia to Sardinia, and from Sardinia to Corsica. While a Baysian and ML trees showed that the Corsican haplotypes are nested within the Sardinan ones, suggesting that the Corsica might have been colonized from Sardinia (Biollaz *et al.*, 2010: 8). Compared with the North African populations, the two islands harbour significant lower allelic richness as well as observed and expected heterozygosities, which could reflect recent population crashes or a bottleneck during the colonization of the islands (Biollaz *et al.*, 2010). The Sardinian and Corsican populations were estimated to date back to the early and mid-Pleistocene, respectively (Biollaz *et al.*, 2010). During the glacial episodes that punctuated this period, low sea levels exposed land that was previously underwater. Geographical distances between the islands and the mainland were thus reduced with the emergence of land bridges between some of the islands, favouring island colonization, with the first the colonization of Sardinia from North Africa and then the colonization of Corsica from Sardinia. As the Ice Age ended, sea levels rose and islolated the two islands, explaining the strong reduction of gene flow currently observed (Biollaz *et al.*, 2010).
The large divergence between the Moroccan and Tunisian populations suggest that both populations had been isolated since the Pleistocene (Biollaz *et al.*, 2010), despite current nuclear gene flow, no female exchange seems to have occured since then. The confinement of Moroccan populations in the High Atlas Range and the philopatric behaviour of females could have enhanced the isolation of these populations, explaining the low haplotype diversity (Biollaz *et al.*, 2010). In North Africa, poor nuclear differentiation between colonies associated with a strong mitochondrial differentiation suggested current male-biased dispersal on the continental area.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Dietz and von Helversen (2004) and Baron (2012: 1) mention the following external characters: large size (comparable to *M. myotis*), the wing membrane starting at the base of the toes, a lancet shaped tragus and distinct dorsal (light brown) and ventral (white) fur coloration.

ECHOLOCATION:
Walters *et al.* (2012: suppl.) report the following figures for 26 calls (6 sequences) from French bats: duration: 3.62 ± 0.96 msec, F_{max}: 60.42 ± 15.65 kHz, F_{min}: 27.07 ± 2.26 kHz, bandwidth: 33.35 ± 14.25 kHz, F_{peak}: 35.82 ± 4.21 kHz

For this species, Disca *et al.* (2014: 226) report two call types: A - FM APMF, with the following parameters: F_{start}: 79.2 ± 16.4 kHz, F_{end}: 25.0 ± 2.1 kHz, F_{peak}: 37 ± 7.9 kHz, bandwidth: 54.2 ± 15.5 kHz, duration: 5.5 ± 0.6 msec; B - FM APBF, with the following parameters: F_{start}: 77.3 ± 6.6 kHz, F_{end}: 20.2 ± 1.2 kHz, F_{peak}: 32.0 ± 5.2 kHz, bandwidth: 57.1 ± 7.1 kHz, duration: 8.6 ± 0.6 msec.

MOLECULAR BIOLOGY:
DNA - See Castella *et al.* (2000) and Biollaz *et al.* (2010).
Karyotype - Unknown.

ROOST:
Benda *et al.* (2014c: 38-39) reported that, in Libya, these bats are only found in ruins, which might serve as temporary roosts or perhaps as maternity roost.

DIET:
Ahmim and Moali (2011: 45, 48) found that the diet of *M. punicus* in Algeria consisted of 96.06 % of insects, 2.82 % of chilopods, and 1.12 % of spiders. Among the insects, Diptera (46.32 %), Lepidoptera (20.33 %), and Hemiptera (10.16 %) were found most frequently in the bat's guano.
On Malta, Baron and Borg (2013: 415) report that the major food sources are Orthoptera (65 %), Lepidoptera (20 %), and Coleoptera (15 %), whereas on Corsica, the Orthoptera only account for 36 %.
In Libya, Benda *et al.* (2014c: 44) analyses two groups of pellets. One set (from one individual) contained only large spiders (Aranea), while the other consisted primarily of Coleoptera (Scarabaeidae: Melolonthinae), which were supplemented by solifuges (Solpugida), cockroaches (Blattodea) and small scorpions (Scorpionida).

POPULATION:
Structure and Density - Over 10,000 individuals, found in large colonies (300 - 500 individuals). On Corsica, there are around 4,000 individuals in four colonies. The total population size on Corsica, Sardinia and Malta is estimated at between 7,000 and 9,000 individuals. This is a cave dwelling species, therefore there are few colonies. On Malta, over 50 % of the population was lost between the latter half of the 1980s and the early 1990s. Numbers appear to have stabilised at 400 - 450 individuals (Borg, 2002, J.J. Borg *unpubl. data* [in Aulagnier *et al.* (2008c) in IUCN (2009)]).
Trend - 2008 - Decreasing (Aulagnier *et al.*, 2008c; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
At Sabratha (Libya), Benda *et al.* (2014c: 40) collected a pregnant female on 2 April and a juvenile female on 14 April.

PARASITES:
Bruyndonckx *et al.* (2010) collected *Spinturnix myoti* (Kolenati, 1856) in 11 colonies in North Africa, Corsica and Sardinia.

From Libya, Benda *et al.* (2014c: 44) reported the following ectoparasites:
Nycteribiidae: *Nycteribia vexata* Westwood, 1835, *Nycteribia latreillii* (Leach, 1817),
Spinturnicidae: *Spinturnix myoti* (Kolenati, 1856),
Macronyssidae: *Steatonyssus occidentalis* (Ewing, 1933),
Ischnopsyllidae: *Rhinolophopsylla unipectinata* (Taschenberg, 1880).

From Algeria, Bendjeddou *et al.* (2013: 325) reported the following ectoparasites:
Nycteribiidae: *Penicillidia dufouri* (Westwood, 1825), *Phthiridium biarticulatum* Hermann, 1804,
Spinturnicidae: *Spinturnix myoti* (Kolenati, 1856),
Ixodidae: *Rhipicephalus sanguineus* (Latreille, 1806).
Bendjeddou *et al.* (2016a: 109) added *Ixodes vespertilionis* Koch, 1844.
Bendjeddou *et al.* (2017: 15) mentioned the following species from Algeria: Nycteribiidae: *Nycteribia (Nycteribia) latreillii* (Leach, 1817) and *Phthiridium biarticulatum* Hermann, 1804; Streblidae: *Brachytarsina (Brachytarsina) flavipennis* Macquart, 1851 and Arachnida: *Spinturnix myoti* (Kolenati, 1856) and *Ixodes vespertilionis* Koch, 1844.

Blackwell (1980: 145) and Haelewaters *et al.* (2017: Suppl.) mention the presence of the Nycteribiid bat-fly *Nycteribia vexata* Westwood, 1835 on "*M. oxygnathus*" in Tunisia, which in turn was infected by the fungus *Arthrorhynchus nycteribiae* (Peyritsch) Thaxter.

VIRUSES:
Coronaviridae - Coronaviruses
Alphacoronavirus
Ar Gouilh *et al.* (2018: 92) reported the EPI 9 virus from Tunisia (3 infected out of 8 bats).

Rhabdoviridae
Lyssavirus
Serra-Cobo *et al.* (2018: 2) tested 63 Algerian bats for European bat lyssavirus type 1 and found one being seropositive. This was also the case for 15 out of 262 Moroccan bats.

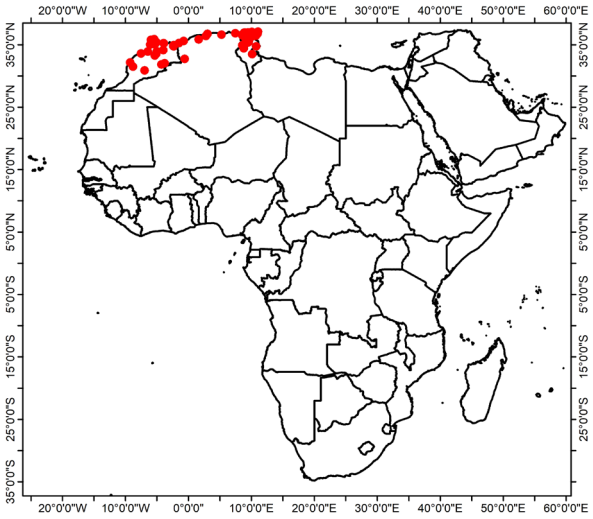


Figure 246. Distribution of *Myotis punicus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Libya, Morocco, Tunisia.

Myotis scotti Thomas, 1927

*1927. *Myotis scotti* Thomas, Ann. Mag. nat. Hist., ser. 9, 19 (113): 554. Publication date: 1 May 1927. Type locality: Ethiopia: Shoa province: ca. 40 mi (64 km) W Addis Ababa: Djem-djem Forest [09 00 N 38 12 E, 8 000 ft]. Holotype: BMNH 1927.3.4.1:. Paratype: BMNH 1927.3.4.2:. Paratype: BMNH 1927.3.4.3:. Paratype: BMNH 1927.3.4.4:. Paratype: BMNH 1927.3.4.5:. (Current Combination)

TAXONOMY:
See Simmons (2005).

Csorba *et al.* (2014: 667) include *scotti* in the subgenus *Chrysopteron*.

COMMON NAMES:
Czech: netopýr habešský. English: Scott's Mouse-eared Bat, Scott's Mouse-eared Myotis. French: Murin de Scott, Vespertilion de Scott. German: Scotts Mausohr.

CONSERVATION STATUS:
Global - Listed as Vulnerable (VU B2ab(iii) ver 3.1 (2001)) because its area of occupancy is possibly less than 2,000 km^2, its distribution is likely to be severely fragmented, and there is continuing decline in the extent and quality of its forest habitat in Ethiopia (Benda and Lavrenchenko, 2008; IUCN, 2009).

Assessment History -
2008 - VU B2ab(iii) ver 3.1 (2001) (Benda and Lavrenchenko, 2008; IUCN, 2009). 2004 - VU B2ab(iii) ver 3.1 (2001) (Benda and Lavrenchenko, 2004; IUCN, 2004). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The forest habitat of this species is being impacted through conversion of land to agricultural use and logging (Benda and Lavrenchenko, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Benda and Lavrenchenko (2008) [in IUCN (2009)] report that there appear to be no conservation measures in place, and it is not known if the species is present in any protected areas. There is a need to conserve areas of suitable montane forest habitat for this species. Further studies are needed into the abundance, biology and ecology.

GENERAL DISTRIBUTION:
Myotis scotti is endemic to the highlands of Ethiopia, where it has been recorded from ten localities between 1,300 and 2,500 m asl.

Native: Ethiopia.

POPULATION:
Structure and Density - It appears to be a rare species that is known from only about 20 specimens (Benda and Lavrenchenko, 2008; IUCN, 2009).
Trend - 2008 - Decreasing (Benda and Lavrenchenko, 2008; IUCN, 2009).

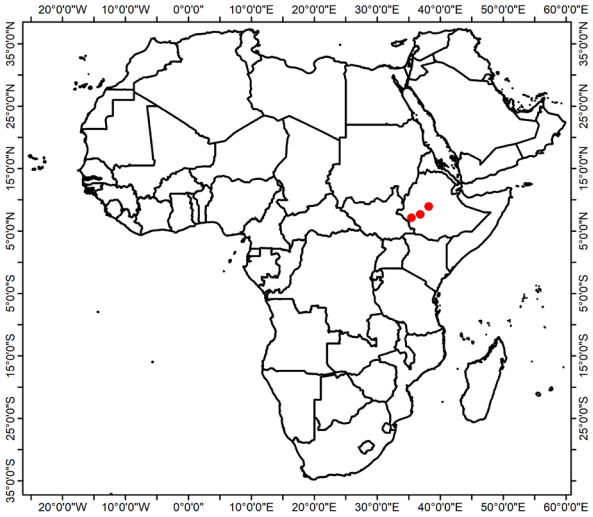


Figure 247. Distribution of *Myotis scotti*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia.

Myotis tricolor (Temminck, 1832)

*1832. *V[espertilio] tricolor* Temminck, in: Smuts, Enumer. Mamm. Capensium, 106. Publication date: 1832. Type locality: South Africa: Cape province: Cape Town [33 56 S 18 28 E] [Goto Description]. - Comments: Type specimen: RMNH ???.
1924. *Eptesicus loveni* Granvik, Acta Univ. Lund, ser. 2, 21 (3): 12. Publication date: 1924. Type locality: Kenya: E slopes of Mount Elgon [01 07 N 34 35 E, 8 000 ft].

? *Myotis (Selysius) tricolor:* (Name Combination)
? *Myotis tricolor A:*
? *Myotis tricolor:* (Name Combination, Current Combination)

TAXONOMY:



Figure 248. *Myotis tricolor* (TM 48188) caught at the Farm Schaapplaats, Free State, South Africa.

Includes *Eptesicus loveni*, see Aggundey and Schlitter (1986).

Csorba *et al.* (2014: 667) include *tricolor* in the subgenus *Chrysopteron*, but see Ruedi and Mayer (2001: 436), Ghazali *et al.* (2016: 476) and Patterson *et al.* (2019: "2"), who reject the division into subgenera.

The phylogenetic analyses on mitochondrial DNA performed by Patterson *et al.* (2019: "5", "9"') identified three separate groups, two corresponding to South African samples and a third from Kenya (close to the type locality of *loveni*, which might possibly represent a separate (sub)species. The *Cytb* sequences of these groups differed by 3.7 - 3.8 %.

COMMON NAMES:
Afrikaans: Temminck se langhaarvlermuis, Temminck-langhaarvlermuis, Kaapse Langhaarvlermuis. Chinese: 南非鼠耳蝠. Czech: netopýr trojbarvý. English: Temminck's Mouse-eared Bat, Cape Myotis, Cape Hairy Bat, Tricoloured Mouse-eared Bat, Cape Hairy Myotis, Temminck's Hairy Bat, Three-coloured bat. French: Murin tricolore, Petit murin brun, Murin velu du Cap, Vespertilion d'Angola, Murin d'Angola. German: Dreifarb-Mausohr.

ETYMOLOGY OF COMMON NAME:
The colloquial name is after C.J. Temminck, who was the author of *Monographies de Mammalogie* (1827) (Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
This species was represented in the very late Holocene at Border Cave, South Africa (Avery, 1991: 6).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs, 2008e; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs, 2004e; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016k). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Jacobs, 2008e; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs (2008e) [in IUCN (2009)] report that it has been recorded from the Virunga National Park in the Democratic Republic of the Congo (Baeten *et al.*, 1984) and in view of its East African range, it seems likely that it is present in additional protected areas. Further studies are needed into the range of this species in West and Central Africa.

GENERAL DISTRIBUTION:
Myotis tricolor has been patchily recorded in sub-Saharan Africa. In West Africa the species has currently only been reported from the northwestern uplands of Liberia (Koopman *et al.*, 1995), while in Central Africa it is known only from a few records in the Democratic Republic of the Congo and Rwanda (Hayman *et al.*, 1966; Baeten *et al.*, 1984). *Myotis tricolor* is much more widely recorded in East Africa, ranging from Ethiopia in the north, through Uganda, Kenya, Tanzania, Malawi, Zambia, Mozambique and Zimbabwe through to southern South Africa.

In the RSA, its distribution is best predicted by geology (Babiker Salata, 2012: 50).

Native: Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 564); Ethiopia; Kenya; Lesotho (Lynch, 1994: 193; Monadjem *et al.*, 2010d: 564); Liberia (Fahr, 2007a: 104); Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 564); Mozambique

(Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 564; Monadjem *et al.*, 2010c: 384); Rwanda; Saõ Tomé (Rainho *et al.*, 2010a: 31); South Africa (Monadjem *et al.*, 2010d: 564); Swaziland (Monadjem *et al.*, 2010d: 565); Tanzania; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 565); Zimbabwe (Monadjem *et al.*, 2010d: 565).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Schoeman and Jacobs (2002: 157) mention the following parameters for 1 specimen from the Algeria Forestry Station (RSA): Fa: 46.9 mm, Wing area: 156.6 cm^2, Wing span: 30.6 cm, Wing loading: 6.9 N/m^2, and aspect ratio: 6.0.

DETAILED MORPHOLOGY:
Baculum - Kearney *et al.* (2002).

FUNCTIONAL MORPHOLOGY:
Jordaan and Jacobs (2009: 35) indicate that the wing morphology of *M. tricolor* is intermediate between that of a typical aerial forager, gleaner (takes insects off a substrate) and trawler (takes prey from the water surface).

ECHOLOCATION:
See Taylor (1999b). Rainho *et al.* (2010a: 21) reports the calls of 5 individuals from Saõ Tomé.

From Algeria Forest Station (RSA), Schoeman and Jacobs (2002: 157) reported the type of calls to be low duty echolocation dominated by frequency modulated calls, with a F_{peak}: 50.0 kHz.

Jordaan and Jacobs (2009: 35) found that its echolocation call structure is intermediate between that of typical aerial foragers, gleaners and trawlers.
Schoeman and Waddington (2011: 291) mention a peak frequency of 40.8 kHz and a duration of 4.4 msec for a specimen from Durban, South Africa.

In Waterberg, South Africa and Swaziland, Taylor *et al.* (2013b: 17) recorded 6 calls with the following parameters: F_{max}: 86.1 ± 5.92 (76.6 - 91.9) kHz, F_{min}: 42.7 ± 4.43 (37.1 - 50.0) kHz, F_{knee}: 57.6 ± 7.25 (48.5 - 67.5) kHz, F_{char}: 52.4 ± 6.13 (45.3 - 62.2) kHz, duration: 2.0 ± 0.40 (1.6 - 2.6) msec.
At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 58 (48 - 68) kHz.
Four calls recorded at Mapungubwe National Park (RSA) by Parker and Bernard (2018: 57) had the following values: F_{char}: 42.68 ± 0.70 kHz, F_{max}: 70.40 ± 3.85 kHz, F_{min}: 40.88 ± 1.98 kHz, F_{knee}: 52.68 ± 3.43 kHz, duration: 3.03 ± 0.70 msec and 11.20 ± 7.85 calls/sec.

Release calls recorded at Telperion Nature Reserve by Kearney *et al.* (2019: 37) had a F_{char}: 37.04 kHz, slope at the start of the call: 372.62, time from start of call to F_{char}: 2.62 msec and duration 3.13 msec.

From Swaziland, Monadjem *et al.* (2017c: 179) reported F_{min}: 38.0 ± 3.78 (34.2 - 41.7) kHz, F_{knee}: 55.4 ± 10.8 (44.6 - 66.2) kHz, F_c: 49.4 ± 11.4 (38.0 - 60.8) kHz, duration: 2.4 ± 0.33 (2.07 - 2.72) msec. The maximum distance over which they were able to detect the calls was 10 m (mean: 4.6 ± 0.73 m).

Adams and Kwiecinski (2018: 4) reported F_{char}: 41.8 ± 4.3 kHz, F_{max}: 81.5 ± 6.2 kHz, F_{min}: 38.8 ± 2.2 kHz and duration: 2.9 ± 0.9 msec for six calls from the Kalahari Desert.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 44, FN = 50, BA = 8, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from South Africa and Zimbabwe. These results are the same as those obtained for *M. bocagii* specimens from South Africa (Rautenbach *et al.*, 1993).
Protein / allozyme - Unknown.

HABITAT:
Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *M. tricolor* activity was not significantly, nor positively influenced by size of wetland, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body. *M. tricolor* was observed near trees and in orchards but also in open habitats surrounding wetlands (Sirami *et al.*, 2013: 35).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 820,776 km^2.

ROOST:
In the Durban area, Taylor *et al.* (1999: 69) reported it roosting in the Shongweni Dam tunnel, with a colony size between 100 and 400. A colony consisting of females only, occupied this tunnel from September to the end of January.

DIET:
From the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following prey groups based on 11 faecal pellets from 1 bat (in volume percent): Coleoptera (50), Hemiptera (25), Hymenoptera (25).

PREDATORS:
Avery *et al.* (2005: 1054) found this bat species in pellets from *Tyto alba* in South Africa.

POPULATION:
Structure and Density - This is a common species with colonies often consisting of thousands of animals (Jacobs, 2008e; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs, 2008e; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Bernard (1982b) [in Badwaik and Rasweiler (2000: 276) and Racey and Entwistle (2000: 374)] indicates that females exhibit partial regression of the corpus luteum during pregnancy, and that it has a restricted seasonal monoestry reproduction pattern. Bernard (1982b: 83) also indicated that in Natal copulation occurred in April, and that ovulation and fertilization probably occurred in mid-September, suggesting that sperm storage probably occurred during winter and ovulation was delayed until spring.

Jordaan and Jacobs (2009: 35) found that late pregnancy females forage for longer (307.0 ± 173.5 min) than early pregnant females (147.7 ± 154.5 min) to meet the high energy demands associated with the developping fetus.

PARASITES:
HAEMOSPORIDA:
Lutz *et al.* (2016: 9) examined 3 *M. tricolor* specimens from East Africa and found one of them infected with a haemosporidan parasite of the genus *Polychromophilus*.

DIPTERA:
Streblidae: *Raymondia hardyi* Fiedler, 1954 from South Africa (Shapiro *et al.*, 2016: 254).
Nycteribiidae: *Nycteribia capensis* Karaman, 1939 which may be the natural parasite for this species (Haeselbarth *et al.*, 1966: 108). *Nycteribia latiterga* Theodor, 1957 from Mt. Menengai, Kenya (Haeselbarth *et al.*, 1966: 108). *Penicillidia fulvida* (Bigot, 1885) (Haeselbarth *et al.*, 1966: 114).

SIPHONAPTERA
Ischnopsyllidae: *Oxyparius isomalus* (Waterston, 1915) locality not stated (Haeselbarth *et al.*, 1966: 188). *Rhinolophopsylla capensis* Jordan and Rothschild.

ACARI:
Trombiculidae: Stekolnikov (2018a: 189) reported *Willmannium natalense* (Lawrence, 1949) from bats in South Africa.

VIRUSES:
In their country-wide survey of Kenyan bats, Waruhiu *et al.* (2017) found the following viruses in *Myotis tricolor*: Astroviruses and Polyomaviruses.

Bunyaviridae
Phlebovirus
Rift Valley Fever Virus (RVFV) - Oelofsen and Van der Ryst (1999) tested two individuals from two localities in the Free State Province, South Africa and Lesotho for RVFV antigen using an enzyme linked immunosorbet assay (ELISA), none tested positive.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested 10 individual brains, from four localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Ethiopia, Kenya, Lesotho, Liberia, Malawi, Mozambique, Nigeria, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

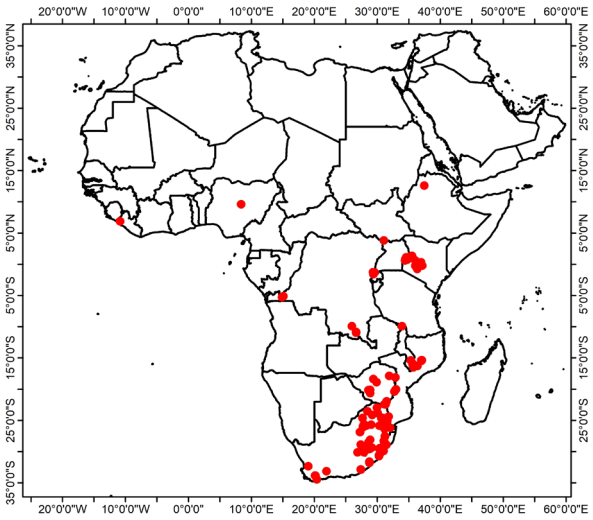


Figure 249. Distribution of *Myotis tricolor*

Myotis welwitschii (Gray, 1866)

*1866. *Scotophilus welwitschii*Gray, Proc. zool. Soc. Lond., 1866, II: 211, pl. 24. Publication date: September 1866. Type locality: Angola: NE Angola: (probably near Pungo Andongo: see Crawford-Cabral (1989: 17) in Thorn *et al.* (2009: 50)). [Goto Description]. Holotype:

BMNH 1866.4.12.2: ♂. Collected by: Dr. F.M. Welwitsch. - Etymology: Named after Welwitsch, an Austrian botanist who made extensive collections in Angola (Taylor, 2005).

1878. *Vespertilio welwitschii:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 306. (Name Combination)

1899. *Vespertilio venustus* Matschie, Sber. Ges. naturf. Freunde Berlin, 74. Publication date: 1899. Type locality: Tanzania: Morogoro district: Ukami Mts., [north slope of Uluguru Mountains]: Kinole [06 50 S 37 42]. Holotype: ZMB 54653: ♂, skin and skull. Vendor: Schlüter; see Turni and Kock (2008: 63).

1922. *Myotis welwitschii:* Kershaw, Ann. Mag. nat. Hist., ser. 9, 10 (56): 181. Publication date: 1 August 1922. (Name Combination, Current Combination)

1951. *Scotophilus welwetschii:* Roberts, Mammals of South Africa, 80. (Lapsus)

1967. *Myotis venustus:* Kock, Senckenb. biol., 48 (5/6): 319. (Name Combination)

2014. *Myotis wilwitschii:* Ndara R., IJISR, 12 (1): 254. Publication date: November 2014. (Lapsus)

2016. *Myotis weltwitschii:* Simmons, Seiffert and Gunnell, Am. Mus. Novit., 3857: 43. Publication date: 9 May 2016. (Lapsus)

? *Myotis (Chrysopteron) welwitschii:* (Name Combination)

TAXONOMY:



Figure 250. *Myotis welwitschii* (TM 47968) caught at Lapalala Wilderness area, Limpopo Province, South Africa.

Csorba *et al.* (2014: 667) include *welwitschii* in the subgenus *Chrysopteron*, although Ruedi and Mayer (2001: 436), Ghazali *et al.* (2016: 476) and Patterson *et al.* (2019: "2") reject the division in subgenera.

Myotis welwitschii is monotypic (Kershaw, 1922b: 181; Hayman and Hill, 1971; Findley, 1972; Kock, 1967; Meester *et al.*, 1986; Simmons, 2005). However, the phylogenetic analyses by Patterson *et al.* (2019: "5", "9") indicate the existence of two groups within this species: one corresponding to an equatorial group occurring from Guinea to western Kenya and a second group existing in eastern and southern Africa, from Tanzania to South Africa (possibly representing *venustus*). These groups differ by 5 % in their *Cytb* sequence.

COMMON NAMES:

Afrikaans: Welwitsch se langhaarvlermuis, Welwitsch-langhaarvlermuis. Chinese: 魏氏鼠耳蝠. Czech: netopýr Welwitschův, netopýr Welwitschiův. English: Welwitsch's Mouse-eared Bat, Welwitsch's Hairy Bat, Welwitch's Bat, Welwitsch's Myotis. French: Murin de Welwitsch, Myotis de Welwitsch, Vespertilion de Welwitsch. German: Welwitschs Mausohr. Kiluba (DRC): Mulima. Portuguese: Morcego lanudo de weltsch.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:

No fossils are known (Ratcliffe, 2002).

CONSERVATION STATUS:

Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008p; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008p; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004d; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016l). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:

There appear to be no major threats to this species as a whole (Jacobs *et al.*, 2008p; IUCN, 2009).

CONSERVATION ACTIONS:

Jacobs *et al.* (2008p) [in IUCN (2009)] report that this species has been recorded from the Sengwa Wildlife Research Area and Kruger National Park in South Africa, and seem likely to be present in additional East or southern African protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:

Myotis welwitschii has been widely, but patchily, recorded over much of East Africa and southern

Africa, parts of southern Central Africa, and with a single West African locality in southeastern Guinea. In East and southern Africa, it is distributed from Ethiopia and the Sudan in the north, through Kenya, Tanzania and Malawi, to Zambia, Mozambique, Zimbabwe and northeastern South Africa (where its distribution is linked with land use/land cover (Babiker Salata, 2012: 50)). In Central Africa, it is largely confined to southern Democratic Republic of the Congo, northern Angola, Rwanda and Burundi and western Uganda. It has not been recorded from Namibia or Botswana.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 920,261 km^2.

Native: Angola (Hayman, 1963; Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 565; Taylor *et al.*, 2018b: 63); Burundi (Fahr and Ebigbo, 2003: 128); Congo (The Democratic Republic of the) (Fahr and Ebigbo, 2003; Monadjem *et al.*, 2010d: 565); Ethiopia; Guinea (Fahr and Ebigbo, 2003: 128); Kenya; Malawi (Happold *et al.*, 1988; Happold and Happold, 1997b: 819; Fahr and Ebigbo, 2003; Monadjem *et al.*, 2010d: 565); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 565); Rwanda; South Africa (Fahr and Ebigbo, 2003; Monadjem *et al.*, 2010d: 565); Sudan; Tanzania; Uganda (Kityo and Kerbis, 1996: 61); Zambia (Fahr and Ebigbo, 2003; Monadjem *et al.*, 2010d: 565); Zimbabwe (Fahr and Ebigbo, 2003; Monadjem *et al.*, 2010d: 565).

GEOGRAPHIC VARIATION:



Figure 251. *Myotis welwitschii* (TM 47968) - showing wing reticulations.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Ratcliffe (2002).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Ratcliffe (2002).

DETAILED MORPHOLOGY:
Baculum - Unknown
For a description of the skull, teeth, ears and tragus, and wingshape and aspect ratio see Ratcliffe (2002).

ECHOLOCATION:
In Soutpansberg, South Africa, Taylor *et al.* (2013b: 17) recorded 1 call with the following parameters: F_{max}: 73.8 kHz, F_{min}: 33.8 kHz, F_{knee}: 52.9 kHz, F_{char}: 50.3 kHz, duration: 2.1 msec.
Linden *et al.* (2014: 40) reported the following parameters from the Southpansberg range (RSA): F_{min}: 34 kHz, F_{char}:50 kHz, F_{knee}: 53, Slope: 563 OPS, duration: 2.1 msec.

Thiagavel *et al.* (2017: Suppl.) mention a F_{peak} of 32.66 kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 44, FN = 50, BA = 8, and submetacentric X and Y chromosomes, for specimens from South Africa.
Protein / allozyme - Unknown.

HABITAT:
See Ratcliffe (2002).

In southern Africa, it occurs in Savanna (70 %) and Afromontane (20 %) habitats (Cooper-Bohannon *et al.*, 2016: Table S2).

HABITS:
See Ratcliffe (2002).

ROOST:
See Ratcliffe (2002).

POPULATION:
Structure - Considered solitary in its roosting habits (Smithers and Wilson, 1979; Ratcliffe, 2002). However in a single instance two animals were found roosting in the same bush (Smithers and Wilson, 1979).
Density - Unknown, although this species is widespread, it does not appear to be particularly common (Jacobs *et al.*, 2008p; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008p; IUCN, 2009).

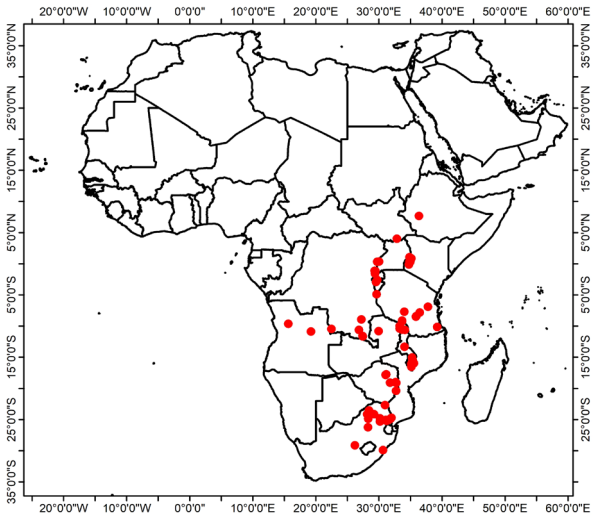


Figure 252. Distribution of *Myotis welwitschii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Angola, Burundi, Congo (Democratic Republic of the), Ethiopia, Kenya, Malawi, Rwanda, South Africa, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe.

Myotis zenatius Ibáñez, Juste, Salicini, Puechmaille and Ruedi, 2019

2019. *Myotis escalerai cabrerae* Çoraman, Mayer and Dietz, in: Çoraman et al., J. Biogeogr., 46 (2): 350. Publication date: 28 January 2019. Type locality: Morocco: Sous_Massa region: Wim Timdouine cave: near Agadir [30 40 49 N 09 20 42 W, 1340 M] [Goto Description]. Holotype: ZMB 107229: ♀, tissue. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of Angel Cabrera, who described *M. escalerai* from Spain.

*2019. *Myotis zenatius* Ibáñez, Juste, Salicini, Puechmaille and Ruedi, in: Juste et al., Acta Chiropt., 20 (2): 293, 295, figs 3C, 5D (for 2018). Publication date: 30 January 2019. Type locality: Morocco: Tanger-Tétouan-Al Hoceima region: Mizou Cave [c. 35 30 42 N 05 19 53 W, 330 m] [Goto Description]. Holotype: EBD MAM 29831: ad ♂, skull and alcoholic. Collected by: Irene Salicini, Carlos J. Ibáñez Uargui and Javier Juste; collection date: 18 July 2011; original number: 110718MspB12. Paratype: EBD MAM 26020: ♀, skull and alcoholic. Collection date: 10 June 2002; original number: MNA-56. Paratype: EBD MAM 26023: ♂, skull and alcoholic. Collection date: 11 July 2002; original number: MNA-15. Paratype: EBD MAM 29826: ad ♀, skin and skull. Collected by: Irene Salicini, Carlos J. Ibáñez Uargui and Javier Juste; collection date: 18 July 2011; original number: MspB6. Paratype: EBD MAM 29829: ad ♂, skull and alcoholic. Collected by: Irene Salicini, Carlos J. Ibáñez Uargui and Javier Juste; collection date: 18 July 2011; original number: Msp7. Paratype: EBD MAM 29830: ad ♀, skull and alcoholic. Collected by: Irene Salicini, Carlos J. Ibáñez Uargui and Javier Juste; collection date: 18 July 2011; original number: Msp11. - Etymology: "*zenatius*" refers to "Zanatah", a little known Berber tribe that lived in the Maghreb region in the Middle Ages (see Juste *et al.*, 2019: 297).

TAXONOMY:

The specimens forming this taxon were formerly included in *Myotis nattereri* (e.g. Brosset, 1963: 440; Gaisler, 1983: 362; Gaisler, 1984: 89; Kowalski *et al.*, 1986: 185; Aulagnier and Thevenot, 1986: 44; Benda *et al.*, 2004d: 19; Dieuleveut, 2010: 37). Various authors (e.g. García-Mudarra *et al.*, 2009: 442; Puechmaille *et al.*, 2011a: 225; Salicini *et al.*, 2011: 890; 2012: 1185), however, found differences between the European representatives of *M. nattereri* and the animals from northern Africa and assigned the latter tentatively to "*Myotis* sp. B".

Based on DNA, Çoraman *et al.* (2019: 350) indicated that "*Myotis* sp. B" is clearly distinct, both in mitochondrial and nuclear markers from *M. nattereri*, and suggests that this taxon should be considered as a subspecies of *Myotis escalerai*, for which they propose the name *Myotis escalerai cabrerae* Çoraman, Mayer and Dietz 2018. The paper only contains a short paragraph on the proposed name, where as the "description" itself is in the online supplement and is also restricted to a single sentence. The description is not supported by the designation of a physical museum specimen, but rather a DNA (tissue) sample, which according to the ICZN (http://iczn.org/content/can-dna-be-type-specimen) should nevertheless be acceptable.

Juste *et al.* (2019) compared physical specimens of "*Myotis* sp. B" with *M. escalerai* from the Iberian Peninsula and found a number of differences (including a much darker dorsal fur), which led them to describe a new species: *Myotis zenatius*.

As these two publications suggest a name for the populations previously assigned to "*Myotis* sp. B" (see Salicini *et al.*, 2011; 2012) the priority principle comes into play. Both papers were published in early 2019:

1) "*Myotis zenatius* Ibáñez, Juste, Salicini, Puechmaille and Ruedi, 2019" was published in "Acta Chiropterologica, 20 (2): 225 - 300, 2018", the front page of which indicates "December 2018", but the BioOne website (https://bioone.org/journals/Acta-Chiropterologica/volume-20/issue-2/15081109ACC2018.20.2.001/Two-New-Cryptic-Bat-Species-within-the-Myotis-nattereri-Species/10.3161/15081109ACC2018.20.2.001.full) mentions 14 February 2019 as date. Furthermore, the paper header mentions: "Version of Record, published online January 30, 2019 with fixed content and layout in compliance with Art.8.1.3.2.ICZN and registered in Zoobank with LSID urn:lsid:zoobank.org:pub:2348ACBD-2ECC-4A80-8EA4-E3DF05C878E3". This suggest that 30 January is to be considered as date of publication.

2) "*Myotis escalerai cabrerae* Çoraman, Mayer and Dietz, 2018" was published in "Journal of Biogeography, 46 (2): 343 - 354, 2019". Here the Wiley Online Library website (https://onlinelibrary.wiley.com/loi/13652699) mentions "February 2019" as publication date for the issue and for the paper itself (https://onlinelibrary.wiley.com/doi/10.1111/jbi.13509), it mentions "First published: 28 January 2019". The fact that the authors mention "2018" in the header of their description should be ignored.

ICZN article 21.9. mentions "Works issued on paper and electronically. A name or nomenclatural act published in a work issued in both print and electronic editions takes its date of publication from the edition that first fulfilled the criteria of publication of Article 8 and is not excluded by Article 9."

The members of our "Taxonomic Advisory Committee" [Petr Benda, Gábor Csorba, Peter Taylor, Stéphane Aulagnier] indicated that a description published in an online (part of the) paper without a ZooBank number (a requirement since 2012; IUCN, 2012: 1) is invalid for taxonomic purposes [="*nomen nudum*"]. ZooBank currently contains urn:lsid:zoobank.org:pub:A4A8BF4B-D592-485C-9E02-DC2A0B7C94F8 for the paper by Çoraman et al. and mentions publication date "February 2019". This agrees with the remark made in IUCN (2012: 3): "The following are examples of inadmissible errors: An author, in preparing a manuscript for publication, states that day's date for the registration date, intending to register it later that day but forgetting to do so. The author discovers the omission after the work is published and immediately registers it; because registration occurred after publication, the work is not available."

The problem was also signaled by Ruedi *et al.* (2019), who indicated that the new names proposed by Çoraman *et al.* (2019) (besides *M. escalerai cabrerae*, they also introduced *M. nattereri helverseni*) do not follow several mandatory rules imposed by the Code, they are declared unavailable and are not to be used for further taxonomy studies.

As such, we accept the name *Myotis zenatius* proposed in Juste *et al.* (2019) for this taxon.

COMMON NAMES:
English: Zenati myotis. French: Murin Zenati. German: Zenati Mausohr. Spanish: Murcielago ratonero
Zenate.

GENERAL DISTRIBUTION:
Probably endemic to the Mediterranean region of Morocco and Algeria, and possibly Tunisia (Juste *et al.*, 2019: 296).

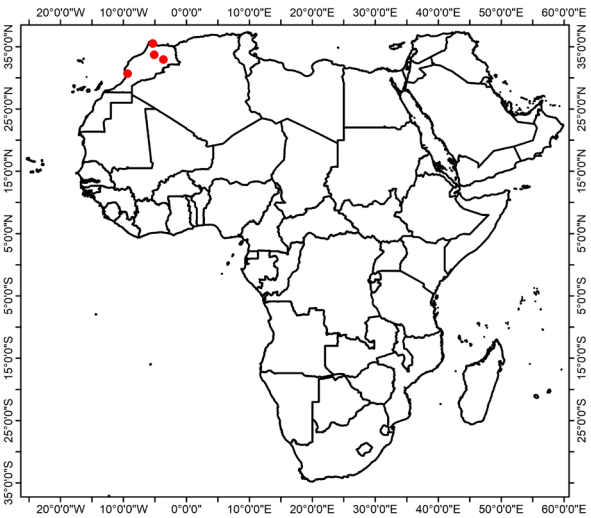


Figure 253. Distribution of *Myotis zenatius*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Morocco.

Subfamily Scotophilinae Van Cakenberghe and Seamark, 2008

1866. *Scotophili* A. Murray, The geographical distribution of mammals., 238. - Comments: Type genus: *Scotophilus* Leach, 1821. Introduced as "section". Synonymized with the Nycticeiini tribe by McKenna and Bell (1997: 320) (see Jackson and Groves, 2015: 276).
1866. *Scotophilina* Gray, Ann. Mag. nat. Hist., er. 3, 17 (98): 90.
1985. *Philisidae* Sigé, Geol. Palaeontol., 19: 161-189. - Comments: Described as a distinct Family level.
1987. *Scotophilini* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 278. Publication date: 30 July 1987. - Comments: Type genus: *Scotophilus* Leach, 1821. Introduced as tribe, and originally included the genera *Scotomanes* Dobson, 1875 [including *Scoteinus* Dobson, 1875] and *Scotophilus* Leach, 1821. The rank was recognized by Hoofer and Van Den Bussche (2003: 38), but synonimized with the Nycticeiini tribe by McKenna and Bell (1997: 320) (see Jackson and Groves, 2015: 276).
2006. *Philisinae* Horácek, Fejfar and Hulva, Lynx, 37: 145. - Comments: Type genus: *Philisis* Sigé, 1985.
*2008. *Scotophilinae* Van Cakenberghe and Seamark, African Chiroptera Report, 238. Publication date: 1 July 2008. - Comments: Type genus: *Scotophilus* Leach, 1821. Following the principle of typification. (Current Combination)

TAXONOMY:
Known genera of the subfamily Scotophilinae: †***Scotophilisis*** Horácek, Fejfar and Hulva 2006; †***Vampyravus*** Schlosser, 1910; ***Scotophilus*** Leach 1821.

COMMON NAMES:
Czech: mračníkové.

†Genus *Scotophilisis* Horácek, Fejfar and Hulva, 2006

*2006. *Scotophilisis* Horácek, Fejfar and Hulva, Lynx, n.s.37: 131, 140. - Comments: Type species - *Scotophilisis libycus* Horácek, Fejfar and Hulva, 2006.
The publication might date from 2007, since the paper was only received on 8 December 2006. - Etymology: Combination of the extant genus *Scotophilus* Leach, 1821 and a Palaeogene genus *Phylisis* Sigé, 1985, as this new genus is supposedly related to the stem line (Horácek *et al.*, 2006). (Current Combination)
2014. *Scotiphilisis:* Ravel, Adaci, Bensalah, Mahboubi, Mebrouk, Essid, Marzougui, Ammar, Charruault, Lebrun, Tabuce, Vianey-Liaud, and Marivaux, J. Syst. Palaeontol., 13 (8): 694. Publication date: 21 August 2014. (Lapsus)

TAXONOMY:
Known species of the genus *Scotophilisis*: †***libycus*** Horácek, Fejfar and Hulva, 2006.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Time frame - Early Miocene (Burdigalian).

†*Scotophilisis libycus* Horácek, Fejfar and Hulva, 2006

*2006. *Scotophilisis libycus* Horácek, Fejfar and Hulva, Lynx, n.s. 37: 131, 140, figs. 1 - 3. Type locality: Libya: MS2: Jebel Zelten [28 28 N 20 00 E]. Holotype: NMP NMPC/OF.J.Zel./Chil.:. Right mandible with M_1 and M_2 and alveoli of I_1 to P_4 and M_3. - Comments: Early Miocene, MN4-5. (Current Combination)

Genus *Scotophilus* Leach, 1821

*1821. *Scotophilus* Leach, Trans. Linn. Soc. Lond., 13 (1): 69, 71. Publication date: 23 May - 21 June 1821 [Goto Description]. - Comments: Type species: *Scotophilus kuhlii* Leach, 1821

(According to Meester *et al.*, 1986: 59 "=juvenile *Vespertilio temmincki* Horsfield"). Not *Scotophilus* Swainson, 1836 (Aves, Strigiformes, Strigidae). Not *Scotophilus* Meinert, 1870 (Arthropoda, Chilopoda, Geophilomorpha, Dignathodontidae). Not *Scotophilus* Hesse, 1881 (Crustacea, Maxillopoda, Cyclopodea, Family incertae sedis) (see Jackson and Groves, 2015: 272). - Etymology: From the Greek "*σκόοτος*", meaning "darkness" and "*φίλος*", meaning "loving" (see Palmer, 1904: 627). - ZooBank: EE74E9E4-260A-48A5-9CD7-C690F661AF90. (Current Combination)

1831. *Pachyotus* Gray, Zool. Misc., 1: 38. Publication date: 1831 [Goto Description]. - Comments: Type species: *Scotophilus kuhlii* Leach, 1821. - Etymology: From the Greek "*παχύς*" meaning thick and "*ούς*" or "*ώτός*", meaning ear (see Palmer, 1904: 495).
1842. *Nicticejus* Rüppell, Mus. Senckenberg., 3 (2): 157, 188. - Comments: Type species: *Nycticejus leucogaster* Cretzschmar, 1826.
1981. *Scotophilous:* Demeter, Vertebr. Hung., 20: 135. (Lapsus)
2018. *Schotophilus:* Leopardi, Holmes, Gastaldelli, Tassoni, Priori, Scaravelli, Zamperin and De Benedictis, Infec. Gen. Evol., 58: 284. Publication date: 30 January 2018. (Lapsus)
2018. *Scotophilis:* Adams and Kwiecinski, Diversity, 10 (3) 103: 4. Publication date: 18 September 2018. (Lapsus)

TAXONOMY:
Bronner *et al.* (2003) states that the taxonomy of African *Scotophilus* remains problematic. Three species, differing mainly in body size, probably occur in the [southern African] subregion, but species limits and phylogenetic inter-relationships are unclear (Meester *et al.*, 1986). Ellerman *et al.* (1953) referred to the largest species as *gigas*, but Robbins (1978a) showed that in describing *gigas*, Dobson (1875a) had in fact re-described *nigrita*, the name used by Ellerman *et al.* (1953) for the medium-sized species. Koopman (1982) accepted *nigrita* as a senior synonym of *gigas*, but argued that *nigrita* is a *nomen dubium* and should therefore not be used; a position later recanted (Koopman, 1993a, 1994). Since *nigrita* was no longer available for the medium-sized species, Robbins (1978a) used *dinganii* as the next valid name. Koopman (1975, 1978), however, regarded *leucogaster* as a senior synonym of *dinganii*, but later revised this opinion and recognised these as discrete species (Koopman, 1993a). Shortly thereafter he reverted to his earlier treatment and again listed *dinganii* under *leucogaster* (Koopman, 1994).

Ellerman *et al.* (1953) referred to the smallest of the three species in the [southern African] subregion as *viridis*, containing two subspecies (*S. v. viridis* and *S. v. damarensis*), which they recognised as distinct from *borbonicus* on Reunion Island. Hill (1980) regarded these taxa as conspecific and, therefore, used *borbonicus* as the prior name for this taxon. Corbet and Hill (1980) followed Koopman (1975) in confining *borbonicus* to Madagascar and Reunion, and thus once again recognised *viridis* as a mainland species, a treatment followed by Swanepoel *et al.* (1980) and Koopman (1982). Robbins *et al.* (1985) followed suit, but also listed *leucogaster* to accommodate *damarensis*, which they considered distinct from *viridis*, a treatment endorsed by Corbet and Hill (1992). Koopman (1993a) considered *damarensis* synonymous with *viridis*, but subsequently recognised both of these as only subspecies of *borbonicus* (Koopman, 1994).

Vallo *et al.* (2010: 303) indicate that several unrelated mitochondrial lineages occur within *S. dinganii*, but also that the African *Scotophilus* as a whole is in need of more detailed investigation and formal revision of systematics.

For a discussion on the names introduced by Brooks and Bickham, see Vallo and Van Cakenberghe (2017: 6).

Demos *et al.* (2018: 10) used multi-locus coalescent delimitation methods and concluded that 15 different species may occur in continental Africa, keeping in mind that large parts of the continent are seriously undersampled.

Prié *et al.* (2016) report on the echolocation characteristics of a "Chiroptera sp. 1" from Réunion, which they believe to be a *Scotophilus*. However, due to the terrible physical status and the taxonomic uncertainty of the *S. borbonicus* specimen(s) collected on the island, they feel it impossible to use the name *borbonicus* for these "Chiroptera sp. 1" specimens. Additional acoustic and distributional information on this species is provided by Augros (2017).

Known species of the genus *Scotophilus*: ***altilis*** G.M. Allen, 1914; ***andrewreborii*** Brooks and Bickham, 2014; ***borbonicus*** (E. Geoffroy, 1803); *celebensis* Sody, 1928 – Sulawesi (Indonesia) (Simmons, 2005: 465); *collinus* Sody, 1936 – Sabah, western Java, Bali, Lombok, Flores, Lembata, Timor, Semanu and Roti Isls (Indonesia) (Simmons, 2005: 466); ***dinganii*** (A. Smith, 1833);

Scotophilus ejetai Brooks and Bickham, 2014; *heathii* (Horsfield, 1831) – Afghanistan to southern China, including Hainan Isl, south to Sri Lanka, Vietnam, Cambodia, Thailand and Burma (Simmons, 2005: 466); *kuhlii* Leach, 1821 – Bangladesh, Pakistan to Taiwan, south to Sri Lanka, Burma, Cambodia, western Malaysia, Java, Bali, Nusa Tenggara (Indonesia), southeast to Philippines and Aru Isls (Indonesia) (Simmons, 2005: 466); ***leucogaster*** (Cretzschmar, 1830); ***livingstonii*** Brooks and Bickham, 2014; ***marovaza*** Goodman, Ratrimomanarivo and Randrianandrianina, 2006; ***nigrita*** (Schreber, 1774); ***nigritellus*** de Winton, 1899; ***nucella*** Robbins, 1973; ***nux*** Thomas, 1904; ***robustus*** Milne-Edwards, 1881; ***tandrefana*** Goodman, Jenkins and Ratrimomanarivo, 2005; ***trujilloi*** Brooks and Bickham, 2014; ***viridis*** (Peters, 1852).

COMMON NAMES:
Czech: mračníkové, mrakolibové. English: Yellow bats, House bats, Brown bats. French: Scotophiles. German: Hausfledermäuse. Italian: Scotòfili.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) for a *S. borbonicus* from Kenya.
Karyotype - Volleth *et al.* (2006) reported 2*n* = 36, FN = 50, BA = 18, a submetacentric X and a submetacentric Y chromosome for a male *S. leucogaster* from Burkina Faso. Recently, Eick *et al.* (2007) reported 2*n* = 36, FN = 50, BA = 16, a metacentric X chromosome and an acrocentric Y chromosome for South African specimens of *S. dinganii*.

HABITS:
Foord *et al.* (2018: 5) indicate that clutter-edge bats such as *Scotophilus* spp. may commute up to 3 km between roosts and feeding areas, but generally use a smaller core area.

DIET:
Jacobs (2000: 201) reported the following proportions of prey categories for 32 "*Scotophilus borbonicus*" specimens: Lepidoptera (13.8 ± 23.0), Coleoptera (37.4 ± 38.1), Isoptera (15.8 ± 28.7), Hymenoptera (11.5 ± 26.0), Diptera (7.5 ± 23.1), Hemiptera (13.4 ± 29.8), and unknown (0.6 ± 2.0).

REPRODUCTION AND ONTOGENY:
van der Merwe and Rautenbach (1988: 321) described the placenta of the lesser yellow house bat ("*S. borbonicus*") as antimesometrial discoidal, deciduate and hemodichorial. van der Merwe and Rautenbach (1990: 540) reported that this bat commonly gives birth to twins and occasionally even triplets. van der Merwe *et al.* (1988: 551) found that insemination,
ovulation and fertilization take place in autumn. The embryonic growth is soon retarded. but
not arrested and the embryo remains in the morula stage for 6 to 8 weeks, followed by a
blastocyst stage of about two months.
In the same species, van der Merwe and Rautenbach (1989: 83) found that spermatogenesis was prolonged and extended over 8 months, coinciding with spring, summer and autumn.

The above information might pertain to either *S. leucogaster* or *S. viridis*.

PARASITES:
PROTOZOA
Espinosa-Álvarez *et al.* (2018: 572, Suppl.) reported new trypanosomes (*Trypanosoma vespertilionis*-like G1 and *Trypanosoma* sp. HochG3) from *Scotophilus* bats collected in Guinea-Bissau.

DIPTERA
Nycteribiidae: *Basilia ansifera* Theodor, 1956 mainly a West African species, reaching Lake Victoria in the east and Lake Nyasa in the south, nearly all localities lie between 15° latitude north and south (Haeselbarth *et al.*, 1966: 110).

SIPHONAPTERA
Ischnopsyllidae: The genus *Scotophilus* was reported by Beaucournu and Kock (1996) as the first African host (in Eritrea) for *C. brockmani* Rothschild, 1915.

VIRUSES:
Togaviridae
Alphavirus
Chikungunyavirus- isolated from Senegal in 1962, from the salivary glands of *Scotophilus* sp. by Bres and Chambon (1963).

ZOOBANK:
EE74E9E4-260A-48A5-9CD7-C690F661AF90

Scotophilus altilis G.M. Allen, 1914

*1914. *Scotophilus altilis* G.M. Allen, Bull. Mus. comp. Zool., 58 (7): 350. Publication date: July 1914. Type locality: Sudan: Blue Nile province: north of [Er] Roseires: Aradeiba [12 25 N 34 20 E]. Holotype: MCZ 14463: ad ♂, skin and skull. Collected by: Glover Morrill Allen

and The Phillips Sudan Expedition; collection date: 22 January 1913; original number: 73. See Helgen and McFadden (2001: 147). Paratype: FMNH ad ♂, skin and skull. Exchanged; formerly MCZ (14462); see Helgen and McFadden (2001:147). Paratype: FMNH 34161: ad ♂, skin and skull. Collected by: Glover Morrill Allen; collection date: 6 January 1913; original number: 22. Presented/Donated by: ?: Collector Unknown. Formely MCZ 14462. Paratype: MCZ 14610: ad ♂, alcoholic (skull not removed). Paratype: MCZ 14611: ad ♂, alcoholic (skull not removed). See Helgen and McFadden (2001: 147).

TAXONOMY:
Traditionally considered a synonym of *Scotophilus leucogaster*, but see Vallo *et al.* (2019: 148) who found that there is a 10% genetic difference for *cytb* between *S. leucogaster* and specimens from southwestern Ethiopia and southern South Sudan. These latter specimens were also slightly smaller and had a slightly different ventral colour. Additionally, two nuclear markers (*zfy* and *fgb7* also showed similar differences.

GENERAL DISTRIBUTION:
Native: Democratic Republic of the Congo, Ethiopia, Kenya, South Sudan, Sudan (Vallo *et al.*, 2019: 151).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Ethiopia, Kenya, South Sudan, Sudan.

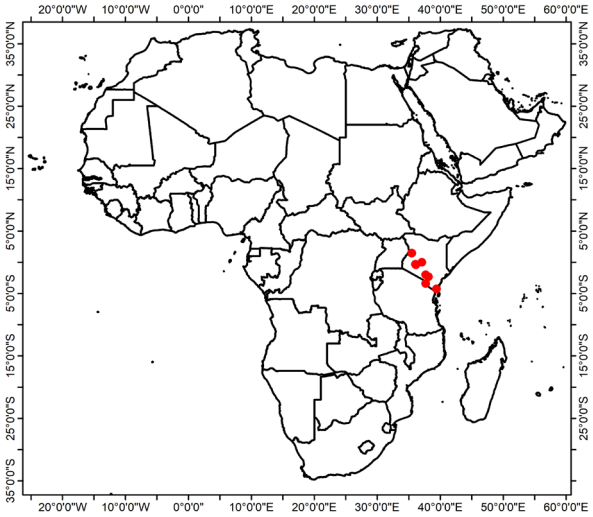


Figure 254. Distribution of *Scotophilus altilis*

Scotophilus andrewreborii Brooks and Bickham, 2014

*2014. *Scotophilus andrewreborii* Brooks and Bickham, Occ. Pap. Mus. Texas Tech Univ., 326: 1, 8, fig. 2. Publication date: 26 June 2014. Type locality: Kenya: Nakuru district, 12 km S, 4 km E Nakuru [00 24 S 36 07 E] [Goto Description]. Holotype: CM 98049: ad ♂, skin and skull. Collected by: Dr. Kimberlyn ("Kim") Nelson; collection date: 7 October 1985; original number: 217. Muscle tissue sample TK 33143. Paratype: CM 98048: ad ♀, skin and skull. Collected by: Dr. Kimberlyn ("Kim") Nelson; collection date: 7 October 1985; original number: 214. Muscle tissue sample TK 33140. Paratype: CM 98050: ad ♂, skin and skull. Collected by: Dr. Kimberlyn ("Kim") Nelson; collection date: 8 October 1985; original number: 219. Muscle tissue sample TK 33149. - Etymology: In honor of Andrew N. Rebori (1948 - 2011), who unknowingly touched the lives and inspired many individuals, including many museum professionals. He always maintained a keen interest in animals, especially bats, which exemplified his spirit and attitude toward life, 'Take flight every new day!' (see Brooks and Bickham, 2014: 8).

TAXONOMY:
Brooks and Bickham (2014) described four new species in the genus *Scotophilus*. However, they did not compare them with a number of already described taxa such as *colias* Thomas, 1904 or *flavigaster* Heuglin, 1861, which make the validity of (some of) these names doubtfull.

The analyses performed by Demos *et al.* (2018: 2) confirmed the validity of the taxon, but these authors also indicate that they cannot vouch for the validity of the name with respect to older taxa that would have nomenclatural priority.

COMMON NAMES:
Chinese: 安氏黄蝠. English: Andrew Rebori's House Bat. German: Andrews Hausfledermaus

GENERAL DISTRIBUTION:
Brooks and Bickham (2014: 8) indicate that the type series was collected in two localities in Kenya, and that there are at least five other Kenyan localities where this species occurs.

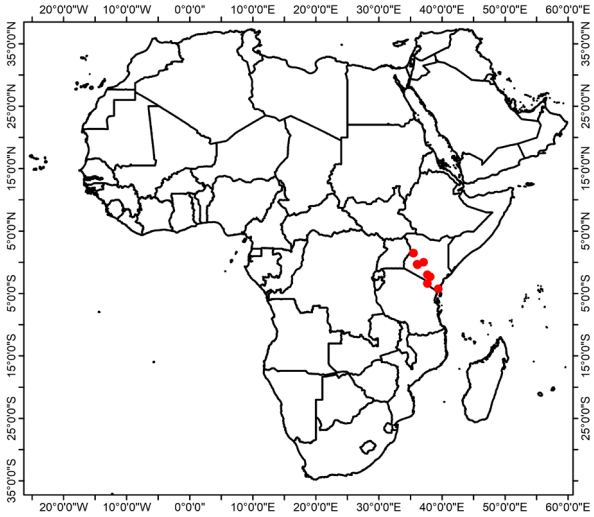


Figure 255. Distribution of *Scotophilus andrewreborii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Kenya.

Scotophilus borbonicus (E. Geoffroy St.-Hilaire, 1803)

*1803. *Vespertilio borbonicus* E. Geoffroy Saint-Hilaire, Catalogue des Mammifères du Muséum national d'Histoire naturelle, Paris, 55. Type locality: Réunion: Ile Bourbon [=Réunion Island] [Goto Description]. Lectotype: RMNH MAM.28508: ad ♂, mounted skin (skull not removed). "Individu adulte monté, figuré dans la Mammalogie de Temminck, T.H. Pl. XLVII, fig. 6. Bourbon. Du voyage de M. Macé": see Goodman *et al.* (2005b: 871). - Etymology: Refering to "Ile Bourbon" where the type specimen was collected.
1855. *N[ycticejus] borbonicus:* Giebel, Die Säugethiere, 928. (Name Combination)
? *Scotophilus borbonicus:* (Name Combination, Current Combination)
? *Scotophilus cf. borbonicus:*

TAXONOMY:
Included equivocally in *leucogaster* by Hayman and Hill (1971: 50 - 51), but see Koopman (1975: 414 - 416). Hill (1980) considered African *viridis* and *damarensis*, and possibly *leucogaster* to be conspecific with *borbonicus*; but Robbins *et al.* (1985) rejected any affinity with African mainland species. Also see comment under *leucogaster* and genus. Koopman (1986) included *viridis*, *damarensis*, and *nigritellus* (but not *leucogaster*) in this species.

The authorship and date of this name was fixed to E. Geoffroy St.-Hilaire (1803) by Opinion 2005 (Case 3022) (see Anonymus, 2002b: 154).

COMMON NAMES:
Czech: mračník réunionský, netopýr zelený. English: Lesser Yellow Bat, Lesser Yellow House Bat, Madagascar Yellow House Bat, Bourbon Bat. French: Scotophile de Bourbon, Scotophile de Madagascar, Petite Chauve-souris jaune des maisons, chauve-souris des Hauts. German: Réunion-Hausfledermaus, Bourbonische Schwirrfledermaus. Portuguese: Morcego amarelo pequeno.

CONSERVATION STATUS:
Global - There have been exhaustive surveys of Réunion (e.g. Moutou, 1982) and this species has not been recorded for nearly 140 years. However, there is not enough information to determine its taxonomic status, as the holotype is badly damaged and other possible specimens cannot be reliably assigned to this species. If the taxonomic status of this species is confirmed, then the species may qualify for a higher threat category and may well be extinct (Andriafidison *et al.*, 2008j; IUCN, 2009).

Jones *et al.* (2009b: 507) assessed its status as Critically endangered - A1c. Conenna *et al.* (2017: Suppl.) assessed it as Data Deficient (DD).

Assessment History -
2008 - DD ver 3.1 (2001) (Andriafidison *et al.*, 2008j; IUCN, 2009). 2004 - CR A1c ver 2.3 (1994) (IUCN, 2004). 2002 - CR: A1c (Mickleburgh *et al.*, 2002a: 22);

MAJOR THREATS:
The threats to this species are not known (Andriafidison *et al.*, 2008j; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008j) [in IUCN (2009)] report that there are no conservation measures in place.

GENERAL DISTRIBUTION:
This holotype was described from two specimens from La Réunion and one of these was designated as the lectotype but is now in very poor condition (Goodman *et al.*, 2005a). In Madagascar, it is known only from a single specimen collected in 1868, at Sarodrano, near Toliara in the south (Goodman *et al.*, 2005a). The identity of the Madagascar specimen cannot be confirmed due to absence of reliable material from La Réunion. The area near Sarodrano has been relatively well surveyed recently, but no new specimens were obtained (Goodman *et al.*, 2005a).

Records from Mauritius (Mascarene Islands) are erroneous, see Cheke and Dahl, 1981: 217, Moutou, 1982: 44).

Native: Madagascar (?); Réunion.

ECHOLOCATION:
During their field work on Réunion, Barataud and Giosa (2013) captured some echolocation calls of two unidentified bats, which were neither *Mormopterus francoismoutoui* nor *Taphozous mauritianus*. The signals for one of these ("Chiroptera sp1" - QFC = 60 kHz, FM = 61 kHz) were very similar to those of Madagascan and African continental *Scotophilus*, which lead them to hypothesize that "Chiroptera sp1" might possibly be *S. borbonicus*.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) for the results of a specimen from Kenya (which most probably represents a different species).

Karyotype, Protein / allozyme - Unknown.

HABITAT:
Maillard (1862: 158) indicated that this species usually lived in forests and also near the coast of Réunion.

POPULATION:
Structure and Density - This species was considered to be relatively common in the early 19th Century on La Réunion; however, it was not recorded in the 20th century or 21st century (Cheke and Dahl, 1981).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008j; IUCN, 2009).

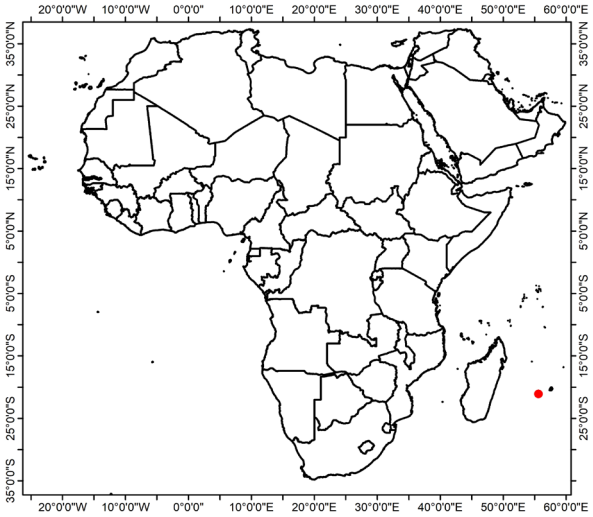


Figure 256. Distribution of *Scotophilus borbonicus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Réunion.

Scotophilus dinganii (A. Smith, 1833)

1832. *Vespertilio epichrysus* Temminck, in: Smuts, Enumer. Mamm. Capensium, 106. Type locality: South Africa: Cape Town [33 56 S 18 28 E]. - Comments: Allen (1939a) and Ellerman *et al.* (1953) regard this taxon as unidentifiable, besides which it appears to fall outside the known range of the species as a whole (see Roberts, 1951: 90); Meester *et al.*, 1986: 60), who include it with a question mark). However, if valid, this is the senior name for the species. Dobson (1878: 303) mentions *Vespertilio epichrysus* (Temminck, Monogr. Mamm., 2: 208) with a question mark in the synonymy of *Vespertilio* [=*Myotis*] *emarginatus*.

*1833. *Vespertilio Dinganii* A. Smith, S. Afr. Quart. J., ser. 2, 1 (2): 59. Publication date: November 1833. Type locality: South Africa: Port Natal [=Durban] & Delagoa Bay [=Maputo], btwn [Goto Description]. - Etymology: In honour of Dingane (or Dingan / Dingaan), king of the Zulus (1795 - 1840) (see Lanza *et al.*, 2015: 487).

1852. *Nycticejus planirostris* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 65, pl; 17, fig. 1, a-e. Publication date: 1852. Type locality: Mozambique: Lower Zambesi River: Tete [16 10 S 33 35 E, 230 m] [Goto Description]. Holotype: ZMB 527: ad ♂, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: March 1845. See Turni and Kock (2008) [=An 16363].

1855. *N[ycticejus] Dingani:* Giebel, Die Säugethiere, 927. (Name Combination)
1904. *Scotophilus nigrita colias* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (75): 207. Publication date: 1 March 1904. Type locality: Kenya: Fort Hall [=Muranga] [00 43 S 37 09 E] [Goto Description]. Holotype: BMNH 1902.7.6.11: ad ♂. Collected by: Mrs. Hildegarde Hinde; collection date: 25 January 1902; original number: 107. Presented/Donated by: Mrs. Hildegarde Hinde.
1906. *Scotophilus nigrita herero* Thomas, Ann. Mag. nat. Hist., ser. 7, 17 (98): 174. Publication date: 1 February 1906. Type locality: Namibia: Ovamboland: Olifants Vlei [18 00 S 17 30 E] [Goto Description]. Holotype: BMNH 1907.1.1.449: ad ♀, skin and skull. Collected by: Mr. C.J. Andersson; collection date: 8 August 1859; original number: 260. Formerly in Tomes collection. - Comments: Ellerman *et al.* (1953) point out that the type locality is not in Damaraland, as claimed by Thomas for both *herero* and *damarensis*: see Meester *et al.* (1986: 60).
1921. *Scotophilus nigrita dingani:* Kershaw, Durban Mus. Novit., 3 (1): 29. (Name Combination, Alternate Spelling)
1946. *Scotophilus nigrita pondoensis* Roberts, Ann. Transv. Mus., 20 (4): 304. Type locality: South Africa: Transkei, Western Pondoland: Port St.Johns [31 27 S 29 33 E] [Goto Description].
1951. *Vespertilio epichrysurus:* Roberts, Mammals of South Africa, 90. (Lapsus)
1953. *Scotophilus nigrita dingaanii:* Lawrence and Loveridge, Bull. Mus. comp. Zool., 110 (1): 6. (Lapsus)
1958. *Scotophilus nigrita coreas:* Eisentraut, Veröff. Überseemus. Bremen, (A) 3: 23. - Comments: Lapsus for colias (see Kock, 1969a: 193). (Lapsus)
2001. *scotophilus nigrata:* Lameed, Biodiversity, 8 (4): 8. - Comments: We can not exclude that this might be a synonym for *S. nigrita*. (Lapsus)
? *Scotophilus cf. dinganii:*
? *Scotophilus dingani:* (Alternate Spelling)
? *Scotophilus dinganii colias:* (Name Combination)
? *Scotophilus dinganii dinganii:* (Name Combination)
? *Scotophilus dinganii herero:* (Name Combination)
? *Scotophilus dinganii:* (Name Combination, Current Combination)
? *Scotophilus nigrita dinganii:* (Name Combination)
? *Scotophilus nigrita nigrita:* (Name Combination)
? *Scotophilus nigrita:*

TAXONOMY:
Placed in *leucogaster* by Koopman (1975: 414 - 416, as *nigrita*; 2004ah: 11) and Koopman *et al.* (1978: 4 - 5); but see also Schlitter *et al.* (1980).

See also the discussion under the genus and under *nigrita* and *leucogaster*.

In their study on Arabian *Scotophilus*, Vallo *et al.* (2011c: 359) tentatively suggest to use the name *S. colias* for the East African yellow-bellied house bat as these bats clearly differ from the typical *S. dinganii* from southern Africa.

Trujillo *et al.* (2009: 554) found several divergent cytochrome *b* lineages in *S. dinganii*, suggesting that cryptic species might be present in different geographic areas southern Africa, eastern Africa, Ghana to Kakamega Forest (Kenya).

COMMON NAMES:
Afrikaans: Geel Dakvlermuis. English: Yellow House Bat, Dingan's Bat, Dingaan's House Bat, Yellow-bellied House Bat, Dingaan's Yellow Bat, African Yellow Bat, African Yellow House Bat. French: Scotophile africain, Chauve-souris jaune des maisons, Scotophile à ventre jaune. German: Gelbbäuchige Hausfledermaus, Natalischen Schwirrfledermaus, Flachschnauzigen Schwirrfledermaus. Italian: Scotòfilo di Dìngan. Portuguese: Morcego caseiro amarelo.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
This species has been recovered from the upper Pleistocene in South Africa, at Border Cave (Avery, 1991: 6), and Wonderwerk (Avery and Avery, 2011: 19).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Griffin, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Griffin, 2008a; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Griffin, 2004b;

IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016s). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Griffin, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Griffin (2008a) [in IUCN (2009)] report that in view of the species wide range it is believed to be present in many protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Scotophilus dinganii is widely distributed in sub-Saharan Africa. It ranges from Senegal and the Gambia in the west, through West Africa and parts of Central Africa, to Sudan, Eritrea, Djibouti and Ethiopia in the east, from here it ranges south through much of East Africa and southern Africa, being recorded as far south as eastern South Africa, Lesotho and Swaziland. For South Africa, Babiker Salata (2012: 49) found that its distribution is stongly associated with the mean temperature of the coldest quarter.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,251,825 km^2.

Native: Angola (Crawford-Cabral, 1989; Cotterill, 2004a: 262; Monadjem *et al.*, 2010d: 573; Taylor *et al.*, 2018b: 63); Benin (Capo-Chichi *et al.*, 2004: 163); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 573); Burkina Faso (Kangoyé *et al.*, 2012: 6026; 2015a: 626); Burundi; Cameroon; Central African Republic; Congo (Bates *et al.*, 2013: 337); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Dowsett *et al.*, 1991: 259; Van Cakenberghe *et al.*, 1999; Monadjem *et al.*, 2010d: 573); Côte d'Ivoire; Djibouti (Pearch *et al.*, 2001: 398); Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 131); Gambia; Ghana; Guinea; Guinea-Bissau (Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 71); Kenya; Lesotho; Liberia; Malawi (Ansell and Dowsett, 1988: 38; Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 573); Mali; Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 573; Monadjem *et al.*, 2010c: 384); Namibia (Monadjem *et al.*, 2010d: 573); Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa (De Graaf, 1960; Monadjem *et al.*, 2010d: 573); Sudan; Swaziland (Monadjem *et al.*, 2010d: 574); Tanzania (Stanley and Goodman, 2011: 45); Togo; Uganda; Yemen (Benda *et al.*, 2011b: 42); Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 574); Zimbabwe (Monadjem *et al.*, 2010d: 574).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

ECHOLOCATION:
See Taylor (1999b) and Taylor *et al.* (2005).

Jacobs *et al.* (2007a) recorded the peak echolocation frequency (33.4 ± 1.4 kHz) for individuals from St. Lucia, KwaZulu Natal, South Africa. Schoeman and Waddington (2011: 291) mention a peak frequency of 33.9 ± 1.1 kHz and a duration of 4.1 ± 0.7 msec for specimens from Durban, South Africa.

Taylor *et al.* (2013b: 17) recorded the following parameters for 7 calls from Soutpansberg, South Africa: F_{max}: 51.6 ± 8.19 (42.1 - 65.2) kHz, F_{min}: 33.1 ± 0.79 (31.6 - 34.1) kHz, F_{knee}: 36.4 ± 1.10 (34.4 - 37.4) kHz, F_{char}: 33.8 ± 1.03 (31.9 - 35.3) kHz, duration: 3.4 ± 0.66 (2.7 - 4.6) msec.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg range (RSA): F_{min}: 32 - 34 kHz, F_{char}: 32 - 35 kHz, F_{knee}: 34 - 37 kHz, Slope: 287 - 588 OPS, duration: 3 - 5 msec.

At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 36 (34 - 37) kHz.

From Maroua, Cameroon, Manga Mongombe (2012: 79) and Bakwo Fils *et al.* (2018: 4) reported for 19 calls a call type of FM/QCF and the following parameters: F_{max}: 58.5 ± 8.9 (49.4 - 84.8) kHz, F_{min}: 52.6 ± 6.2 (46.7 - 69.5) kHz, F_{mean}: 55.6 ± 7.5 (48.1 - 77.0) kHz, F_{knee}: 58.5 ± 8.9 (49.4 - 84.0) kHZ, F_{char}: 52.7 ± 6.2 (46.8 - 69.5) kHz, and duration: 0.88 ± 0.92 (0.73 - 1.02) msec.

Eisenring *et al.* (2016: SI 2) report on two calls from *S. nigrita* from the Aberdares Range in Kenya with the following characteristics: PF: 36.8 ± 3.3 (34.5 - 39.2), HF: 57.3 ± 12.4 (48.5 - 66.1), LF: 29.8 ± 0.4 (29.5 - 30.1), DT: 0.1 ± 0.0 (0.1 - 0.1) DF: 27.5 ± 12.9 (18.4 - 36.6), IPI: 1.1 ± 0.4 (0.9 - 1.4). As they compare their values with those presented by Fenton (1975), Fenton and Bell (1981) and O'Shea and Vaughan (1980), these values are probably also for *S. dinganii*.

From Swaziland, the following parameters were reported by Monadjem *et al.* (2017c: 179): F_{min}: 33.2 ± 1.26 (30.3 - 34.7) kHz, F_{knee}: 36.4 ± 1.61 (32.1 - 38.6) kHz, F_c: 33.7 ± 1.44 (30.3 - 35.6) kHz,

and duration: 3.8 ± 0.94 (2.6 - 6.1) msec. The calls were detectable up to a distance of 20 m.

Adams and Kwiecinski (2018: 4) recorded the following characteristics for four calls of bats from the Kalahari Desert: F_{char}: 33.9 ± 2.4 kHz, F_{max}: 40.9 ± 2.1 kHz, F_{min}: 33.4 ± 2.0 kHz, duration: 3.3 ± 0.9 msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) for the results of a specimen from Tanzania.
Karyotype - Peterson and Nagorsen (1975), Schlitter *et al.* (1980) and Ruedas *et al.* (1990) all reported 2*n* = 36. However, while Schlitter *et al.* (1980) reported FN = 52, BA = 18, an acrocentric X chromosome, and a metacentric Y chromosome, Ruedas *et al.* (1990) reported FN = 50, BA = 16, a submetacentric X chromosome, and a telocentric Y chromosome. Eick *et al.* (2007) reported the following autosomal pairs: seven meta- to submetacentric, nine acrocentric, and one subtelocentric. One homologue of the smallest acrocentric pairs showed a small heterochromatic short arm in one specimen, resulting in a subtelocentric state (Eick *et al.*, 2007). The diploid chromosome number (2*n*) is 36, the fundamental number of autosomal arms (Fna) is 50 (Eick *et al.*, 2007). The X chromosome is a medium-sized metacentric and the Y chromosome a small, probably acrocentric, partly heterochromatic chromosome (Eick *et al.*, 2007).
Protein / allozyme - Unknown.

HABITAT:
In southern Africa, this species is found in Savanna habitatas(80 %; Cooper-Bohannon *et al.*, 2016: Table S2).

HABITS:
Scotophilus dinganii is gregarious, roosting in small groups of up to 12 individuals (Skinner and Smithers, 1990).
Thermoregulation - See Jacobs *et al.*, 2007b).

ROOST:
Type - Buildings (Skinner and Smithers, 1990). In KwaZulu Natal, South Africa, Jacobs *et al.* (2007b), found *S. dinganii* roosted in the roofs of buildings in the crevices between the roof (either made of asbestos, clay tiles, or corrugated metal sheets) and the brickwork of the walls. Jacobs *et al.* (2007b) did not find any relationship between aspect and roost selection, or any relationship that the bats preferred roosts which received the direct rays of the afternoon sun. Monadjem *et al.* (2010b: 74) found that they roosted in *Combretum imberbe* trees.
Microclimate - Jacobs *et al.* (2007b) found that the temperature of building roosts appeared to track ambient temperature with a slight lag.

DIET:
On the Umbilo River (KwaZulu Natal, RSA), Naidoo *et al.* (2011: 26) found the diet to contain the following volume percentages during summer: Lepidoptera (17.5 ± 15.9), Coleoptera (81.9 ± 16.6), and Diptera (0.6 ± 1.3). And during winter: Lepidoptera (24.9 ± 12.9), Coleoptera (66.4 ± 21.7), and Diptera (8.9 ± 8.7).

Taylor *et al.* (2017b: 245, 252 - 254) reported the following 23 food items in the Limpopo province (RSA): five insect orders: Lepidoptera (*Toxocampinae tathorhynchus* + *Achrosis* sp. + *Isturgia roraria* + *Sena* sp. + *Sena prompta* + *Cortyta canescens* + *Pandesma robusta* + *Pericyma atrifusa* + *Argyrogrammatini*sp. + *Spodoptera exigua* + *Maurilia arcuata* + unmatched), Orthoptera (Tettigoninae + unmatched), Hemiptera (*Nezera viridula* + *Macrorhaphis acuta* + unmatched), Coleoptera (unmatched) and Blattodea (unmatched).

Weier *et al.* (2019b: 6) investigated droppings from this species in the Levubu region (Limpopo, RSA) and found DNA sequences of: Lepidoptera: *Cryptophlebia peltastica* (Meyrick, 1921) and *Thaumatotibia batrachopa* (Meyrick, 1908); Hemiptera: *Bathycoelia distincta* Distant, 1878 and *Nezara viridula* (Linnaeus, 1758).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) and the African harrier-hawk (*Polyboroides typus* Smith, 1829) as diurnal avian predators.

POPULATION:
Strucuture and Density - Little information is available on the population abundance or size of this species (Griffin, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Griffin, 2008a; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Jacobs *et al.* (2007b) found that bats roost exit times were variable, but most left their roost for the first time on a particular day between 17h15 and 18h00 and returned between 18h45 and 19h15 (remaining out of the roost on avarage for about 1hr).

REPRODUCTION AND ONTOGENY:
van der Merwe *et al.* (2006) reported, from examination of serially sectioned reproductive tracts of females, that *S. dinganii* is monoestrous species and that insemination, ovulation and

fertilization take place during mid to late autumn (April to May), Kruger-NP., South Africa. Early embryonic development of normally two embryos (one in each uterine horn) was retarded and implantation delayed until mid-winter (July), when the blastocysts implanted (van der Merwe *et al.*, 2006). van der Merwe (2006) found *S. dinganii* in the Kruger-N.P., South Africa to be seasonally monestrus, carrying a single foetus in each of the two uterine horns of the bicornute uterus. The amnion in *S. dinganii* was a schizamnion, and van der Merwe (2006) deduced that its formation was preceded by cavitation of the inner cell mass, with formation of the definitive amniotic cavity, where the floor of the cavity eventually formed the embryonic disc and its roof the ectodermal part of the true or definitive amnion.

van der Merwe and Rautenbach (1990: 540) reported that *S. dinganii* commonly gives birth to twins and occasionally even triplets.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births taking place between November and December.

Two pregnant females were reported from Sierra Leone on 7 April and 29 May by Weber *et al.* (2019: 27).

PARASITES:

BACTERIA

Dietrich *et al.* (2016b: 3) found one out of 12 bats from Rocktail Bay (RSA) to be positive for *Rickettsia*. Also from the RSA, Dietrich *et al.* (2018a: 4) reported the presence of *Leptospira borgpetersenii*.

Protozoa

Kassahun *et al.* (2015: 168) examined Ethiopian 12 *S. colias* specimens and found one (out of 11 from Metu) infected with *Leishmania* parasites.

HEMIPTERA

Cimicidae: *Cacodmus sparsilis* Rothschild, 1914 was described from one female specimen taken from a *S. dinganii* at Durban, South Africa (Haeselbarth *et al.*, 1966: 10, referred to as *Scotophilus nigrita*). *Stricticimex transverses* Ferris and Usinger, 1957 recorded from Windhoek, Namibia (Haeselbarth *et al.*, 1966: 14).

DIPTERA

Nycteribiidae: *Basilia bouvieri* (Falcoz, 1924) from Tanzania, Sudan, Senegal and Sierra Leone (Haeselbarth *et al.*, 1966: 111), referred to as *Scotophilus nigrita*).

Scotophilus ejetai Brooks and Bickham, 2014

SIPHONAPTERA

Ischnopsyllidae: (*Chiropteropsylla brockmani* Rothschild, 1915 was reported on *Scotophilus dinganii flavigaster* from Eritrea by Beaucournu and Kock (1996).

ACARI

Trombiculidae: Stekolnikov (2018a: 134) reported the presence of *Ericotrombidium scotophilum* (Vercammen-Grandjean and Langston, 1976) from "*Scotophilus nigrita*" from Pietermaritzburg, RSA.

VIRUSES:

Coronaviridae - Coronaviruses

SARS-CoV - Müller *et al.* (2007b) tested between 1986 to 1999, for antibody to SARS-CoV in sera in five individuals from Limpopo Province, South Africa, none were tested positive (0/5). One out of 14 (7.1 %) Kenyan bats tested by Tao *et al.* (2017: Suppl.) was positive for CoV.

Flaviviridae

Pegivirus (BPgV) - 1 of 2 Kenyan specimens examined by Quan *et al.* (2013: Table S5) (50.0 %) was infected by clade G type *Pegivirus*.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:

"Africa", Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Eritrea, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

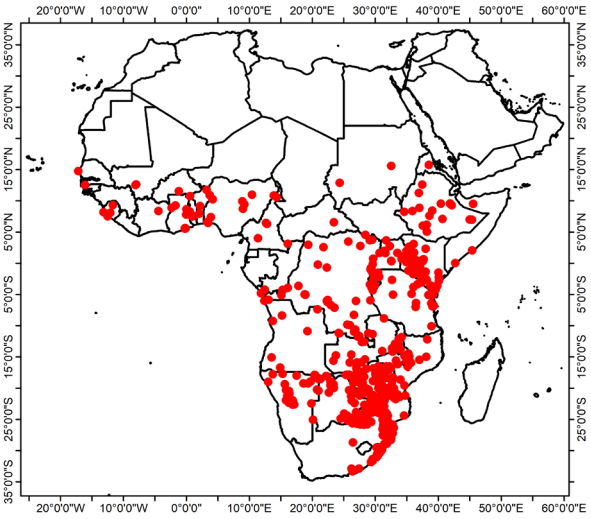


Figure 257. Distribution of *Scotophilus dinganii*

*2014. *Scotophilus ejetai* Brooks and Bickham, Occ. Pap. Mus. Texas Tech Univ., 326: 1, 14, fig. 5. Publication date: 26 Jun 2014. Type locality: Ethiopia: Orimaya region: Dogy River Bridge [08 21 43 N 35 53 02 E, 1390 m] [Goto Description]. Holotype: BRTC 57950: ad ♂, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 23 February 2001; original number: 10310. Presented/Donated by: ?: Collector Unknown. Muscle tissue sample AK 21235. Paratype: BRTC 57954: ad ♀, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 21 February 2001; original number: 10292. Presented/Donated by: ?: Collector Unknown. Tissue sample AK 21213. Paratype: CM 114043: ad ♀, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 2 April 1995; original number: 9986. Presented/Donated by: ?: Collector Unknown. Tissue sample SP 13027. - Etymology: In honour of Dr. Gebisa Ejeta, distinguished professor of plant breeding & genetics and international agriculture at Purdue University (see Brooks and Bickham, 2014: 14).

TAXONOMY:
Brooks and Bickham (2014) described four new species in the genus *Scotophilus*. However, they did not compare them with a number of already described taxa such as *colias* Thomas, 1904 or *flavigaster* Heuglin, 1861, which make the validity of (some of) these names doubtfull.

COMMON NAMES:
English: Ejeta's House Bat. German: Äthiopische Hausfledermaus.

GENERAL DISTRIBUTION:
Known from three localities in Ethiopia.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia, Kenya.

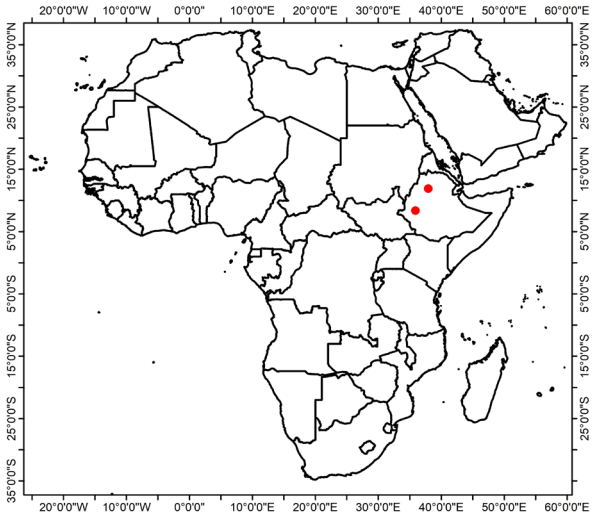


Figure 258. Distribution of *Scotophilus ejetai*

Scotophilus leucogaster (Cretzschmar, 1826)

*1826. *Nycticejus leucogaster* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 71, pl. 28a, 1, 2. Publication date: 1826. Type locality: Sudan: Kordofan province: Brunnen Nedger [=Nedger Wel; Bir Nedger]: [Goto Description]. Holotype: RMNH MAM.27432: ad. Mertens (1925: 22) mentions SMF 4309 (old catalog II.O.1.b, coll. E. Rüppell, 1825) as lectotype). Lectotype: SMF 4309: Collected by: Wilhem Peter Edward Simon Rüppell. Mertens (1925: 22) old catalog II.O.1.b. - Comments: The publication date of Cretzschmar's work is sometimes indicated as "1826" (as mentioned on the title page), but also as "1827", "1828", "1830-1831". - Etymology: From the masculine Greek adjective "*λευκος*" (leukós), meaning "white" and the feminine Greek substantive "*γαστήρ*" (gastér), meaning "stomach", referring to the relatively light belly colour of the type specimen (see Lanza *et al.*, 2015: 487).

1861. *Nycticejus flavigaster* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 5, 14. Publication date: 1861. Type locality: Eritrea: Kérén [ca. 15 45 N 38 20 E] [Goto Description]. Syntype: SMNS 983: ad ♂, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See Dieterlen *et al.* (2013: 294). Syntype: SMNS 983a: ad ♀, skull and alcoholic. Collected by: Martin Theodor von Heuglin; collection date: 1861. Presented/Donated by: ?: Collector Unknown. See Dieterlen *et al.* (2013: 294).

1861. *Nycticejus murino-flavus* Heuglin, Nov. Act. Acad. Cæs. Leop.-Carol., 29 (8): 5, 15. Publication date: 1861. Type locality: Ethiopia: near Massaua [=Massawa]: M'kullu [15 38 N 39 24 E] [Goto Description]. Holotype: [Unknown] ad ♂.

1878. *Scotophilus borbonicus:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 260. - Comments: .

1906. *Scotophilus damarensis* Thomas, Ann. Mag. nat. Hist., ser. 7, 17 (98): 175. Publication date: 1 February 1906. Type locality: Namibia: Ovamboland: Olifants Vlei [18 00 S 17 30 E] [Goto Description]. Holotype: BMNH 1907.1.1.463: ad ♂, skin and skull. Collected by: Mr. C.J. Andersson; collection date: 10 August 1859; original number: 276. Received in the Tomes collection. - Comments: Included in *borbonicus* by Meester *et al.* (1986: 61), in *viridis* by Koopman (1993a: 228), but in *leucogaster* by Simmons (2005).
1938. *[Pachyotus] altilis:* Frechkop, Exploration du Parc National Albert, 53.
? *Scotophilus borbonicus damarensis:* (Name Combination)
? *Scotophilus cf. leucogaster:*
? *Scotophilus leucogaster damarensis:* (Name Combination)
? *Scotophilus leucogaster leucogaster:* (Name Combination)
? *Scotophilus leucogaster:* (Name Combination, Current Combination)
? *Scotophilus nigrita leucogaster:* (Name Combination)
? *Scotophilus viridis damarensis:*

TAXONOMY:
Does not include *damarensis*, see Koopman (1986); but see Robbins *et al.* (1985). Herkt *et al.* (2017: Appendix S9) found that *damarenis* occupies a noticeably different ecological niche as compared with the northern populations of *leucogaster*.

Included *nucella*; but see Robbins *et al.* (1985).

For scope of this species see Koopman (1975: 414 - 416); as *nigrita*) and Koopman *et al.* (1978: 4 - 5). However Robbins (1978a: 212 - 213) has shown that the name *nigrita* was misapplied to another species, for which the next available name was *dinganii*, and which would be included in *leucogaster* if Koopman (1975)'s reasoning were followed. However Schlitter *et al.* (1980) listed *dinganii* as distinct from *leucogaster*, as did Robbins *et al.* (1985). See Koopman (1986).

COMMON NAMES:
Chinese: 白腹黃蝠. Czech: mračník bělobřichý, netopýr bělobřichý. English: Lesser Yellow House Bat, White-bellied House Bat, White-bellied Yellow Bat, Cretzschmar's Brown Bat. French: Scotophile à ventre blanc. German: Weißbäuchige Hausfledermaus, Weissbauchige Schwirrfledermaus, Gelbbauchige Schwirrfledermaus, Olivenbraune Schwirrfledermaus. Italian: Scotòfilo panciabianca.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Griffin, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Griffin, 2008b; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Griffin, 2004a; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Taylor *et al.*, 2016e).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Griffin, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Griffin (2008b) [in IUCN (2009)] reports that in view of the species wide range it is presumably present in many protected areas. No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Scotophilus leucogaster has been recorded in much of West Africa (including northern parts of Cameroon, Nigeria, Benin, Togo, Ghana, Côte d'Ivoire, Sierra Leone, and Guinea, much of Senegal, Gambia, and Burkina Faso, and southern parts of Mali and Niger). There are isolated records from southwestern Mauritania, as well as western parts of the Central African Republic. The eastern parts of the distribution include records from Sudan, and the northern parts of Uganda and Kenya. Further south this species is found in Mozambique, Angola and Namibia, Zambia, northern Botswana, and northern South Africa.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 426,596 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 575; Taylor *et al.*, 2018b: 60); Benin (Capo-Chichi *et al.*, 2004: 163); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 575); Burkina Faso (Kangoyé *et al.*, 2015a: 626); Cameroon; Central African Republic; Chad; Côte d'Ivoire; Ethiopia; Gambia; Ghana; Guinea;

Guinea-Bissau (Vaughan *et al.*, 1997b; Robbins *et al.*, 1985; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 70); Kenya; Mali (Meinig, 2000: 105); Mauritania; Mozambique (Monadjem *et al.*, 2010d: 575; Monadjem *et al.*, 2010c: 385); Namibia (Monadjem *et al.*, 2010d: 575); Niger; Nigeria; Senegal; Saudi Arabia; Sierra Leone; South Africa (Monadjem *et al.*, 2010d: 575); Sudan; Togo; Uganda (Kityo and Kerbis, 1996: 62); Yemen; Zambia (Monadjem *et al.*, 2010d: 575); Zimbabwe (Monadjem *et al.*, 2010d: 575).

DETAILED MORPHOLOGY:
Baculum - Unknown
Brain - Amrein *et al.* (2007), from specimens collected from Bénin, reported that proliferating cells, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus was found to be absent. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. Amrein *et al.* (2007) furthermore detected few DCX positive cells in the rostral migratory stream and the olfactory bulb. Hippocampal granule cells were homogeneously positive for NeuroD (Bigalke, 1968).

SEXUAL DIMORPHISM:
In Burkina Faso, Kangoyé *et al.* (2015a: 626) found the averages of the body measurements (except 3ph2) to be larger in females than in males, but the averages of the cranial measurements were larger in males.

ECHOLOCATION:
12 FM/QCF type calls from Maroua (Cameroon) were reported by Manga Mongombe (2012: 79) and Bakwo Fils *et al.* (2018: 4) with the following parameters: F_{max}: 55.7 ± 4.3 (48.5 - 64.1) kHz, F_{min}: 50.6 ± 3.0 (46.1 - 56.3) kHz, F_{mean}: 53.2 ± 3.6 (47.3 - 59.3) kHz, F_{knee}: 55.7 ± 4.3 (48.5 - 64.1) kHz, F_{char}: 50.7 ± 3.0 (46.1 - 55.0) kHZ, and duration: 0.81 ± 0.23 (0.44 - 1.00) msec.

Thiagavel *et al.* (2017: Suppl.) mention a F_{peak} of 46.27 kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) for the results of a specimen from Kenya.
Karyotype - See discussion in generic account.
Protein / allozyme - Unknown.

HABITAT:
In southern Africa, it occurs in Savanna (89 %) and SW arid (10 %) habitats (Cooper-Bohannon *et al.*, 2016: Table S2).

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Griffin, 2008b; IUCN, 2009).
Trend - 2008 - Unknown (Griffin, 2008b; IUCN, 2009).

PARASITES:
ACARI
Dermanyssidae: Zumpt and Till (1954: 50) reported the presence of *Steatonyssus nyassae* (Hirst, 1922) on a "*Scolophilus murinoflavus*" from near Torit, South Sudan.
Trombiculidae: Stekolnikov (2018a: 114) reported *Schoutedenichia (Schoutedenichia) trombiculoides* Vercammen-Grandjean, 1958 and *Microtrombicula scotophili* Vercammen-Grandjean, 1965 from *S. leucogaster leucogaster* from South Sudan.

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - In Nigeria during June 2008, Quan *et al.* (2010) screened the gastrointestinal tissue for the presence of coronaviruses by PCRs, none tested positive.

Rhabdoviridae
Lyssavirus - Rabies related viruses
In Nigeria during June 2008, Quan *et al.* (2010) did not detect any lyssavirus-specific antigens from the brains by use of direct fluroescent anitbody testing.

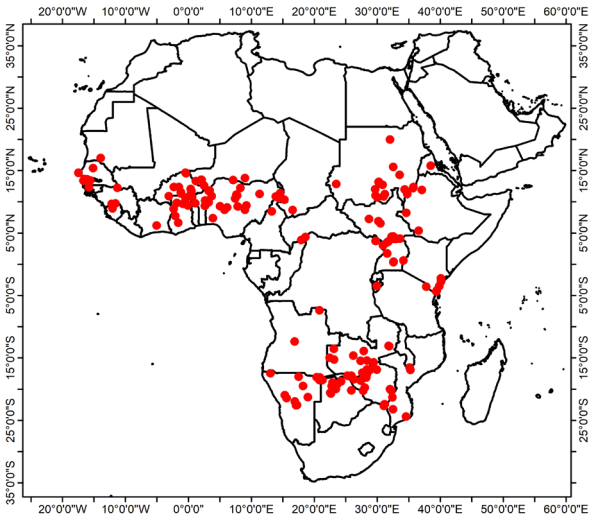


Figure 259. Distribution of *Scotophilus leucogaster*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Côte d'Ivoire, Eritrea, Ethiopia, Ghana, Guinea-Bissau, Kenya, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone,

South Africa, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Scotophilus livingstonii Brooks and Bickham, 2014

*2014. *Scotophilus livingstonii* Brooks and Bickham, Occ. Pap. Mus. Texas Tech Univ., 326: 1, 11, fig. 4. Publication date: 26 June 2014. Type locality: Kenya: Western province: Kakamega district: Ikuywa River Bridge, 6.5 km S, 19 km E Kakamega [00 13 N 34 55 E] [Goto Description]. Holotype: CM 98051: ad ♂, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 8 November 1985; original number: 7394. Presented/Donated by: ?: Collector Unknown. Muscle tissue sample TK 33534. Paratype: CM 98053: ad ♀, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 8 November 1985; original number: 7396. Presented/Donated by: ?: Collector Unknown. Muscle tissue sample TK 33536. Paratype: USNM 412150: ad ♀, skin and skull. Collected by: Bruce Joliffe Hayward; collection date: 22 July 1967; original number: 4135. Presented/Donated by: ?: Collector Unknown. Collected at University of Ghana Botanical Garden (5º40'N, 10º12'W [sic]), Legon, Eastern (Greater Accra) Region, Ghana (Brooks and Bickham, 2014: 13). - Etymology: In honour of David Livingstone (1813 - 1873) (see Brooks and Bickham (2014: 13).

TAXONOMY:
Brooks and Bickham (2014) described four new species in the genus *Scotophilus*. However, they did not compare them with a number of already described taxa such as *colias* Thomas, 1904 or *flavigaster* Heuglin, 1861, which make the validity of (some of) these names doubtfull.

The analyses performed by Demos *et al.* (2018: 2) confirmed the validity of the taxon, but these authors also indicate that they cannot vouch for the validity of the name with respect to older taxa that would have nomenclatural priority.

COMMON NAMES:
Chinese: 利文斯顿黄蝠. English: Livingstone's House Bat. German: Livingstone-Hausfledermaus.

GENERAL DISTRIBUTION:
This species is known from SW Kenya and SE Ghana, with a gap of about 4,000 km between them.

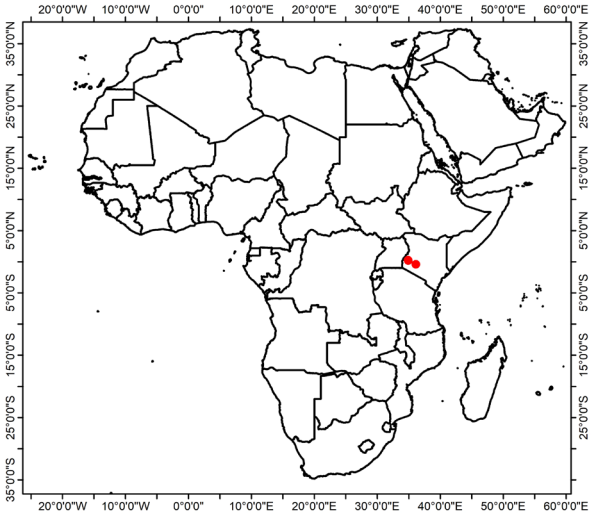


Figure 260. Distribution of *Scotophilus livingstonii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ghana, Kenya.

Scotophilus marovaza Goodman, Ratrimomanarivo and Randrianandrianina, 2006

2005. *Scotophilus nov. sp.:* Ratrimamanarivo and Goodman, ABCN, 6: 4.
*2006. *Scotophilus marovaza* Goodman, Ratrimomanarivo and Randrianandrianina, Acta Chiropt., 8 (1): 23, figs 2 - 5. Type locality: Madagascar: Mahajanga province: Marovaza [14 56 S 47 16 E, 5 m] [Goto Description]. Holotype: FMNH 184050: ad ♂, skull and alcoholic. Collected by: Steven M. Goodman and Fania H. Ratrimomanarivo; collection date: 11 December 2004. Paratype: FMNH 184051: Collected by: Steven M. Goodman and Fania H. Ratrimomanarivo; collection date: 21 - 22 April 2005. locality: Madagascar: Province de Mahajanga - Marovaza [14 56 S 47 16 E, 5 m asl]. Paratype: FMNH 184052: Collected by: Steven M. Goodman and Fania H. Ratrimomanarivo; collection date: 21 - 22 April 2005. Presented/Donated by: ?: Collector Unknown. Locality: Madagascar: Province de Mahajanga - Marovaza [14 56 S 47 16 E, 5 m asl]. Paratype: FMNH 184085: Collected by: Steven M. Goodman and Fania H. Ratrimomanarivo; collection date: 21 - 22 April 2005.

Locality: Madagascar: Province de Mahajanga - Marovaza [14 56 S 47 16 E, 5 m asl]. Paratype: FMNH 184086: Collected by: Steven M. Goodman and Fania H. Ratrimomanarivo; collection date: 21 - 22 April 2005. Locality: Madagascar: Province de Mahajanga - Marovaza [14 56 S 47 16 E, 5 m asl]. Paratype: MNHN ZM-MO-1984-433: Collected by: Steven M. Goodman and Fania H. Ratrimomanarivo; collection date: 29 April 1869. Paratype: UADBA 46965: Collected by: Richard K.B. Jenkins; collection date: 24 November 2004; original number: RBJ 215. Locality: Madagascar: Antafinimihakatra, Parc National d' Ankarafantsika [16 16 S 46 48 E). - Comments: Publication date: prior to 15 May 2006. - Etymology: The name of the type locality (Marovaza) is placed in apposition to the generic name (Goodman *et al.*, 2006b). (Current Combination)

TAXONOMY:
See Goodman *et al.* (2006b).

COMMON NAMES:
Czech: mračník Goodmanův. English: Marovaza House Bat. French: Scotophile de Marovaza. German: Marovaza-Hausfledermaus.

ETYMOLOGY OF COMMON NAME:
Refers to the name of the type locality (Marovaza).

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) because it is widely distributed in lowland areas of western Madagascar, there are no major threats, and its survival is not dependent on the conservation of intact forests (Jenkins *et al.*, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jenkins *et al.*, 2008b; IUCN, 2009).

MAJOR THREATS:
Jenkins *et al.* (2008b) [in IUCN (2009)] report that there are no major threats known. It is a widely distributed species and is tolerant of habitat disturbance (Goodman *et al.*, 2006b; Rakotoarivelo and Randrianandrianina, 2007).

CONSERVATION ACTIONS:
Jenkins *et al.* (2008b) [in IUCN (2009)] report that given the wide distribution of this species and occurrence in heavily disturbed habitats there are no pressing conservation measures. However, it should be noted that prevalence for synanthropic roosts does not automatically indicate a bat species is not of conservation concern. Furthermore, it should be noted that *S. marovaza* was not found in many of the sites surveyed for bats in western Madagascar (Goodman *et al.*, 2005a) which included areas from where it is suspected of being present (Goodman *et al.*, 2006b). Additional field studies are therefore needed to define its range, local abundance and habitat needs, but this is not a conservation priority (Goodman *et al.*, 2006b).

GENERAL DISTRIBUTION:
Scotophilus marovaza is known from a wide area of western Madagascar from near Morondava in the south, to the holotype locality at Marovaza in the north near Mahajanga (Goodman *et al.*, 2006b; Rakotoarivelo and Randrianandrianina, 2007). Goodman *et al.* (2006b) suspect that *S. marovaza* is distributed across much of western lowland Madagascar although specimen evidence for this is still lacking (Goodman *et al.*, 2005a). Current records are from below 200 m.

Native: Madagascar (Goodman *et al.*, 2006b).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Goodman *et al.* (2006b).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Goodman *et al.* (2006b).

DETAILED MORPHOLOGY:
Baculum:
Rakotondramanana and Goodman (2017: 64) mention that the baculum is a flat triangular structure, with a rounded, expanded proximal portion and which gradually tapers to a rounded distal tip; length: 1.60 ± 0.155 (1.47 - 1.77) mm, width: 0.99 ± 0.071 (0.93 - 1.07) mm.

For a description of the crania, teeth, ears and tragus see Goodman *et al.* (2006b).

ECHOLOCATION:
Kofoky *et al.* (2009: 384) reported the calls of nine individuals, characterized by broadband steep FM followed by QCF, and emitted low duty cycle calls with a maximum energy at about 45.9 kHz.

MOLECULAR BIOLOGY:
DNA, karyotype, protein / allozyme - Unknown.

HABITAT:
See Goodman *et al.* (2006b).

Ravelomanantsoa *et al.* (2019: 110) caught it over a pool surrounded by banana trees.

ROOST:
The type specimen was collected day roosting in dry palm leaves (*Bismarckia nobilis*) forming the roof of a building (Goodman *et al.*, 2006b).

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of one individual in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

POPULATION:
Structure and Density - There is very little information on this species. Only singletons are known from two of the four sites from which it has been recorded (Goodman *et al.*, 2006b). It has been found in small roosting colonies (< 5 individuals) in huts made from palm leaves (Ratrimomanarivo and Goodman, 2005).
Trend - 2008 - Unknown (Jenkins *et al.*, 2008b; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
See Goodman *et al.* (2006b).

PARASITES:
BACTERIA
Gomard *et al.* (2016: 5) found the single specimen they tested to be posifive for *Leptospira*.

INSECTA
Diptera:
Nycteribiidae: Wilkinson *et al.* (2016) reported the presence of *Basilia (Paracyclopodia)* sp. Ramasindrazana *et al.* (2017: Suppl.) refer to this bat fly as "*Basilia* sp. 2". Szentiványi *et al.* (2019: Suppl.) indicated that these flies were, in turn, infected by bacteria belonging to: Enterobacteriales, *Wolbachia* sp., *Bartonella* sp.

ANTHROPOPHILOUS:
Known to roost in the palm roofs of houses (Goodman *et al.*, 2006b).

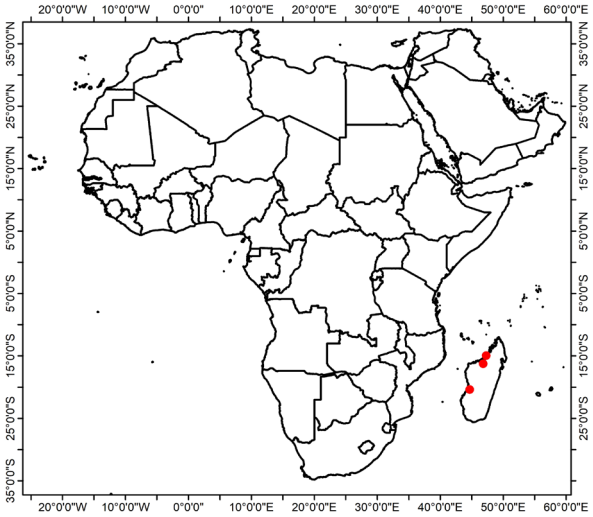


Figure 261. Distribution of Scotophilus *marovaza*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Scotophilus nigrita (Schreber, 1774)

*1774. *Vespertilio Nigrita* Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, 1 (8): pl. 58 + 1 (9): 171. Publication date: 1774. Type locality: Senegal: "Senegal" [Goto Description]. - Etymology: Lanza *et al.* (2015: 493) state: "From the scientific Latin *nigritus*, diminutive of the masculin Latin adjective *nìger* (nìger) 'black', (masculine *nigrìtus*; feminin *nigrìta*, neuter *nigrìtum*), referring to the blackish uropatagial colour of the type specimen: 'Die Schwanzhaut ist schwärzlich' (Schreber 1774). Note that Schreber erroneously used a feminine adjective with the masculine gender noun *Vespertilio*, unless he did not consider *nigrita* as a noun in apposition (noun seemingly non-existent even in the post-classic Latin; instead, there exists in classic Latin the noun *nigritia*, meaning 'black or blackish colour').
1855. *N[ycticejus] nigrita:* Giebel, Die Säugethiere, 928. (Name Combination)
1875. *Scotophilus gigas* Dobson, Ann. Mag. nat. Hist., ser. 4, 16 (92): 122. Publication date: 1 August 1875. Type locality: Nigeria: Western region: Lagos [06 27 N 03 23 E] [Goto Description]. Holotype: BMNH 1872.10.24.5: ad ♀, skull and alcoholic.
1965. *Scotophilus alvenslebeni* Dalquest, J. Mamm., 46 (2): 254, 258. Publication date: May 1965. Type locality: Mozambique: S bank Save River: Zinave National Park [ca. 21 26 S 33 52 E] [Goto Description]. Holotype: KU 105222: ad ♂, skin and skull. Collected by: Prof. Dr. Walter Woelberg Dalquest; collection date: 9 October 1963; original number: MWUC 18767. Presented/Donated by: ?: Collector Unknown. See Jones and Genoways (1969: 132). - Comments: Type locality originally as "S Bank Save River, bei Zinave, 212 km SSW Beira": see Kock (1969a: 204). - Etymology: In honour of Baron Werner von Alvensleben, in partial recognition of his labors in behalf of our work in Mozambique (see Dalquest, 1965: 258).
2016. *Scotophilus nigritta:* Mikula, Morelli, Lucan, Jones and Tryjanowski, Mammal Rev., Suppl. Data. Publication date: 20 January 2016. (Lapsus)

? *Scotophilus nigrita alvenslebeni:* (Name Combination)
? *Scotophilus nigrita nigrita:* (Name Combination)
? *Scotophilus nigrita:* (Name Combination, Current Combination)

TAXONOMY:
For a review of this species see Robbins (1978a). The identity of this species is clear and *nigrita* is the senior synonym of *gigas*. Most specimens called *nigrita* prior to 1978 should be called *dinganii* (see Robbins, 1978a: 212 - 213).

Based on cytochrome *b*, Vallo *et al.* (2014: 225) found *N. nigrita* to be paraphyletic with respect to the other continental African species *S. colias, S. dinganii, S. nigritellus* and *S. viridis*. They also found that cytochrome *b* from West and Southern African *S. nigrita* specimens differed between 7.6 and 8.1 %, which suggest that *S. nigrita* might differ on specific level from *alvenslebeni*. However, they (p. 229) find it too preliminary to officialize this split, and suggest further, more extensive genetic sampling and morphological analyses.

See Lanza *et al.* (2015: 493)'s remark on the taxon's suffix in the synonymy list above.

COMMON NAMES:
Afrikaans: Groot geel dakvlermuis. Chinese: 非洲大黄蝠. Czech: mračník olbřímí. English: Giant House Bat, Giant Brown House Bat, Brown House Bat, Great Brown House Bat, Giant Yellow House Bat, Schreber's Yellow Bat, Geat Brown Bat, Giant Brown Bat, Senegal Bat, Schreber's Brown Bat. French: Grand scotophile africain. German: Riesen-Hausfledermaus, Hundkopf-Schwirrfledermaus. Italian: Scotòfilo scùro. Portuguese: Morcego gigante amarelo das casas. Spanish (Castillian): Murciélago Amarillo.

ETYMOLOGY OF COMMON NAME:
Most of the colloquial names refer to its colour (yellow) and being a House bat. The colloquial name Schreber's Yellow bat refers to J. von Schreber, who originally described the species (Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Cotterill, 2008d; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Cotterill, 2008d; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Cotterill, 2004d; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT D2 ver 3.1 (2001) (Fernsby *et al.*, 2016). 2004 - considered a vagrant not assessed, not recorded in SA (Friedmann and Daly, 2004).

MAJOR THREATS:
This species is threatened by the conversion of its habitat to agricultural use in parts of its range (Cotterill, 2008d; IUCN, 2009).

CONSERVATION ACTIONS:
Cotterill (2008d) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Management of protected areas is necessary.

GENERAL DISTRIBUTION:
Scotophilus nigrita has been recorded as scattered records from West, East, and south-east Africa. It has been reported from Senegal, Côte d'Ivoire, Ghana, Togo, Nigeria and Cameroon in West Africa, from central Sudan, and from western Democratic Republic of the Congo, western Kenya and Tanzania, south to Mozambique, Malawi, eastern Zimbabwe and north-eastern South Africa.

Native: Cameroon (Bakwo Fils *et al.*, 2012: 55); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 575); Côte d'Ivoire; Ghana; Kenya; Malawi (Ansell and Dowsett, 1988: 37; Monadjem *et al.*, 2010d: 575); Mozambique (Dalquest, 1965; Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 575); Nigeria; Senegal; South Africa (Monadjem *et al.*, 2010d: 575); Sudan; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 63); Zimbabwe (Cotterill, 1996a; Monadjem *et al.*, 2010d: 575).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

ECHOLOCATION:
Thiagavel *et al.* (2017: Suppl.) mention a peak frequency of 32.85 kHz.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the African goshawk (*Accipiter tachiro* (Daudin, 1800)) preying upon *S. nigrita*. They also mention this bat to be a possible prey of the Lanner falcon

(*Falco biarmicus* Temminck, 1825), Peregrine falcon (*Falco peregrinus* Tunstall, 1771), and Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850).

POPULATION:
Structure and Density - It appears to be a rare, or rarely recorded, species (Cotterill, 2008d; IUCN, 2009).
Trend - 2008 - Decreasing (Cotterill, 2008d; IUCN, 2009).

VIRUSES:
Bunyaviridae
Nairovirus
Qalyub virus was reported by Luis *et al.* (2013: suppl.).

Coronaviridae - Coronaviruses
SARS-CoV - In Nigeria during June 2008, Quan *et al.* (2010) screened the gastrointestinal tissue for the presence of coronaviruses by PCRs, none tested positive.

Flaviviridae
Flavivirus
The presence of Dakar bat virus was mentioned by Luis *et al.* (2013: Suppl.), Blitvich and Firth (2017: 3), Willoughby *et al.* (2017: Suppl.).

Rhabdoviridae
Lyssavirus - Rabies related viruses
In Nigeria during June 2008, Quan *et al.* (2010) did not detect any lyssavirus-specific antigens from the brains by use of direct fluroescent anitbody testing.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Burundi, Cameroon, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Guinea, Kenya, Malawi, Mozambique, Niger, Nigeria, Senegal, South Africa, South Sudan, Sudan, Tanzania, Togo, Zambia, Zimbabwe.

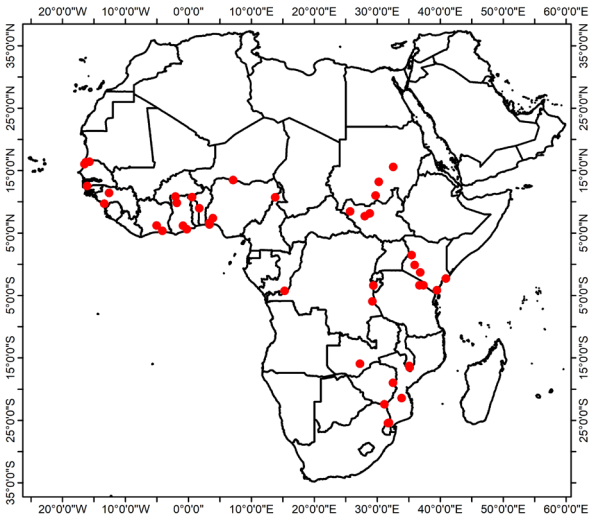


Figure 262. Distribution of *Scotophilus nigrita*

Scotophilus nigritellus de Winton, 1899

1899. *Scotophilus nigritellus* de Winton, Ann. Mag. nat. Hist., ser. 7, 4 (23): 355. Publication date: 1 November 1899. Type locality: Ghana: Gambaga [10 32 N 00 26 W] [Goto Description]. Holotype: BMNH 1899.6.15.9: ad ♂. Collected by: Captain W. Giffard; collection date: 9 January 1899.
? *Scotophilus leucogaster nigritellus:*
? *Scotophilus viridis nigritellus:* (Name Combination)

TAXONOMY:
This small sized *Scotophilus* has been included in *leucogaster* (Robbins *et al.*, 1985) or *viridis*, but see Vallo and Van Cakenberghe (2017) and Demos *et al.* (2018)

Vallo *et al.* (2011a: 45) showed that their cytochrome *b* analyses indicated that *S. viridis* contains two paraphyletic lineages, differing by about 12 %. They indicated that the greenish-yellow specimens from West Africa could be reliably identified with *S. nigritellus*. mtDNA analyses performed by Trujillo *et al.* (2009: 553) confirm that *S. viridis* is distinct from *S. nigritellus*, as suggested by Grubb *et al.* (1998).

Vallo *et al.* (2012: 5), who analyses the cytochrome *b* gene of West African "*S. nigritellus*" specimens, found that two paraphyletic lineages were present (agreeing with the belly colour of the specimens), with a genetic divergence ranging between 12.3 and 13.5 %. The white bellied lineage differed only 2.6 to 2.8 % from *S. leucogaster*. Their analysis of the *zfy* gene (zinc finger protein on the Y-chromosome) indicated that the white bellied lineage differed by 10 substitutions from the yellow bellied lineage, and that the white bellied lineage furthermore differed by 9 substitutions from *S. leucogaster*. Vallo *et al.* (2012: 10) concluded that the yellow bellied form agrees with the form *S. nigritellus* described by de Winton in 1899 but were unable to provide a name for the white bellied form.

GENERAL DISTRIBUTION:
Scotophilus nigritellus is widespread in West Africa, ranging from Senegal and Gambia to northern Cameroon and the Central African Republic.

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Burkina Faso (Kangoyé *et al.*, 2015a: 626); Cameroon; Central African Republic; Chad; Côte d'Ivoire; Gambia; Ghana; Guinea-Bissau (Peters, 1870; Seabra, 1900a; Rainho and Ranco, 2001: 72); Mali; Niger; Nigeria; Senegal; Togo.

Scotophilus nucella Robbins, 1983

*1983. *Scotophilus nucella* Robbins, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., 273: 19. Type locality: Ghana: Eastern region: Nkawkaw, 1 mi N [06 33 N 00 44 W]. Holotype: USNM 412141: ad ♂, skin and skull. Collected by: Bruce Joliffe Hayward; collection date: 5 August 1967. - Etymology: *nucella* is a diminutive of *nux*. Following the rules for construction of a diminutive, the latin root of *nux* is used (=*nuc*). Although *Scotophilus* is masculine in gener, formation of a diminutive of a noun in apposition (*nux*) must retain the same gender as its root (*nuc*) which is feminine. The only ending then possible are *-ula* or *-ella*. (Current Combination)

TAXONOMY:
Included in *leucogaster* by Koopman (1993a: 227), Grubb *et al.* (1998: 91).

Vallo *et al.* (2016: 302) showed that cytochrome *b* sequences separated *S. nucella* 7.8 - 9.4 % from *S. nux* and puts both in a sister position. This was corroborated by the nuclear zinc finger protein gene on the Y-chromosome. Both species were separated from one another at the Pliocene-Pleistocene transition, some 2.5 MYA.

COMMON NAMES:
Czech: mračník guinejský. English: Lesser Nut-coloured House Bat, Rainforest House Bat, Robbins's House Bat, Robbin's House Bat, Nucella House Bat, Little Nut-coloured House Bat, Robbins's Yellow Bat. French: Scotophile de Robbins, Scotophile des hauteurs. German: Robbins Hausfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status. The range is very poorly known, and it is unclear if the species is declining (Fahr, 2008o; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Fahr, 2008o; IUCN, 2009). 2004 - VU A2a; B2ab(iii) ver 3.1 (2001) (Fahr, 2004b; IUCN, 2004).

MAJOR THREATS:
The threats to this species are not known (Fahr, 2008o; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008o) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed.

GENERAL DISTRIBUTION:
Scotophilus nucella has only been recorded from southeastern Côte d'Ivoire, southern Ghana, and western Uganda close to the border with the Democratic Republic of the Congo, and Kambai Forest Reserve in the East Usambara Mountains of Tanzania (Cunneyworth, 1996b). Known from the high forest vegetation zone in Ghana (Decher and Fahr, 2007: 20) and Uganda, but it may occur in the high forest areas of West, Central and East Africa (Robbins, 1983).

Native: Côte d'Ivoire; Ghana (Decher and Fahr, 2007: 20); Tanzania Cunneyworth, 1996b); Uganda.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species. It is suspected to be declining as it appears that the species has not been collected since 1984 (Fahr, 2008o; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008o; IUCN, 2009).

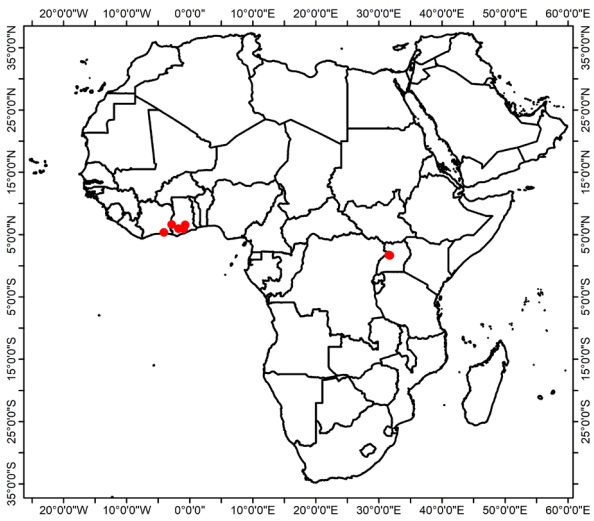


Figure 263. Distribution of *Scotophilus nucella*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Côte d'Ivoire, Ghana, Tanzania, Uganda.

Scotophilus nux Thomas, 1904

*1904. *Scotophilus nigrita nux* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (75): 208. Publication date: 1 March 1904. Type locality: Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. Holotype: BMNH 1903.2.4.5: ad ♂. Collected by: George Latimer Bates Esq. - Etymology: From the Latin "*nux*" meaning nut.
1915. *Scotophilus nux:* Thomas, Ann. Mag. nat. Hist., ser. 8, 16 (96): 468. Publication date: 1 December 1915. (Name Combination, Current Combination)
1938. *[Pachyotus] nux:* Frechkop, Exploration du Parc National Albert, 53. (Name Combination)
1938. *Pachyotus mux:* Frechkop, Exploration du Parc National Albert, 59. (Lapsus)
1938. *Pachyotus nigrita mux:* Frechkop, Exploration du Parc National Albert, 59. - Comments: Mentioned in the synonymy of *Pachyotus mux* (sic). (Lapsus)
1938. *Scotophilus nigrita mux:* Frechkop, Exploration du Parc National Albert, 59. - Comments: Mentioned in the synonymy of *Pachyotus mux* (sic). (Lapsus)
? *Scotophilus dinganii nux:* (Name Combination)
? *Scotophilus leucogaster nux:* (Name Combination)

TAXONOMY:
S. nux has been most often recognized as a subspecies of *nigrita*, when *nigrita* was used for the species now called *dinganii*; see Allen (1939a), Rosevear (1965), and Hayman and Hill (1971: 50). Koopman (1965: 4 - 5) listed it as a subspecies of *leucogaster*. Grubb *et al.* (1998: 90) include *nux* as a subspecies of *dinganii*.

Vallo *et al.* (2016: 306) found that the cyt *b* of specimens from Guinea differs 3.4 - 4.5 % from that of conspecifics from other parts of Africa and therefore these specimens might probably be assigned to a separate subspecies.

COMMON NAMES:
Chinese: 喀麦隆黄蝠. Czech: mračník ořechový. English: Nut-coloured House Bat, Dark House Bat, Nut-colored Yellow Bat, Nux Yellow House Bat. French: Scotophile noisette, Scotophile nux. German: Nußfarbene Hausfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr, 2008p; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Fahr, 2008p; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Fahr, 2004q; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species. Some populations may be impacted by general deforestation, however, this needs to be confirmed (Fahr, 2008p; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008p) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas.

GENERAL DISTRIBUTION:
Scotophilus nux has been patchily recorded from West Africa (Sierra Leone, Guinea, Liberia Côte d'Ivoire, Ghana and Nigeria), Central Africa (Cameroon and Democratic Republic of the Congo) and East Africa (Uganda and Kenya), and is believed to likely occur more widely than is currently known. It is possibly present in Equatorial Guinea, however, this needs to be confirmed.

Native: Cameroon; Congo (Bates *et al.*, 2013: 337); Congo (The Democratic Republic of the); Côte d'Ivoire; Ghana (Decher and Fahr, 2007: 21); Guinea (Fahr *et al.*, 2006a: 74; Decher *et al.*, 2016: 274); Kenya; Liberia (Fahr, 2007a: 104); Nigeria; Rwanda; Sierra Leone; Uganda.
Presence uncertain: Equatorial Guinea.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
From western Uganda, Monadjem *et al.* (2011: 30) reported the following data: Fa: 55.6 mm, mass: 30 g, wing loading: 6.4 N/m^2, aspect ratio: 5.5.

ECHOLOCATION:
From western Uganda, Monadjem *et al.* (2011: 32) reported the following values: F_{min}: 40.71 kHz, F_{max}: 54.05 kHz, F_{char}: 43.01 kHz, F_{knee}: 45.07 kHz, and duration: 2.0 ms.
For a *S.* cf. *nux* specimen from Gabon, Peereboom and van Lieshout (2015: 6) mention F_{min}: 38.49 ± 0.83 (37.82 - 40.04) kHz, F_{max}: 59.45 ± 7.23 (52.54 - 75.79) kHz, $F_{min\ dom}$: 44.54 ± 1.91 (41.11 - 47.37) kHz, duration: 1.87 ± 0.30 (1.60 - 2.50) ms, interpulse interval: 57.08 ± 33.44 (16.20 - 108.60) ms.

Thiagavel *et al.* (2017: Suppl.) mention a peak frequency of 26.09 kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Unknown.
Protein / allozyme - Unknown.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:



Figure 264. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1903.2.4.5, holotype of *Scotophilus nigrita nux* Thomas, 1904.

HABITAT:
Monadjem *et al.* (2016y: 371) collected two specimens over water in a disturbed forest habitat on the Liberian side of Mount Nimba at 520 m.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Fahr, 2008p; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008p; IUCN, 2009).

VIRUSES:
Coronaviridae
Anthony *et al.* (2017b: Suppl.) mention the alpha-coronavirus Predict_CoV_33.

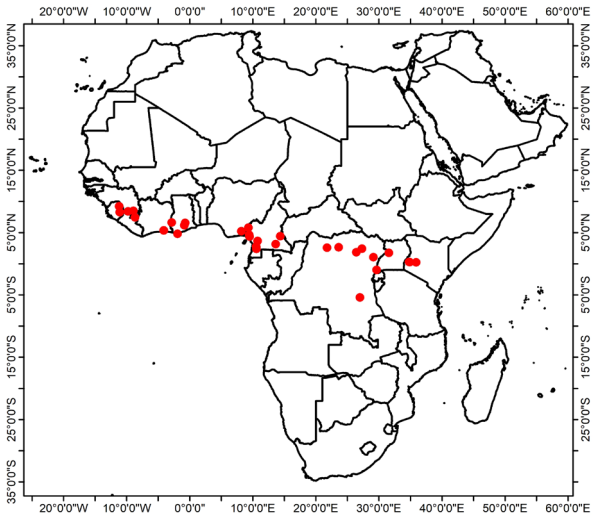


Figure 265. Distribution of *Scotophilus nux*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Cameroon, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Guinea, Kenya, Liberia, Nigeria, Sierra Leone, Uganda.

Scotophilus robustus A. Milne-Edwards, 1881

*1881. *Scotophilus robustus* A. Milne-Edwards, C. R. séances Acad. Sci., Paris, 91: 1035. Publication date: 1881. Type locality: Madagascar: "Madagascar" [Goto Description]. Holotype: MNHN 218: ♀. Presented/Donated by: ?: Collector Unknown. Holotype: MNHN ZM-MO-1997-1883a: ad ♀, alcoholic (skull not removed). Collected by: Léon Humblot. Number 218 in Rode (1941: 248). See also Peterson *et al.* (1995: 112), Goodman *et al.* (2005b: 873). Paratype: MNHN ZM-MO-1997-1883b: ad ♀, alcoholic (skull not removed). Collected by: Léon Humblot. Number 218a in Rode (1941: 248). Goodman *et al.* (2005b: 873) additionally mention that the jar with the type specimen contains two specimens (1997-1883a and 1997-1883b), but that not can be determined which of the two is the holotype. - Comments: Goodman *et al.* (2005b: 873) mention "entre Foulpointe et le lac d'Alaoutre" in the central portion of het eastern humid forest as type locality. Goodman *et al.* (2005b: 873) also mention that the jar with the type specimen contains two specimens (1997.1883a and 1997.1883b), but that not can be determined which of the two is the holotype. (Current Combination)

? *Scotophilus nigrita robustus:* (Name Combination)

TAXONOMY:
Recognized as a subspecies of *nigrita* (when *nigrita* was used for the species now called *dinganii*) by Hayman and Hill (1971: 50). However, Robbins *et al.* (1985) considered it specifically distinct from *dinganii* and *borbonicus*.

COMMON NAMES:
Czech: mračník statný. English: Robust Yellow Bat. French: Scotophile de Madagascar, Chauve-souris domestique malgache, Scotophile robuste. German: Madagaskar-Hausfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) as although the species is not thought to be abundant and has not often been recorded, the available information indicates that the species is widespread across Madagascar occurring in a wide variety of habitats, including in human habitations. While the threats affecting the species are imperfectly known, there is no reason to expect that the species is currently undergoing a decline that would warrant listing in a threatened category (Andriafidison *et al.*, 2008k; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Andriafidison *et al.*, 2008k; IUCN, 2009). 1996 - LR/nt ver 2.3 (1994).

MAJOR THREATS:
Andriafidison *et al.* (2008k) [in IUCN (2009)] report that the major threats to this species are not well known. This species uses forest habitat, but it also occurs outside of forested areas. There is one reported occurrence of this species being hunted by food by local people, but there is no evidence that this constitutes a major threat (Goodman *et al.*, 2008d).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008k) [in IUCN (2009)] report that this species is known from a number of protected areas across Madagascar and does not appear to require specific conservation measures but, like many other Malagasy bats that are not

considered to be threatened, there is a lack of basic natural history data.

GENERAL DISTRIBUTION:
Scotophilus robustus is endemic to the island of Madagascar, where it is broadly distributed from the coast to the highland plateau up to 1,400 m in Tsinjoarivo (Goodman *et al.*, 2005a). This species is rarely recorded, but as more surveys are conducted it is likely that this species will be found to have a wider distribution.

Native: Madagascar (Russ *et al.*, 2001).

DETAILED MORPHOLOGY:
Baculum:
This bone has a flat triangular structure, with a distinct indentation to the proximal margin (Rakotondramanana and Goodman, 2017: 64); length: 2.02 ± 0.048 (.94 - 2.09) mm, width: 1.18 ± 0.096 (0.98 - 1.29) mm.

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls which were characterized by a broadband steep FM followed by a QCF calls at low duty cycle. The fundamental was always the most intense with peak energy at about 38.1 kHz.

HABITAT:
Ravelomanantsoa *et al.* (2019: 110) indicated that this large species occurs in wet and dry deciduous forests. It is known for inhabiting human constructions. They also caught it near the base of a *Ficus cocculifolia* and near a *Mangifera indica* plantation.

DIET:
The following prey volume percentages were reported from the faeces of 2 *S. robustus* specimens by Rakotondramanana *et al.* (2015: 74): Coleoptera: 14.5 ± 20.51; Lepidoptera: 50.0 ± 70.71; Homoptera: 8.0 ± 11.31; Blattoidea: 27.5 ± 38.90. Expressed as frequency percentages, the values are: Coleoptera: 50.0 ± 70.71; Lepidoptera: 50.0 ± 70.71; Homoptera: 60.0 ± 42.43; Blattoidea: 50.0 ± 70.71.

Rasoanoro *et al.* (2015: 63) found that Coleoptera formed about 68 % of the diet, whereas sampling in the feeding area revealed that only 3 % of the available prey consisted of Coleoptera. They indicated that - at least in the hot season - *S. robustus* is a Coleopteran specialist. The droppings of three bats contained the following volume percentages of prey types: Aranea: 5.7 ± 0.33, Coleoptera: 68.0 ± 10.08, Diptera: 1.9 ± 1.88, Homoptera: 2.1 ± 2.06, Hymenoptera: 8.7 ± 3.87, Lepidoptera: 9.1 ± 4.50, and Orthoptera: 4.3 ± 2.15.

POPULATION:
Structure and Density - A number of bat surveys have failed to locate this species (Goodman *et al.*, 2005b; Robinson *et al.*, 2006; Rakotoarivelo and Randrianandrianina, 2007) and it appears not to be locally abundant (Andriafidison *et al.*, 2008k; IUCN, 2009).
Trend - 2008 - Unknown (Andriafidison *et al.*, 2008k; IUCN, 2009).

PARASITES:
Diptera:
Nycteribiidae: Duron *et al.* (2014: 2108) refer to a *Basilia* nov. sp. collected from this bat species.
Wilkinson *et al.* (2016) reported the presence of *Basilia (Paracyclopodia)* sp., which was carrying *Bartonella* bacteria, as well as Enterobacteriales. Ramasindrazana *et al.* (2017: Suppl.) refer to the bat fly as "*Basalia* sp. 1". They also mention (p. 6) a *Basilia (Paracyclopodia) madagascarensis*, which was collected from a "*Scotophilus borbonicus*" from Nosy Be, but this bat most probably should be assigned to *S. robustus*. Szentiványi *et al.* (2019: Suppl.) furthermore indicated that a new bat fly (Basilia nov. spec.) found on a *S. robustus* bats, was parasited by an *Arsenophonus* sp. Bacteria.

VIRUSES:
Flaviviridae
Flavivirus
Dakar Bat Virus (DBV)- Isolated from salivary glands (Coulanges *et al.*, 1974; Rousset and Andrianarivelo, 2003).

UTILISATION:
See Goodman *et al.* (2008d).

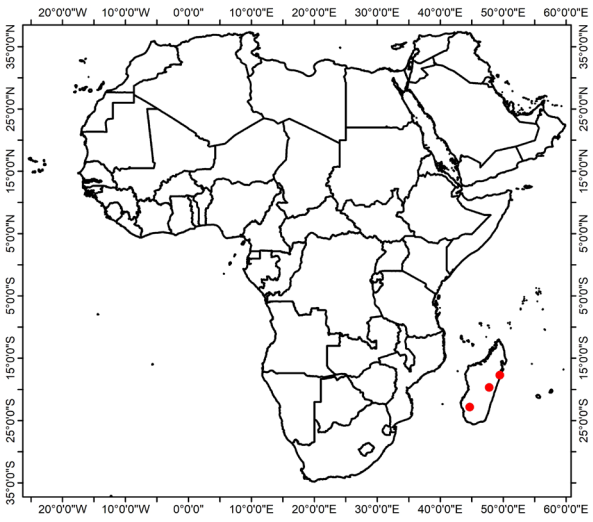


Figure 266. Distribution of *Scotophilus robustus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Scotophilus tandrefana Goodman, Jenkins and Ratrimomanarivo, 2005

*2005. *Scotophilus tandrefana* Goodman, Jenkins and Ratrimomanarivo, Zoosystema, 27 (4): 867, 875, figs 3 - 5. Type locality: Madagascar: Mahajanga province: just outside the Parc national de Bemaraha: 1.8 km SE Bekopake and 0.6 km NE Andadoany [19 08 S 44 49 E, 50 m] [Goto Description]. Holotype: UADBA 46923: ad ♂, skull and alcoholic. Collected by: Richard K.B. Jenkins and Fania H. Ratrimomanarivo; collection date: 27 July 2003; original number: RBJ 161. - Etymology: From the Malagasy meaning "from the west" (see Goodman *et al.*, 2005b: 875). (Current Combination)

TAXONOMY:
Goodman *et al.* (2005b) described this species based on three specimens which were collected in 1868, 1869 and 2003 (the latter being designated as the holotype). One of these (the specimen collected in 1869) was later reassessed as *S. marovaza* (Goodman *et al.*, 2006b).

Trujillo *et al.* (2009: 553) indicate that inferred phylogenies do not support the separation of *S. tandrefana* and *S. marovaza* as the cytochrome *b* phylogeny only reveals a genetic divergence of 0.6 %, a level indicative of within-species divergence. This might indicate that cytochrome *b* is not representative or that the separation between the two taxa occurred too recent to be already reflected in that gene.

COMMON NAMES:
Czech: mračník madagaskarský. English: Western Yellow Bat. French: Scotophile d'Andadoany. German: Westliche Hausfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) as the species is known from only two specimens (one collected as recently as 2003) and there is no information on its population status or threats (Jenkins *et al.*, 2008c; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jenkins *et al.*, 2008c; IUCN, 2009).

MAJOR THREATS:
The major threats to this species are not known (Jenkins *et al.*, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Jenkins *et al.* (2008c) [in IUCN (2009)] report that this species has been recorded from near Parc National Tsingy de Bemaraha and the managed forest of Kirindy CFPF (Goodman *et al.*, 2005a), but evidence is lacking that it actually roosts or feeds in these forests.

GENERAL DISTRIBUTION:
Scotophilus tandrefana is endemic to Madagascar where it is known from two localities: near Parc National Tsingy de Bemaraha in the west and Sarodrano in the south (Goodman *et al.*, 2005a). Photographs and forearm measurements of an individual from Kirindy (CFPF) forest in the west represents the third known locality for this species (Goodman *et al.*, 2005a).

Native: Madagascar.

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls from a single individual in a flight cage, which emitted broadband FM/QCF calls at low duty cycle with frequency containing most energy at about 48.2 kHz.

POPULATION:
Structure and Density - There are no data on the population of this species and all existing information is based on two specimens that were collected in 1868 and 2003 (Goodman *et al.*, 2005b; 2006b).
Trend - 2008 - Unknown (Jenkins *et al.*, 2008c; IUCN, 2009).

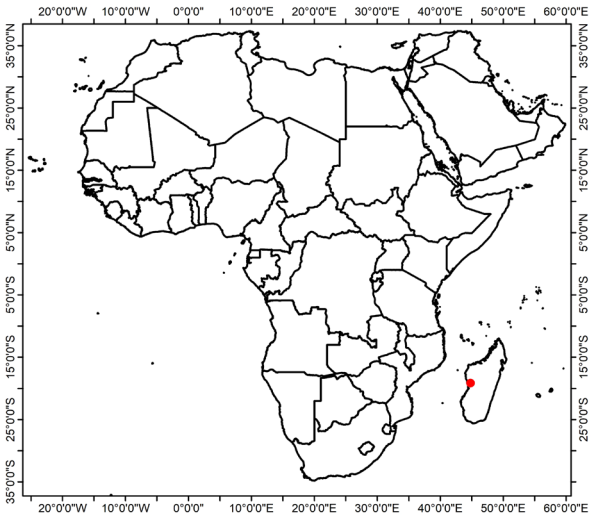


Figure 267. Distribution of *Scotophilus tandrefana*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Madagascar.

Scotophilus trujilloi Brooks and Bickham, 2014

*2014. *Scotophilus trujilloi* Brooks and Bickham, Occ. Pap. Mus. Texas Tech Univ., 326: 1, 16, fig. 6. Publication date: 26 Jun 2014. Type locality: Kenya: Coastal province: Kwale district: Moana Marine Station, 1 km S, 2 km E Ukunda [04 18 S 39 35 E] [Goto Description]. Holotype: CM 98038: ad ♂, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 18 October 1985; original number: 7086. Presented/Donated by: ?: Collector Unknown. Muscle tissue sample TK 33263. Paratype: CM 98040: ad ♀, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 18 October 1985; original number: 7087. Presented/Donated by: ?: Collector Unknown. Tissue sample TK 33266. Paratype: CM 98041: ad ♀, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 18 October 1985; original number: 7090. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of Dr. Robert Trujillo (b. 1975), who's ground-breaking doctoral dissertation on the molecular systematics of *Scotophilus* paved the way for the description of the four cryptic species described in this paper (Trujillo 2005; Trujillo *et al*. 2009) (see Brooks and Bickham (2014 18).

TAXONOMY:
Brooks and Bickham (2014) described four new species in the genus *Scotophilus*. However, they did not compare them with a number of already described taxa such as *colias* Thomas, 1904 or *flavigaster* Heuglin, 1861, which make the validity of (some of) these names doubtfull.

The analyses performed by Demos *et al.* (2018: 2) confirmed the validity of the taxon, but these authors also indicate that they cannot vouch for the validity of the name with respect to older taxa that would have nomenclatural priority.

Musila *et al.* (2018a: 29) indicate that *trujilloi* should be used for the Kenyan animals formerly included in *S. viridis*.

COMMON NAMES:
Chinese: 特鲁黄蝠. English: Trujillo's House Bat. German: Trujillos Hausfledermaus.

ECHOLOCATION:
Musila *et al.* (2018c: 43) [referring to Monadjem *et al.* (2010d)] mention a shallow frequency modulated call, with a peak frequency of 40 kHz and a bandwidth of 25 kHz, but Monadjem *et al.* (2010d: 528) had these parameters assigned to *S. viridis*.

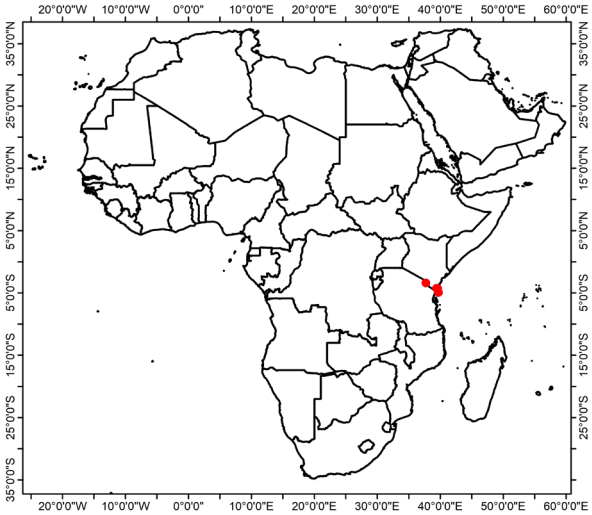


Figure 268. Distribution of *Scotophilus trujilloi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Kenya, Tanzania.

Scotophilus viridis (Peters, 1852)

*1852. *Nycticejus viridis* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 67, pl. 17, fig. 2, a-e. Publication date: 1852. Type locality: Mozambique: Mozambique Island [15 S 40 42 E] [Goto Description]. Holotype: ZMB 73610: ad ♂, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: March 1845. Formerly ZMB 526 [=An 16362]; see Turni and Kock (2008: 53). - Etymology: From the masculine Latin adjective *viridis*, meaning "green", referring to the body colour: "Die Farbe der Rückseite ist ein schönes dunkles Olivengrün, die Haare der Bauchseite sind grünlichgelb" (Peters (1852: 68) (see Lanza *et al.*, 2015: 498).

2018. *Scotophilus viridus:* Adams and Kwiecinski, Diversity, 10 (3) 103: 1. Publication date: 18 September 2018. (Lapsus)
? *Scotophilus borbonicus viridis:* (Name Combination)
? *Scotophilus cf. viridis*
? *Scotophilus leucogaster viridis:* (Name Combination)
? *Scotophilus viridis viridis:* (Name Combination)
? *Scotophilus viridis:* (Name Combination, Current Combination)

TAXONOMY:
Included in *leucogaster* by Hayman and Hill (1971: 50) but see Koopman (1975: 414 - 416) and Schlitter *et al.* (1980). Included *damarensis* but see Robbins *et al.* (1985).

Vallo *et al.* (2011a: 45) showed that their cytochrome *b* analyses indicate that *S. viridis* contained two paraphyletic lineages, differing by about 12 %. They indicated that the greenish-yellow specimens from West Africa could be reliably identified with *S. nigritellus*. mtDNA analyses performed by Trujillo *et al.* (2009: 553) confirm that *S. viridis* is distinct from *S. nigritellus*, as suggested by Grubb *et al.* (1998). They also found that *S. viridis* s.s. is not monophyletic because it is found in 2 divergent clades; specimens from Kenya group with *S. dinganii* from South Africa, and specimens of *S. viridis* from South Africa group with *S. robustus* from Madagascar.

COMMON NAMES:
Afrikaans: Klein geel dakvlermuis. Czech: mračník zelený. English: Green House Bat, Greenish Yellow Bat, Lesser Yellow House Bat. French: Petit scotophile africain, Scotophile verdâtre. German: Grünliche Hausfledermaus, Olivengrüne Schwirrfledermaus. Italian: Scotòfilo vérde.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Griffin, 2008c; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Griffin, 2008c; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Griffin, 2004c; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Richards *et al.*, 2016a). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species (Griffin, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Griffin (2008c) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It has been recorded from the Matusadona National Park in Zimbabwe, and likely is present in several other protected areas.

GENERAL DISTRIBUTION:
Scotophilus viridis is widespread in sub-Saharan Africa, ranging from Sudan and Ethiopia southwards through much of East Africa and southeastern Africa, being reported as far south as eastern South Africa and Swaziland. For South Africa, Babiker Salata (2012: 49) found that its distribution is strongly associated with the mean temperature of the coldest quarter.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 895,732 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 575); Botswana; Ethiopia; Kenya; Malawi (Ansell and Dowsett, 1988: 38; Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 575); Mozambique (Monadjem *et al.*, 2010d: 575; Monadjem *et al.*, 2010c: 385 as *S.* cf. *viridis*); Namibia; South Africa (De Graaf, 1960; Monadjem *et al.*, 2010d: 575); Sudan; Swaziland (Monadjem *et al.*, 2010d: 575); Tanzania (Stanley and Goodman, 2011: 45) (including the islands of Pemba and Mafia [O'Brien, 2011: 290]); Zambia (Monadjem *et al.*, 2010d: 575); Zimbabwe (Cotterill, 2004a: 262; Monadjem *et al.*, 2010d: 575).

ECHOLOCATION:
See Taylor (1999b).

Schoeman and Waddington (2011: 291) mention a peak frequency of 46.9 ± 1.1 kHz and a duration of 2.9 ± 1.2 msec for *S.* cf. *viridis* specimens from St. Lucia Wetland Park, South Africa.

From Swaziland, Monadjem *et al.* (2017c: 179) reported F_{min}: 39.8 ± 1.33 (38.5 - 41.2) kHz, F_{knee}: 42.7 ± 1.05 (41.6 - 43.7) kHz, F_c: 40.1 ± 1.31 (38.8 - 42.4) kHz and duration: 3.5 ± 1.55 (2.0 - 5.0) msec. The calls could be detected up to a distance of 15 m.

Thiagavel *et al.* (2017: Suppl.) mention a peak frequency of 40.1 kHz.

In the Kalahari Desert, Adams and Kwiecinski (2018: 4) recorded three calls with the following parameters: F_{char}: 37.5 ± 1.6 kHz, F_{max}: 70.6 ± 6.6 kHz, F_{min}: 36.7 ± 1.8 kHz, duration: 4.3 ± 0.3 msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) for the results of a specimen from Tanzania.
Karyotype - See discussion in generic account.
Protein / allozyme - Unknown.

HABITAT:
In southern Africa, the species primarily occurs in Savanna (77 %) and Coastal mosaic (13 %) habitats (Cooper-Bohannon *et al.*, 2016: Table S2).

HABITS:
Cotterill and Giddings (1987: 175) studied the activitypatterns of *S. viridis* in Zimbabwe and found that most of the females were active between 7 and 9 p.m (when there is a peak in insect abundance)., whereas most of the males were active between 9 and 10 p.m.

ROOST:
Monadjem *et al.* (2010b: 74) found that they roosted in *Combretum imberbe* and *Acacia nigrescens* trees in Swaziland, where they found that 4 of the 5 radio tracked individuals roosted simultaneously in the same *Combretum imberbe* on a single night, and then one individual switched roosts to a different *Combretum imberbe* for two nights.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the following diurnal avian predators: Red-necked falcon (*Falco ruficollis* Daudin, 1800), Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) [although the prey might have been a *S. nigrita*]; Grey-headed bushshrike (*Malaconotus blanchoti* Stephens, 1826).

POPULATION:
Structure and Density - This is a common species (Griffin, 2008c; IUCN, 2009).
Trend - 2008 - Unknown (Griffin, 2008c; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Delayed development (van der Merwe *et al.*, 1988).

VIRUSES:
Astroviridae
Neither of the two bats from Mozambique tested by Hoarau *et al.* (2018: 2) was positive for these viruses.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested [as *S. borbonicus*] between 1986 to 1999, for antibody to SARS-CoV in sera in one individual from Limpopo Province, South Africa, which turned out to be negative.

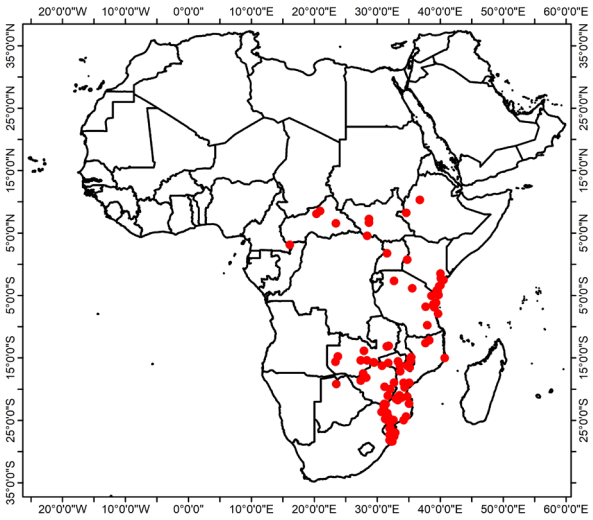


Figure 269. Distribution of *Scotophilus viridis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Botswana, Central African Republic, Ethiopia, Kenya, Malawi, Mozambique, South Africa, South Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

Scotophilus "incertae-sedis"

? *Scotophilus sp.:*

†Genus *Vampyravus* Schlosser, 1910

*1910. *Vampyravus* Schlosser, Zool. Anz., 35: xxx. (Current Combination)

1911. *Provampyrus* Schlosser, Beitr. Paläont. Geol. Öst.-Ung., 24: xxx. - Comments: This is possibly a synonym of *Vampyravus* Schlosser, 1910.

TAXONOMY:
The position of this genus is still uncertain.

Sigé (1985) [in Ravel *et al.* (2014: 696)] found some similarities between the humerus (the only known specimen of this species) and the Natalidae, but Gunnell *et al.* (2009) indicated that the morphology of this bone was more compatible with that of the Emballonuridae and Rhinopomatidae.

Known species of the genus *Vampyravus*: †***orientalis*** Schlosser, 1910.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Time frame - Late Eocene, Early Oligocene (Rupelian).

†***Vampyravus orientalis*** Schlosser, 1910

*1910. *Vampyravus orientalis* Schlosser, Zool. Anz., 35: xxx. Type locality: Egypt: Fayum: Jebel Qatrani Formation. Holotype: SMNS unnumbered:. - Comments: This is a fossil form from Egypt's Lower Oligocene, of which the type (the right humerus) is in the collection of the SMNS. (Current Combination)
1911. *Provampyrus orientalis* Schlosser, Beitr. Paläont. Geol. Öst.-Ung.. (Name Combination)

TAXONOMY:
Gunnell *et al.* (2008: 5) indicate that the holotype is from an unknown horizon in the Jebel Qatrani Formation. The humerus resembles in size to *Rousettus aegyptiacus* (49 mm) and could possible represent the same taxon as *Philisis sphingis*, only known from teeth.

Bown *et al.* (1982: 624) include this taxon in the "*Phyllostomatidae*?".

Subfamily Vespertilioninae Gray, 1821

*1821. *Vespertilioninae* Gray, London Med. Repos., 15: 299. Publication date: 1 April 1821. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. (Current Combination)
1821. *Vespertilionini* Gray, London Med. Repos., 15: 299. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Originally included the genera *Megadermes* [sic = *Megaderma*] É. Geoffroy, 1810; *Rhynolophus* [sic = *Rhinolophus*] Lacépède, 1799; *Nycterus* [sic = *Nycteris*] É. Geoffroy and G. Cuvier, 1795; *Rhynopoma* [sic = *Rhinopoma*] É. Geoffroy, 1818; *Thaphosores* [sic = *Taphozous*] É. Geoffroy, 1818; *Vespertilio* Linnaeus, 1758; *Pecotus* [sic = *Plecotus* É. Geoffroy, 1818; and Barbastella *J. Gray*, 1821 (see Jackson and Groves, 2015: 271). Accepted as tribe by Koopman and Jones (1970: 27), McKenna and Bell (1997: 318), Hoofer and Van Den Bussche (2003: 38) and Simmons (2005: 484) (see Jackson and Groves, 2015: 271).
1842. *Pipistrellini* Tate, Bull. Am. Mus. Nat. Hist., 80 (7): 221, 231. Publication date: 27 November 1942. - Comments: Type genus: *Pipistrellus* Kaup, 1829. Introduced as tribe, and originally including the genera *Pipistrellus* Kaup, 1829 and *Glischropus* Dobson, 1875 (see Jackson and Groves, 2015: 274).
1855. *Nycticeiini* Gervais, in: F. Comte de Castelnau, Exped. Partes Cen. Am. Sud.Zool., Zool. (Sec. 7), Vol. 1, pt. 2: 71 footnote. Publication date: 23 July 1855. - Comments: Type genus: *Nycticeius* Rafinesque, 1819. Introducted as tribe (Nycticéins) and originally included the genera *Atalapha* Rafinesque, 1814 [= *Nyctalus* Bowdich, 1825] and *Nycticejus* [sic = *Nycticeius*] Rafinesque, 1819 (see Jackson and Groves, 2015: 275, who also recognized it as a valid tribe). (Current Spelling)
*1855. *Nycticeina* Gervais, in: F. Comte de Castelnau, Exped. Partes Cen. Am. Sud., Zool. (Sec. 7), Vol. 1, pt. 2: 71 footnote. Publication date: 23 July 1855. - Comments: Type genus: *Nycticeius* Rafinesque, 1819. Introducted as tribe (Nycticéins) and originally included the genera *Atalapha* Rafinesque, 1814 [= *Nyctalus* Bowdich, 1825] and *Nycticejus* [sic = *Nycticeius*] Rafinesque, 1819 (see Jackson and Groves, 2015: 275).
1865. *Nyctophilinae* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1865: 524. - Comments: Type genus: *Nyctophilus* Leach, 1821. Considered a valid subfamily by Hall and Kelson

(1959: 201) [including *Antrozous*], Corbet and Hill (1992: 156), but see Hoofer and Van Den Bussche (2003: 1), who reject this (actually Peters uses "Nyctophili").

1872. *Nycticejinae* Gill, Smiths. Misc. Coll., 11 (1): 17. Publication date: November 1872. - Comments: Type genus: *Nycticeius* Rafinesque, 1819. Introduced as subfamily, but considered a synonym of the tribe Nycticeiini by Jackson and Groves (2015: 276).

1878. *Vespertiliones* Dobson, Catalogue of the Chiroptera of the collection of the British Museum., 168. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Dobson (1878: 168) introduced the name Vespertiliones in his key as "Group II" including the bats of the Vespertilioninae subfamily (see Jackson and Groves, 2015: 227). Originally included the genera *Vesperugo* Keyserling and Blasius, 1839 [= *Vespertilio* Linnaeus, 1758]; *Chalinolobus* Peters, 1865; *Scotophilus* Tomes, 1857; *Nycticejus* [sic = *Nycticeius*] Rafinesque, 1819; *Atalapha* Rafinesque, 1814 [= *Nyctalus* Bowdich, 1825]; *Harpiocephalus* J. Gray, 1842; *Vespertilio* Linnaeus, 1758; and *Kerivoula* J. Gray, 1842. Not Vespertiliones Pallas, 1767, nor Vespertiliones Peters, 1865.

1897. *Plecotinæ* Miller, N. Am. Fauna, 13: 41, 46. Publication date: 16 October 1897. - Comments: Type genus: *Plecotus* E. Geoffroy, 1818. Originally included the genera *Euderma* H. Allen, 1891 and *Plecotus* É. Geoffroy, 1818 (see Jackson and Groves, 2015: 270).

1897. *Vespertilioninæ* Miller, N. Am. Fauna, 13: 41, 54. Publication date: 16 October 1897. - Comments: Type genus: *Vespertilio* Linnaeus, 1758. Originally included the genera *Dasypterus* Peters, 1870 [= *Lasiurus* J. Gray, 1831]; *Rhogeëssa* H. Allen, 1866; *Nycticeius* Rafinesque, 1819; *Lasiurus* J. Gray, 1831; *Vespertilio* Linnaeus, 1758; *Pipistrellus* Kaup, 1829; *Lasionycteris* Peters, 1865; and *Myotis* Kaup, 1829 (see Jackson and Groves, 2015: 270).

1942. *Nycticeini* Tate, Bull. Am. Mus. Nat. Hist., 80 (7): 280. Publication date: 27 November 1942. - Comments: type genus: *Nycticeius* Rafinesque, 1819. Introducted as tribe and originally included the genera *Scoteinus* Dobson, 1875 [= *Scotomanes* Dobson, 1875; *Nycticeius* Rafinesque, 1819; *Rhogeëssa* H. Allen, 1866; *Baeodon* Miller, 1906 [= *Rhogeëssa* H. Allen, 1866; *Scotoecus* Thomas, 1901; *Scotophilus* Leach, 1821; *Scotomanes* Dobson, 1875; and *Otonycteris* Peters, 1859 (see Jackson and Groves, 2015: 276).

1987. *Eptésiformes* Menu, Palaeovert., 17 (3): 78, 104, 134. Publication date: 31 March 1987. - Comments: Type genus: *Eptesicus* Rafinesque, 1820. Originally included the genera *Eptesicus* Rafinesque, 1820 and *Nycterikaupius* Menu, 1987. Emended by McKenna and Bell (1997: 318) as published as ‘les eptésiformes’ as it seems to meet the requirements of Article 11 of the Code (ICZN, 1985a: 19) (see Jackson and Groves, 2015: 271).. Jackson and Groves (2015: 271) erroneously mentioned the genus *Nyctalus* Bowdich, 1825 as type genus.

1987. *Leuconoïdes* Menu, Palaeovert., 17 (3): 77, 82. Publication date: 31 March 1987. - Comments: Type genus: *Leuconoe* Boie, 1830. Introduced without formal rank, and originally including the genera *Leuconöe* Boie, 1830 [= *Myotis* Kaup, 1829]; *Pizonyx* Miller, 1906 [= *Myotis* Kaup , 1829]; and *Perimyotis* Menu, 1984 [= *Pipistrellus* Kaup, 1829] (see Jackson and Groves, 2015: 271). Emended by McKenna and Bell (1997: 316) to 'les leuconoïdes" as it apparently meets the requirements of Article 11 of the Code (ICZN, 1985a: 19) (see Jackson and Groves, 2015: 271).

1987. *Néoeptésiformes* Menu, Palaeovert., 17 (3): 77, 123, 134. Publication date: 31 March 1987. - Comments: Type genus: *Nyctalus* Bowdich, 1825. Originally included the genera *Hypsugo* Kolenati, 1856; *Tylonycteris* Peters, 1872; and *Mimetillus* Thomas, 1904. Emended by McKenna and Bell (1997: 318) as published as ‘les néoeptésiformes’ as it seems to meet the requirements of Article 11 of the Code (ICZN, 1985a: 19) (see Jackson and Groves, 2015: 271)..

1987. *Nyctaliformes* Menu, Palaeovert., 17 (3): 77, 95, 133. Publication date: 31 March 1987. - Comments: Type genus: *Nyctalus* Bowdich, 1825. Its original rank was unclear, but it was ranked in the "Les Nyctaloïdes" and included the genera *Pipistrellus* Kaup, 1829; *Glischropus* Dobson, 1875; *Philetor* Thomas, 1902; *Scotoecus* Thomas, 1901; and *Nyctalus* Bowdich, 1825 (see Jackson and Groves, 2015: 274). Synonymized with Vespertilioninae by McKenna and Bell (1997: 318), but with the tribe Pipistrellini by Jackson and Groves (2015: 274).

1987. *Nyctaloïdes* Menu, Palaeovert., 17 (3): 77, 94. Publication date: 31 March 1987. - Comments: Type genus: *Nyctalus* Bowdich, 1825. Originally, the rank was unclear, and it

included the Nyctaliformes Menu, 1987, Eptésiformes Menu, 1987 and Néoeptésiformes Menu, 1987 (see Jackson and Groves, 2015: 274). McKenna and Bell (1997: 318) synonymized it with the subfamily Vespertilioninae, whereas Jackson and Groves (2015: 274) synonymized it with the tribe Pipistrellini.

2018. *Vespertilininae:* Foord, Swanepoel, Evans, Schoeman, Erasmus, Schoeman, Keith, Smith, Mauda, Maree, Nembudani, Dippenaar-Schoeman, Munyai and Taylor, PLoS ONE, 13(5): e0194336: 6. Publication date: 8 May 2018. (Lapsus)

TAXONOMY:

Bronner *et al.* (2003) state that the classification of the subfamily Vespertilioninae was historically based on facial shortening and dental reduction characters (Miller, 1907), and augmented by bacula morphology (Hill and Harrison, 1987). Interrelationships among *Eptesicus* and *Pipistrellus* species have long been contentious and have for the most part remained unresolved. The principal character used to diagnose these genera was the presence (*Pipistrellus*) or absence (*Eptesicus*) of the anterior upper premolar. However, this character is variable in both genera Wallin, 1969; Koopman, 1975; Heller and Volleth, 1984). Baculum morphology (Heller and Volleth, 1984; Hill and Harrison, 1987) and karyological properties (Heller and Volleth, 1984; Zima and Horácek, 1985) also vary markedly among species assigned to *Pipistrellus* using dental characters. Heller and Volleth (1984) concluded that the genus *Eptesicus* is characterised by a distinct karyotype of 2*n* = 50, and removed those taxa with 2*n* = >44 (*E. capensis* and some Australian species) from *Eptesicus* to *Pipistrellus*, a treatment they considered consistent with patterns of variation in baculum morphology.

After extensively reviewing variation in baculum morphology, Hill and Harrison (1987) divived *Pipistrellus* into seven subgenera. They transferred *anchietae* (see Kock (2001c: 246) for justification of spelling) to the subgenus *Hypsugo* and four African species of *Eptesicus* (*capensis, melckorum, zuluensis* and *rendalli*) to the subgenus *Neoromicia* within *Pipistrellus*. *Hypsugo* was subsequently raised to generic rank on the basis of detailed morphological and biochemical analyses (Horácek and Hanák, 1986; Ruedi and Arlettaz, 1991), a treatment supported also by cytogenetic evidence showing radical reorganization of the genome and karyotypic evolution in *H. anchietae* (Kearney *et al.*, 2002). Most of the other (extralimital) subgenera were subsequently also awarded full genus status, with the exception of *Pipistrellus* and *Neoromicia*. McBee *et al.* (1987) and Morales *et al.* (1991) provided further cytogenetic and electrophoretic evidence supporting the findings of Heller and Volleth (1984), but argued that further studies were needed to justify the inclusion of these species in *Pipistrellus*. Koopman (1993a), therefore, recognised *Neoromicia*, but retained it as a subgenus of *Eptesicus*.

Volleth and Heller (1994) subsequently published more karyotypic evidence supporting the inclusion of *Neoromicia* within *Pipistrellus*, a treatment formalised by Koopman (1994). Most recently, Volleth *et al.* (2001) showed that the four African species included in *Neoromicia* (*capensis, nanus, rendalli* and *zuluensis*) display karyotypic synapomorphies typical of the Vespertilionini, in contrast to the other African *Pipistrellus* that show cytogenetic traits characteristic of the Pipistrellini. *Neoromicia* should thus be elevated to full generic rank to avoid recognising a paraphyletic *Pipistrellus*. Cladistic analysis of chromosomal data (showing that the four *Neoromicia* species also share three Roberstonian fusions), and of baculum characters in southern African species, provide additional support for recognising *Neoromicia* as a distinct genus (Kearney *et al.*, 2002). Consequently, the genus *Eptesicus* in southern Africa is represented by only one species, namely *E. hottentotus*.

Using digenomic DNA, Roehrs *et al.* (2010: 1073) were able to distinguish 6 tribes in the Vespertilioninae: Antrozoini, Lasiurini, Scotophilini, Vespertilionini, and 2 new unnamed tribal clades, the perimyotine group and the hypsugine group. They were unable to confirm a Nycticeiini-Eptesicini group, nor were they able to separate the Plecotini.

COMMON NAMES:

Czech: praví netopýři.

PARASITES:

Nycteribiidae: *Nycteribia tecta* Theodor, 1957 (Haeselbarth *et al.*, 1966: 110 as *Eptesicus sp.*).

SIPHONAPTERA

Ischnopsyllidae: *Dampfia grahami* (Waterston, 1915) collected in the Free State and KwaZulu Natal, South Africa where the host is assumed to belong to the genus *Eptesicus* now possibly referring to *Neoromicia* (Haeselbarth *et al.*, 1966: 187).

Genus ***Barbastella*** Gray, 1821

*1821. *Barbastella* Gray, London Med. Repos., 15 (1): 300. Publication date: 1 April 1821. - Comments: Type species: *Vespertilio barbastellus* Schreber, 1774. - Etymology: From Latin "*barba*" meaning bearded and "*stella*" meaning star (see Rydell and Bogdanowicz, 1997: 5). (Current Combination)

1829. *Barbastellus* Kaup, Skizzierte Entwicklungs-Geschichte Natürliche Systematik der Europäische Thierwelt, 1: ???. Publication date: 1829.

1839. *Synotus* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 305. Publication date: 1839. - Comments: Type species: *Vespertilio barbastellus* Schreber, 1774. - Etymology: From the Greek "*σύν*", meaning together and "*οὖς*" or "*ὠτός*", meaning ear (see Palmer, 1904: 657).

TAXONOMY:
See Simmons (2005), Kruskop *et al.* (2019).

Known species of the genus *Barbastella*: ***barbastellus*** (Schreber, 1774); *caspica* Satunin, 1908, *darjelingensis* Hodgson, 1855, ***leucomelas*** (Cretzschmar, 1826), *pacifica* Kruskop, Kawai and Tiunov, 1919..

COMMON NAMES:
Czech: dasíci, strostlouchové, saukušanové, širokouší ušanové, netopýři širokouší. English: Barbastelle Bats, Barbastelles. French: Barbastelles. German: Mopsfledermäuse.

Barbastella barbastellus (Schreber, 1774)

*1774. *Vespertilio barbastellus* Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, 1 (8): pl. 55 + 1 (9): 168. Publication date: 1774. Type locality: France: Burgundy. - Etymology: From Latin "*barba*" meaning bearded and "*stella*" meaning star (see Rydell and Bogdanowicz, 1997: 5).

1838. *Barbastellus communis* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 495. Publication date: 1 February 1838. Type locality: : Burgundy and Germany. - Comments: Renaming of *V. barbastellus* Schreber, 1774.

1985. *Vespertilio barbestellus:* Qumsiyeh, Spec. Publ. Mus. Texas Tech. Univ., 23: 63. (Lapsus)

2002. *Barbastella barbastellus guanchae* Trujillo, Ibáñez and Juste, Rev. suisse Zool., 109 (3): 544, , figs. 1- 2. Publication date: September 2002. Type locality: Canary Islands (Spain): Tenerife island: La Guancha: "Barranco de La Cantera" [300 m] [Goto Description]. Holotype: MNH 109: ad ♂. Collected by: Domingo Trujillo; collection date: 1 September 1987. Paratype: EBD MAM 16024: Collected by: Domingo Trujillo, Carlos J. Ibáñez Uargui and E. Barone; collection date: 15 - 20 September 1987. Presented/Donated by: ?: Collector Unknown. Agulo, La Gomera Island. Paratype: EBD MAM 16028: Collected by: Domingo Trujillo, Carlos J. Ibáñez Uargui and E. Barone; collection date: 15 - 20 September 1987. Presented/Donated by: ?: Collector Unknown. Agulo, La Gomera Island. Paratype: MNH 110: Collected by: Domingo Trujillo, Carlos J. Ibáñez Uargui and E. Barone; collection date: 15 - 20 September 1987. Presented/Donated by: ?: Collector Unknown. Agulo, La Gomera island. Paratype: MNH 111: Collected by: Domingo Trujillo, Carlos J. Ibáñez Uargui and E. Barone; collection date: 15 - 20 September 1987. Presented/Donated by: ?: Collector Unknown. Agulo, La Gomera island. - Comments: MNH = Museo de La Naturaleza e El Hombre, Santa Cruz de Tenerife, Spain. Trujillo *et al.* (2002) mention 4 paratypes, EBD 16024, 16028, MNH 111, 110; 3 ♀♀ + 1 ♂ from Agulo, La Gomera Island, collector Domingo Trujillo, Carlos Ibáñez & E. Barone, 15-20 September 1987).

? *Barbastella barbastellus:* (Name Combination, Current Combination)

TAXONOMY:
Does not include *leucomelas*, see Rydell and Bogdanowicz (1997: 1, Mammalian Species, 557); but see Qumsiyeh (1985) and Horácek *et al.* (2000: 133), although the latter authors still consider *leucomelas* to be a valid species.
The population from the Canary Islands is at present regarded as an endemic subspecies *B. b. guanchae* (Trujillo *et al.*, 2002). Western

Mediterranean and Canary Island forms reviewed by Juste *et al.* (2003).

COMMON NAMES:
Albanian: Barbastela e zakonshme. Armenian: Եվրոպական լայնականջ չղջիկ. Azerbaijani: Avropa enliqulağı. Basque: Baso-saguzar, Baso-saguzar arrunt. Belarusian: Шыракавух еўрапейскі. Bosnian: Širokouhi šišmiš. Breton: Barbastell Europa. Bulgarian: Широкоух прилеп. Castilian: Barbastela, Murciélago de bosque. Catalan: Ratpenat de bosc, Rat penat de bosc. Croatian: Š irokouhi mrač njak. Czech: Netopýr černý, Ušan širokouchý, Srostlouch, netopýr černý, N. mopsličí, saukušan. Danish: Vestlig bredøret flagermus, Bredøret flagermus. Dutch: Westelijke mopsvleermuis, Mopsvleermuis, Dwarsoorvleermuis. English: Western Barbastelle Bat, Barbastelle, Western Barbastelle, Common Barbastelle, Barbastelle bat. Estonian: Euroopa laikõrv. Finnish: Mopsilepakko. French: Barbastelle, Barbastelle d'Europe, Barbastelle commune, Barbastelle occidentale. Frisian: Westlike breedearflearmûs. Galician: Morcego das fragas. Georgian: ევროპული მაჩქათელა. German: Mopsfledermaus, Kurzmaulige Fledermaus. Greek: Μπαρμπαστέλλος. Hungarian: Nyugati piszedenevér, Pisze denevér, Piszedenevér, Nycteris i mikromolossos. Irish Gaelic: Ialtóg bharbastail lartharach. Italian: Barbastello. Latvian: Eiropas platausis. Lithuanian: Europinis plačiaausis. Luxembourgish: Europäesch Mopsfliedermaus. Macedonian: Широкоушест лилјак. Maltese: Barbastell. Montenegrin: Mirokouhi slijepi miš. Norwegian: Bredøre. Polish: Mopek zachodni, Mopek. Portuguese: Morcego-negro. Rhaeto-Romance: Barbastel, Barbastel ureglio lada. Romanian: Liliacul cârn, Liliac-cârn. Russian: Широкоушка европейская Serbian: Европски широкоушан [= Evropski širokoušan], Европейская широкоушка [= Evropejskaya shirokoushka]. Scottish Gaelic: Ialtag bharbastail iarach. Slovak: Uchaňa čierna. Slovenian: Širokouhi netopir. Swedish: Barbastell. Turkish: Basıkburunlu Yarasa. Ukrainian: Широковух європейський. Welsh: Ystlum du.

CONSERVATION STATUS:
Global - Listed as Near Threatened (NT ver 3.1 (2001)) (approaching A4c), as it is suspected that population declines will approach 30 % over a 15 year period including both the past and the future. Although this species has a large range, it is generally rare, occurring in low density and numbers. It is mainly sedentary. The population is fragmented and linked to particular kinds of old forest habitats, which are declining. The species does not easily colonise new areas. Declines are widely reported in most of its range with a few exceptions in recent years. The status of this species is linked to forestry practices and the decline in the number of old trees (one colony may use up to 30 old trees with holes each summer season). Has specific habitat and diet requirements (Hutson *et al.*, 2008b; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Hutson *et al.*, 2008b; IUCN, 2009). 1996 - VU A2c ver 2.3 (1994).

It is protected by national legislation in most range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention where these apply. It is included in Annex II (and IV) of EU Habitats and Species Directive, and hence requires special measures for conservation including designation of Special Areas for Conservation. Some habitat protection through Natura 2000.

MAJOR THREATS:
Loss of old mature woodland and ancient trees with loose bark or wood crevices (reforested areas are not suitable for this species); disturbance and loss of underground habitats, disturbance and loss of roost sites in older buildings (Hutson *et al.*, 2008b; IUCN, 2009). In Germany, habitat loss and fragmentation (caused by inter alia infrastructure development, forestry, and the renovation or demolition of old buildings used as roost sites), and disturbance (e.g. from cave tourism) are major threats (Schulenberg, 2005); accidental mortality (roadkill) is also a problem (Rudolph *et al.*, 2003).

CONSERVATION ACTIONS:
Hutson *et al.* (2008b) [in IUCN (2009)] indicate that research is underway to establish conservation requirements for this species. Recommendations include adopting forestry practices that maintain old trees in sufficient numbers.

GENERAL DISTRIBUTION:
Barbastella barbastellus is largely restricted to central and southern Europe, although its range extends into the Caucasus, Anatolia, Morocco (North Africa) and the Canary Islands (La Gomera and Tenerife only). It has recently been recorded from Iran on the Arabian Peninsula. It occurs to 1,800 m in the Alps (Spitzenberger, 2002), 1,900 m in the Caucasus and 2,260 m in the Pyrenees (Mitchell-Jones *et al.*, 1999).

Native: Andorra; Armenia; Austria; Azerbaijan; Belarus; Bosnia and Herzegovina; Bulgaria; Croatia; Czech Republic; Denmark; France; Georgia; Germany; Greece; Holy See [Vatican City State]; Hungary; Iran (Benda *et al.*, 2008b) [in Karami *et al.*, 2009: 69]); Ireland; Italy (Sardegna,

Sicilia); Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Yugoslav Republic of; Moldova; Monaco; Montenegro; Morocco (Benda *et al.*, 2010a: 158; Rebelo *et al.*, 2012: 2763; El Ibrahimi and Rguibi Idrissi, 2015: 364); Netherlands; Poland; Portugal; Romania; Russian Federation; San Marino; Serbia; Slovakia; Slovenia; Spain [Baleares, Canary Is.]; Sweden; Switzerland; Ukraine; United Kingdom.

Presence uncertain: Norway; Senegal; Turkey.

ECHOLOCATION:
Walters *et al.* (2012: suppl.) report the following figures for 28 calls from bats from France, Slovenia, Switzerland and the UK: duration: 3.57 ± 1.84 msec, F_{max}: 43.23 ± 8.31 kHz, F_{min}: 28.87 ± 3.18 kHz, bandwidth: 14.36 ± 8.29 kHz, F_{peak}: 35.48 ± 4.32 kHz.

Barataud (2011: 95) indicates that Barbastelles alter their echolocation signals to mislead their prey, which primilary consists of tympanic moths. He reports (p. 96) two sets of data from France:
A) F_{start}: 37.5 ± 1.8 kHz, F_{end}: 27.6 ± 1.1 kHz, F_{peak}: 34.5 ± 1.5 kHz, bandwidth: 9.8 ± 2.0 kHz, duration: 3.2 ± 0.9 msec, interpulse interval: 82.6 ± 40.2 msec (based on 18 calls);
B) F_{start}: 45.5 ± 2.1 kHz, F_{end}: 34.2 ± 4.0 kHz, F_{peak}: 43.1 ± 2.3 kHz, bandwidth: 11.3 ± 3.8 kHz, duration: 5.9 ± 2.5 msec, interpulse interval: 58.5 ± 8.4 msec (based on 17 calls).
These calls are alternately emitted. The interval between type A and type B calls was 58.5 ± 8.4 msec, and between type B and type A 82.6 ± 40.2 msec.

MOLECULAR BIOLOGY:
DNA - See García-Mudarra *et al.* (2009).

Karyotype - Capanna (1968: 624) reported 2*n* = 32. Rushton (1970: 463) reported 2 *n* = 32, FN = 50, X = metacentric, Y = minute. Arslan and Zima (2014: 14) mention 2*n* = 32, FNa = 50, FN = 54, a metacentric X and an acrocentric Y.

MIGRATION:
Movements up to 290 km in Austria (Kepka, 1960).

DIET:
Andreas *et al.* (2012: 81) indicate that, in the Czech Republic, this bat's main food source are larger species of moths. At the end of Autumn (November) the bats switched to smaller preys (e.g. *Operophtera brumata*, wingspan <= 30 mm) as the larger species were no longer flying around. These findings confirmed that *B. barbastellus* is primarily an aerial hawking species.

POPULATION:
Structure - See Hutson *et al.* (2008b) and IUCN (2009) for information on European populations.
Density - See Hutson *et al.* (2008b) and IUCN (2009) for information on European populations.
Trend - 2008 - Decreasing (Hutson *et al.*, 2008b; IUCN, 2009).

In Africa, population size and trends are unknown (Hutson *et al.*, 2008b; IUCN, 2009).

VIRUSES:
Despite sampling and testing of 35 individuals of this species, no evidence of influenza A-like viruses (Orthomyxoviridae) were obtained (Fereidouni *et al.*, 2015).

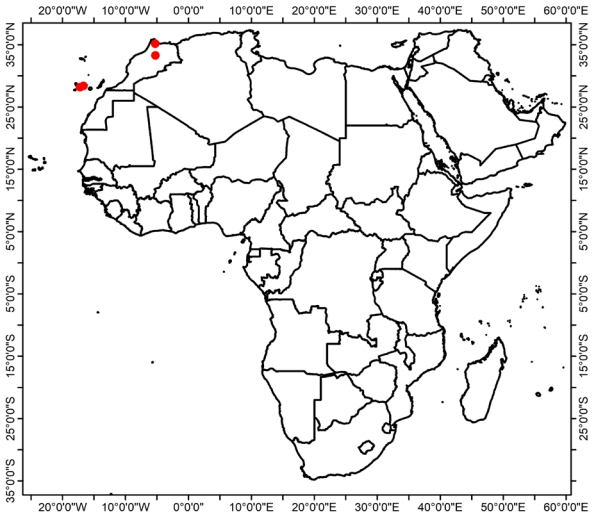


Figure 270. Distribution of *Barbastella barbastellus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Canary Islands (Spain), Morocco.

Barbastella leucomelas (Cretzschmar, 1826)

*1826. *Vespertilio leucomelas* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 73, pl. 28b [Goto Description]. Lectotype: SMF 4373: mounted skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1860; original number: II.M.1.a. See Mertens (1925: 21). - Comments: For an extensive discussion on the type locality see Benda *et al.* (2008f: 50 - 54), who conclude: "From the Rüppell's (1829) descriptions and according to his traveling schedule, it is fully clear, that in his concept the 'Arabia Petraea' represent 'the area of the Sinaitic peninsula to the south of the connecting line between the towns of Suez and Aqaba', as pointed out above, see also

Fig. 52. Since it seems to be appropriate to consider localities given by Cretzschmar to be in accordance with those given by the collector, with the above 'area' is most convenient to associate the type locality of the species Vespertilio leucomelas Cretzschmar, 1830 = Barbastella leucomelas (Cretzschmar, 1830). In this area the type series lectotype: SMF II.M.1.a = SMF 4343; paralectotype: SMF II.M.1.b = SMF 12393; Mertens (1925), Kock (1969a) was collected in 1822 and/or 1826."
Benda and Mlíkovský (2008: 36) mention "Several authors believed that the name *Vespertilio leucomelas* was published in 1826, i.e. in the year when "Rüppell's Atlas" (see Cretzschmar, 1826) begun to be issued. According to Mertens (1925: 19), the sheets 18-19 associated with Tables 27-30 of Cretzschmar (1826-1830), containing also the description of *V. leucomelas* (sheet 18 and Table 28, respectively), were published in 1830 (see also Kock, 1969a, Corbet and Hill, 1992, Bates and Harrison, 1997, and/or Rydell and Bogdanowicz, 1997).". - Etymology: From the Greek "leucos" and "melas".

? *Barbastella barbastellus leucomelas:* (Name Combination)

? *Barbastella leucomelas:* (Name Combination, Current Combination)

TAXONOMY:
Included in *barbastellus* by Kock (1969a: 176). Horácek *et al.* (2000: 133 - 134) indicate that western *leucomelas* might be conspecific with *barbastellus*, but retain it as a valid species. If both are conspecific, the correct name for the eastern Barbastelle would be *Barbastella darjelingensis* Hodgson, in Horsfield, 1855. Zhang (2007: 1393) indicate that *leucomelas* from Sichuan, Taiwan, and Japan is different from the Egyptian one, and should therefore not be considered conspecific with *darjelingensis*.
.
Benda *et al.* (2008f: 49) confirmed that *leucomelas* represents a separate species.

COMMON NAMES:
Arabian: Khaffash. Czech: dasík arabský (netopýr skalní). Dutch: Arabische mopsvleermuis. English: Eastern Barbastelle, Eastern Barbastelle Bat, Arabian barbastelle, Sinai Barbestelle, Asiatic Barbastelle, Asian Barbastelle. French: Barbastelle orientale. German: Östliche Mopsfledermaus. Hebrew: Blumaf Shahor. Russian: Азиатская широкоушка [= Aeiatskaya shirokouchka];

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)), although it seems to be rare, it is very widespread and is unlikely to be declining fast enough to qualify for listing in a more threatened category (Benda *et al.*, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Benda *et al.*, 2008b; IUCN, 2009).

It is included in Eurobats (Bonn Convention) and so should be protected in party range states (e.g. Georgia).
1996 - Lower Risk/least concern.

MAJOR THREATS:
More information is needed regarding threats to this species throughout its range. In South Asia (India, Nepal, and Pakistan) deforestation has decreased the area and quality of the species' habitat. Activities associated with war may be a threat to this species in all parts of its western Palaearctic range (damage and disturbance to caves and old buildings, disruption to habitat) (Benda *et al.*, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Further surveys and monitoring are needed for this species to determine the current population status, range and major threats (Benda *et al.*, 2008b; IUCN, 2009).
It probably occurs in several protected areas throughout its range (Benda *et al.*, 2008b; IUCN, 2009).

GENERAL DISTRIBUTION:
Barbastella leucomelas was considered to be a very widespread species, with a distribution reaching from the Caucasus eastwards to Iran, Afghanistan and India, and onwards to China and Japan. These populations were, however, reassigned to *B. darjelingensis*. In the western part of the distribution area, there were isolated populations known from Sinai (Egypt) and the southern tip of Israel, as well as Eritrea in North Africa (Benda *et al.*, 2008b). It occurs up to 2,500 m asl.

Native: Eritrea, Egypt (Sinai); Israel, Jordan (Benda *et al.*, 2010b: 185; Kruskop *et al.*, 2019: 463), and perhaps Saudi Arabia.

ECHOLOCATION:
In Jordan, Benda *et al.* (2010b: 204) recorded three different types of calls, which they called A, A2, and B. These calls had the following parameters:

A: Start frequency: 37.1 ± 1.3 (34.9 - 40.3) kHz, End frequency: 29.2 ± 1.1 (27.7 - 31.8) kHz, Peak frequency: 33.8 ± 1.0 (32.7 - 36.0) kHz, Pulse duration: 2.9 ± 0.4 (1.9 - 3.5) msec, and Inter-pulse duration: 76.8 ± 39.3 (50.5 - 146.0) msec.
A2: Inter-pulse duration: 125.8 ± 30.5 (94.0 - 201.0) msec.
B: Start frequency: 44.1 ± 0.5 (43.0 - 45.0) kHz, End frequency: 34.3 ± 2.9 (29.8 - 38.5) kHz, Peak frequency: 42.7 ± 1.3 (40.0 - 44.2) kHz, Pulse duration: 13.0 ± 4.2 (6.9 - 17.6) msec, and Inter-pulse duration: 52.6 ± 6.4 (43.0 - 65.0) msec.

In Israel, *B. leucomelas* alternates between two call types (Hackett *et al.*, 2016: 223, 225): type I (8 calls): Pulse duration: 1.81 ± 0.11 msec, F_{start}: 35.85 ± 0.71 kHz, F_{end}: 29.70 ± 0.53 kHz, F_{peak}: 33.20 ± 0 kHz. Type II (6 calls): Pulse duration: 4.62 ± 0.40 msec, F_{start}: 43.90 ± 0 (43.8 - 44.0) kHz, F_{end}: 32.33 ± 2.67 (29.1 - 35.2) kHz, F_{peak}: 39.83 ± 0.75 (38.9 - 41.1) kHz.

ROOST:
It roosts in caves, tunnels, crevices, old buildings, mines, tree hollows, and can be found beneath bark (Benda *et al.*, 2008b).

POPULATION:
Structure - It is a sedentary insectivore, with 3 - 8 females in nursery colonies, with females normally living separately to males (Benda *et al.*, 2008b).
Density - Considering its wide range there seems to be little information available about the population of this species. Within its range in Africa the population size and trends are currently unknown. In Southwest Asia, it is considered to be rare and is poorly known. In 2005, the species was found in Sinai (Egypt) in surveys for the first time in 180 years (D. Kock *pers. comm.,* in Benda *et al.*, 2008b). For the former Soviet Union, the species is listed in the second edition of the Red Book of the USSR (1984) as Rare but was considered to be "least concern" (K. Tsytsulina *pers. comm.,* in Benda *et al.*, 2008b). In Japan, it has been observed only rarely except in Hokkaido. In the past 30 years there have also been records from the prefectures of Iwate, Saitama, Gifu and Ehime (Abe *et al.*, 2005).
Trend - 2008 - Unknown (Benda *et al.*, 2008b; IUCN, 2009).

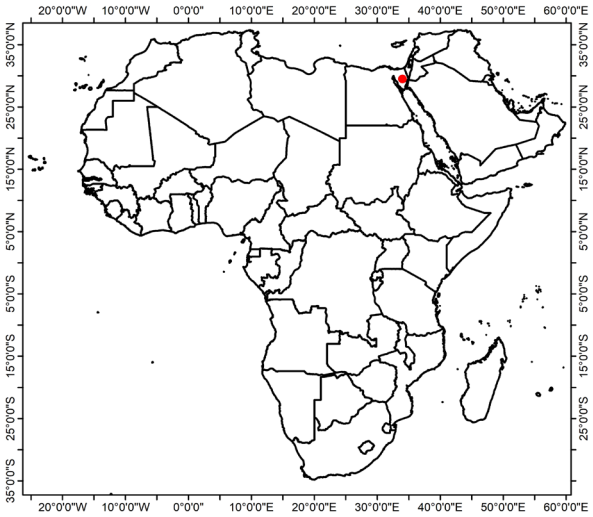


Figure 271. Distribution of *Barbastella leucomelas*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Egypt.

Genus ***Eptesicus*** Rafinesque, 1820

*1820. *Eptesicus* Rafinesque, Annals of nature or annual synopsis of new genera and species of animals, plants &c. discovered in North America, 2. Publication date: 1 March 1820 [Goto Description]. - Comments: Type species: *Eptesicus melanops* Rafinesque, 1820 (=*Vespertilio fuscus* Beauvois, 1796). - Etymology: From the Greek "*επτην*" (aor. of "*πέτομαι*"), meaning to fly or flying and "*οίκος*", meaning house (house flier) (see Palmer, 1904: 268; Flannery, 1995a: 367; Kozhurina, 2002: 15; Álvarez-Castañeda and Álvarez Solórzano, 1996: 43). Braun and Mares (1995: 179) state: "*eptesicus* (NL), a name coined by Rafinesque that he said he derived from *epien* (Greek), to fly + *oikos* (Greek), house (Palmer, 1904; Gotsch, 1979). However, the correct Greek word would more likely be *eptén*, which means "I flew".". - ZooBank: A96CB3CB-AA8F-4450-9EB0-FCEC51D29B8B.

1829. *Cnephæus* Kaup, Skizzierte Entwicklungs-Geschichte Natürliche Systematik der Europäische Thierwelt, 1: 103. Publication date: 1829. - Comments: Type species: *Vespertilio serotinus* Schreber, 1774. Considered a valid subgenus by Hoofer and Van Den Bussche (2003: 38), including *serotinus* and *hottentotus*.

1837. *Noctula* Bonaparte, Iconografia Fauna italiana, 1, fasc. 21 [Goto Description]. - Comments: Type species: *Noctula serotina*: Bonaparte (=*Vespertilio serotinus* Schreber, 1774). Allen (1939a: 92) mentioned it in the genus *Nyctalus*, but referred to a publication from 1841. - Etymology: From the French noctule, common name of a bat, which in turn comes from the Latin "*nox*" or "*noctis*", meaning night (see Palmer, 1904: 460).

1839. *Vesperugo* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 312. Publication date: 1839. - Comments: In part (see Allen, 1939a: 92; Pavlinov *et al.*, 1995: 104). Included 13 species now referred to *Eptesicus, Pipistrellus, Neoromicia, Hypsugo*.
1839. *Vesperus* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 313. Publication date: 1839. - Comments: In part (see Allen, 1939a: 84; Pavlinov *et al.*, 1995: 112). Allen (1939a: 84) assigned it to Dobson, Cat. Chiropt. Brit. Mus., p. 184, 1878. Not of Latreille: see Cabrera (1914: 129). Allen (1894: 111 - 112) mentions that Mr. F.W. True has called his attention to the fact that the *Vesperus* of Keyserling and Blasius, 1840, is antedated by *Vesperus* of Dejean, 1821. The latter was a *nomen nudum* until 1829, when it was taken up by Latreille and described. The *Vesperus* of Keyserling and Blasius is, therefore, untenable. *Vesperus* is valid only in Latreille, 1829 (Coleoptera, Cerambycidae).
1856. *Cateorus* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Type species: *Vespertilio serotinus* Schreber, 1774. - Etymology: From the Greek "*κατήορος*", meaning hanging down, referring to the position of the animal when at rest (see Palmer, 1904: 163).
1856. *Meteorus* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Mentioned by Allen (1939a: 83) as "in part". Included with a question mark in the synonymy of *Eptesicus* by Pavlinov *et al.* (1995: 112). - Etymology: From the Greek "*μετέωρ*", meaning meteor, referring to the flight (see Palmer, 1904: 419).
1858. *Amblyotus* Kolenati, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 29: 252. Publication date: 1858. - Comments: Type species: *Amblyotus atratus* Kolenati, 1858 (=*Vespertilio nilssonii* Keyserling and Blasius, 1839). Considered a valid subgenus by Pavlinov *et al.* (1995: 112). However, based on mtDNA analyses, Artyushin *et al.* (2009: 40) doubt the validity of *Amblyotis* as a subgenus.
1863. *Aristippe* Kolenati, Beitrage zur Kenntniss der Phthiriomyiarien, Petersburg. - Comments: (in part).
1866. *Pachyomus* Gray, Ann. Mag. nat. Hist., ser. 3, 17 (98): 90. Publication date: 1 February 1866. - Comments: Type species: *Scotophilus pachyomus* Tomes, 1857 (=*Vespertilio serotinus* Schreber, 1774). - Etymology: From the Greek "*παχύς*", meaning thick and "*ώμος*", meaning shoulder referring to the specific name of the type species (see Palmer, 1904: 494).
1870. *Nyctiptenus* Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 62 (1): 424. - Comments: Type species: *Vespertilio smithii* Wagner, 1855 (=*Vespertilio hottentota* A. Smith, 1833). - Etymology: From the Greek "*νύξ*" or "*νυκτός*", meaning night and "*πτήν*" or "*πτηρόν*", meaning winged referring to to winged nocturnal creature (see Palmer, 1904: 467).
1892. *Adelonycteris* H. Allen, Proc. Acad. nat. Sci. Philad., 43: 466 (for 1891). Publication date: 19 January 1892. - Comments: Allen (1939a: 84) mentioned it "in part; substitute for *Vesperus*, preoccupied". Ellerman and Morrison-Scott (1951: 153), Hall and Kelson (1959: 184) and Hall (1981: 213) stated that it is a renaming of *Vesperus* Keyserling and Blasius, 1839, which included part of both *Vespertilio* and *Eptesicus* and which is an homonym of *Vesperus* Latreille, 1829, an insect.
1906. *Rhinopterus* Miller, Proc. Biol. Soc. Wash., 19: 85. Publication date: 4 June 1906 [Goto Description]. - Comments: Type species: *Glauconycteris floweri* de Winton, 1901. The date mentioned on the publication is 4 June 1906, although in many cases 23 July 1906 is found as publication date.
1917. *Pareptesicus* Bianchi, Ann. Mus. zool. Acad. Impér. Sci. St. Petersbourg, 21: lxxvii. - Comments: Type species: *Vesperugo pachyotis* Dobson, 1871.
1917. *Rhyneptesicus* Bianchi, Ann. Mus. zool. Acad. Impér. Sci. St. Petersbourg, 21: lxxvii. - Comments: Type species: *Vesperugo nasutus* Dobson, 1877.
1931. *Tuitatus* Kishida and Mori, Zool. Mag., Tokyo, 43: 372-391. - Comments: Nomen nudum (see Ellerman and Morrison-Scott, 1951: 153; Meester *et al.*, 1986: 56; Pavlinov *et al.*, 1995: 112).
1959. *Amblyotis:* Hall and Kelson, Mammals of North America, 1: 183. (Lapsus)
1959. *Nyctiptennis* Hall and Kelson, Mammals of North America, 1: 183.
1975. *Eptiscus:* Dean, Zool. Afr., 10: 218. (Lapsus)
1986. *Rhineptesicus:* Horácek and Hanák, Myotis, 23-24: 16. (Lapsus)
2017. *Eptisecus:* Ahmim, JOTT, 9 (1): 9723. Publication date: 26 January 2017. (Lapsus)
? *Cnephaeus:* (Current Spelling)
? *Eptesicus sp.:*

TAXONOMY:
Does not include *Neoromicia* Roberts, 1926, see Volleth *et al.* (2001), Kearney *et al.* (2002), and Hoofer and Van Den Bussche (2003).

Artyushin *et al.* (2018: 475) indicate that the previously proposed inclusion of the Old World representatives in the subgenus *Cnephaeus* could not be confirmed by their analyses of five nuclear and one mitochondrial (cyt-*b*) genes.

Known species of the genus *Eptesicus*: *andinus* J. A. Allen, 1914 – Colombia, Ecuador, Peru, Venezuela, Amozonian Brazil (Simmons, 2005: 453); *bobrinskoi* Kuzyakin, 1935 - (Simmons, 2005: 453); ***bottae*** (Peters, 1869); *brasiliensis* (Desmarest, 1819) – Veracruz (Mexico) south to northern Argentina, Paraguay and Uruguay, Trinidad and Tobago (Simmons, 2005: 453); *chiriquinus* Thomas, 1920 – Costa Rica, Panama, Colombia, Ecuador, Peru, Venezuela, Guyana, French Guiana, Amozonian Brazil (Simmons, 2005: 454); *diminutus* Osgood, 1915 – Venezuela, eastern Brazil, Paraguay and northern Argentina (Simmons, 2005: 454); ***floweri*** (de Winton, 1901); *furinalis* (d'Orbigny, 1847) – northern Argentina, Paraguary, Bolivia, Brazil and the Guinas east to Peru and north to Jalisco and Tamaulipas (Mexico); *fuscus* (Beauvois, 1796) – southern Canada to Colombia and northern Brazil, Greater Antilles, Bahamas, Dominica and Barbados (Lesser Antilles), Alaska (Simmons, 2005: 454); *gobiensis* Bobrinskii, 1926 – Iran, northern Afghanistan, Kashmir, Pakistan and Nepal, southern Russia, Mongolia (Simmons, 2005: 454); *guadeloupensis* Genoways and Baker, 1975 – Guadeloupe (Lesser Antilles) (Simmons, 2005: 455); ***hottentotus*** (A. Smith, 1833); *innoxius* (Gervais, 1841) – northwestern Peru, western Ecuador, Puna Isl (Ecuador) (Simmons, 2005: 455); ***isabellinus*** Temminck, 1840; *japonensis* Imaizumi, 1953 – Honshû Isl (Japan) (Simmons, 2005: 455); *kobayashii* Mori, 1928 – Korea (Simmons, 2005: 455); *nasutus* (Dobson, 1877) – Saudi Arabia, Oman, Yemen, Iraq, Iran, Afghanistan, Pakistan (Simmons, 2005: 456); *nilssonii* (Keyserling and Blasius, 1839) – western and eastern Europe to eastern Siberia and northwestern China, north beyond Artic Circle in Scandinavia, south to Bulgaria, Iraq, the Elburz Mtns (northern Iran), The Pamirs and western China (not Tibet), Korea, Hokkaido (Japan), Sakhalin Isl (Russia) (Simmons, 2005: 456); *pachyotis* (Dobson, 1871) – Bangladesh, northeastern India, Tibet (China), northern Burma, northern Thailand (Simmons, 2005: 456); ***platyops*** (Thomas, 1901); *serotinus* (Schreber, 1774) – western Europe through Turkey and southern Asiatic Russia to Himalayas, Thailand and China, north to Korea, Taiwan, south England, most islands in Mediterranean, possibility north Africa (Simmons, 2005: 456); *tatei* Ellerman and Morrison-Scott, 1951 – northeastern India (Simmons, 2005: 456).

COMMON NAMES:
Czech: večerní netopýři, podvečerníkové. English: Big-brown bats, Serotines, Greater Serotine Bats, Serotine Bats. French: Sérotines. German: Breitflügelfledermäuse.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery (2007: 619) reported on the presence of *Eptesicus* sp. in Pleistocene deposits at Wonderwerk Cave, South Africa.

ZOOBANK:
A96CB3CB-AA8F-4450-9EB0-FCEC51D29B8B

Eptesicus bottae (Peters, 1869)

*1869. *Vesperus Bottae*Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 406. Type locality: Yemen: "Yemen": Restricted to W Yemen, between Al Hudayda, Ta'izz and Al Mukha, according to Karami *et al.* (2009: 70).. Holotype: MNHN ZM-MO-1987-297: ad, skull and alcoholic. Collected by: Dr. Paolo Emilio Botta; collection date: 1837. Number 212 in Rode (1941: 247). Rode (1941) mentions a male specimen, whereas Peters (1869a: 406) mentions a female. - Etymology: In honour of Paul-Emile Botta (1802 - 1870), who collected the type specimen (see Kozhurina, 2002: 14).

1887. *Vesperugo (Vesperus) Innesi* Lataste, Ann. Mus. civ. Stor. nat. Genova, ser. 2, 4 (O.S. 24): 625, 2 text-figs. Publication date: 25 July 1887. Type locality: Egypt: Cairo [30 03 N 31 15 E] [Goto Description]. Lectotype: BMNH 1919.7.7.3528: sad ♀, skull and alcoholic. Collected by: Dr. Walter F. Innes Bey; collection date: 1885. See Qumsiyeh (1985). Paralectotype: MSNG unknown: ♂. - Etymology: In honour of M. Walter Innes, curator of the Medical Museum, who collected the type specimens (see Lataste, 1887b: 628).

1891. *Vesperugo innesi:* Noack, Jb. Hamb. Wiss. Anst., 9: 139. (Name Combination)

1902. *Vespertilio innesi:* Anderson and de Winton, Zoology of Egypt: Mammalia, 121. (Name Combination)
1919. *E[ptesicus] innesi:* Thomas, J. Bomb. nat. Hist. Soc., 26: 746. (Name Combination)
1932. *Eptesicus innesi:* Flower, Proc. zool. Soc. Lond., 101: 382. (Name Combination)
1942. *Eptesicus [(Eptesicus)] bottae:* Tate, Bull. Am. Mus. Nat. Hist., 80: 275, 277. (Name Combination)
1955. *Eptesicus isabellinus innesi:* Sanborn and Hoogstraal, J. Egypt. Publ. Health Ass., 30 (4): xxx. (Name Combination)
1956. *Eptesicus isabellinus bottae:* Harrison, Proc. zool. Soc. Lond., 127: ???. (Name Combination)
1963. *E[ptesicus] bottae:* Harrison, Z. Säugetierk., 28 (1): 109. (Name Combination)
1964. *Eptesicus bottae bottae:* Harrison, Mammals of Arabia, 140. (Name Combination)
1964. *Eptesicus bottae innesi:* Harrison, Mammals of Arabia, 140. (Name Combination)
1964. *Eptesicus bottae:* Harrison, Mammals of Arabia, 140. (Name Combination, Current Combination)
1971. *Eptesicus [(Eptesicus)] bottae innesi:* Hayman and Hill, Mammals of Africa: Chiroptera, 45. (Name Combination)
1990. *Eptesicus (Eptesicus) bottae bottae:* Nader and Kock, Senckenb. biol., 79 (1/3): 2 (for 1989).
1994. *E[ptesicus (Eptesicus)] b[ottae] bottae:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 120. (Name Combination)
1994. *E[ptesicus (Eptesicus)] b[ottae] innesi:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 120. (Name Combination)

TAXONOMY:
Revised by Nader and Kock (1990). Ellerman and Morrison-Scott (1966: 156) considers *isabellinus* to be a synonym of this species rather than of *E. serotinus*.

Populations in Turkey and northern Syria (and possibly other areas) are considered by Felten (1971) and Benda *et al.* (2006) to be a separate species: *Eptesicus anatolicus* Felten 1971.

Based on mtDNA analyses, Artyushin *et al.* (2018: 473) distinguished two clusters in . bottae: one including *E. b. ognevi* and the second including *E. b. hingstoni*, *E. b. innesi* and *E. b. taftanimontis*, and the differences between them are almost large enough to distinguish them as separate species. The relation of these taxa to *E. b. bottae* still needs to be determined.

COMMON NAMES:
Albanian: Serotinë e Botta's. Arabian: Khaffash. Armenian: Ասպպատայինմաշկեղ. Azerbaijani: Səhra gönlücəsi. Basque: Botta serotino. Belarusian: Кажан Бота. Bosnian: Botin šišmiš. Breton: Serotin Botta. Bulgarian: Полунощен прилеп на Бот. Castilian: Murciélago hortelano de Botta. Catalan: Ratpenat dels graners de Botta. Croatian: Bottin noćnjak. Czech: Netopýr Bottův, Netopýr Ogněvův. Danish: Bottas sydflagermus. Dutch: Botta's vleermuis. English: Botta's Serotine, Botta's Serotine Bat. Estonian: Kõrbe-nahkhiir. Finnish: Turkinserotiini. French: Sérotine de Botta. Frisian: Botta's lette flearmûs. Galician: Morcego das hortas de Botta. Georgian: ჭდაბნოს მეგვიანე. German: Bottas Breitflügelfledermaus, Bottas Fledermaus. Greek: Ασιατική τρανονυχτερίδα Hebrew: aflul matzuy, Aflul Matsui. Hungarian: Botta-késeidenevér. Irish Gaelic: Ialtóg Botta. Italian: Serotino di Botta. Latvian: Botas sikspārnis. Lithuanian: Uolinis šikšnys. Luxembourgish: Botta-Fliedermaus. Maltese: Serotin ta' Botta. Montenegrin: Svijetlotrbušasti slijepi miš. Norwegian: Blekflaggermus. Polish: Mroczek Botty. Portuguese: Morcego-hortelão de Botta. Rhaeto-Romance: Serotin da Botta. Romanian: Liliacul lui Botta. Russian: Кожан пустынный. Serbian: Блискоисточни поноћњак [= Bliskoistoč ni ponoć njak]. Scottish Gaelic: Ialtag Botta. Slovak: Več ernica Bottova. Slovenian: Svetlotrebuš ni poznik. Swedish: Blek sydfladdermus. Turkish: Bottae'nin Geniş kanatlı Yarasası. Ukrainian: іилик (Пергач) пустельний. Welsh: Ystlum adain-lydan Botta.

CONSERVATION STATUS:
Global - The species as described has a relatively wide range. Although generally considered uncommon it is described as locally common in at least part of the range (Egypt). No major threats are known. Hence it is listed as Least Concern (LC ver 3.1 (2001)) (Aulagnier *et al.*, 2008d; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Aulagnier *et al.*, 2008d; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Benda and

Juste, 2004; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Protected through Eurobats (Bonn Convention) and Bern Convention, and included in Annex IV of EU Habitats and Species Directive in the very small part of the range where these apply.

MAJOR THREATS:
The species requires ruins which are decreasing in number and can be disturbed by tourists (A. Karatas *pers. comm.,* 2007), however, this is not thought to be a major threat to the species as a whole at present (Aulagnier *et al.*, 2008d; IUCN, 2009). Bilgin *et al.* (2012: 434) predict that climatic change will result in a major range contraction for this species.

CONSERVATION ACTIONS:
Aulagnier *et al.* (2008d) [in IUCN (2009)] suggest that taxonomic work is required to determine if more than one species is involved here and what the ranges of these are, and what their population status is.

GENERAL DISTRIBUTION:
Eptesicus bottae is a Palaearctic species, occuring from the eastern Mediterranean around margins of Arabian peninsula to Iraq, Iran and southern Caucacus states; also central Asia to India, northwestern China and possibly Mongolia.

Native: Afghanistan; Armenia; Azerbaijan; Egypt (Sinai); Georgia; Greece (East Aegean Is.); India; Iran, Islamic Republic of; Iraq; Israel; Jordan; Kazakhstan; Kyrgyzstan; Lebanon; Oman; Pakistan; Palestinian Territory, Occupied; Saudi Arabia; Syrian Arab Republic; Tajikistan; Turkey; Turkmenistan; United Arab Emirates; Uzbekistan; Yemen.
Presence uncertain: Djibouti; Eritrea; Mongolia; Russian Federation; Somalia; Sudan.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

ECHOLOCATION:
Walters *et al.* (2012: suppl.) report the following figures for 26 calls (21 sequences) from bats from Egypt and Israel: duration: 8.35 ± 2.16 msec, F_{max}: 44.18 ± 6.90 kHz, F_{min}: 30.44 ± 1.10 kHz, bandwidth: 13.73 ± 6.25 kHz, F_{peak}: 33.47 ± 1.80 kHz.

In Jordan, the following parameters were reported by Benda *et al.* (2010b: 204) for 146 calls: F_{start} 53.6 ± 9.3 (37.9 - 83.0) kHz, F_{end}: 30.4 ± 1.5 (27.0 - 33.7) kHz, F_{peak}: 34.3 ± 1.8 (29.6 - 39.5) kHz, Pulse duration: 5.5 ± 1.3 (2.7 - 9.4) msec, and Inter-pulse interval: 123.6 ± 39.7 (52.0 - 241.0) msec.

Hackett *et al.* (2016: 223) reported on 147 calls from Israel: Pulse duration: 6.19 ± 1.51 msec, F_{start}: 42.63 ± 4.05 (38 - 51) kHz, F_{end}: 30.51 ± 1.21 (28.8 - 35.0) kHz, F_{peak}: 32.08 ± 1.29 (29.2 - 37.1) kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Volleth *et al.* (2001) reported 2*n* = 50, FN = 48, BA = 0, a metacentric X chromosome and a metacentric Y chromosome for a male from Greece.
Protein / allozyme - Unknown.

DIET:
Hackett *et al.* (2013: 7) classify *E. bottae* as a background cluttered space aerial insectivore.
In the Dead Sea area of Israel Hymenoptera, Lepidoptera and Coleoptera form the most important groups of food items, whereas in Syria, Coleoptera were the prime food category, followed by Heteroptera and Auchenorrhyncha, and in Iran Hymenoptera (Formicoidea) (89 % volume) and Coleoptera (Scarabaeidae) were the most important food items, indicating that *E. bottae* is a flexible species feeding opportunistically especially on ants and beetles. (Benda *et al.*, 2012a: 387).

POPULATION:
Structure and Density - Reported to be locally common in Egypt, with colonies of up to 200 females being reported (African Mammal Assessment Workshop, 2004).
Trend - 2008 - Unknown (Aulagnier *et al.*, 2008d; IUCN, 2009). *Eptesicus bottae* populations within the Asia Minor and Levant region are unknown population trend, under predictive climate change scenarios (Bilgin *et al.*, 2012: 433).

ACTIVITY AND BEHAVIOUR:
In the Negev desert, Polak *et al.* (2011: 25) found that this species only passed through areas lighted by street lamps (flight speed: 9.25 ± 1.19 m/s), and never foraged there (contrary to *Pipistrellus kuhlii*. The flight speed during foraging in dark areas was 5.7 ± 1.3 m/s.

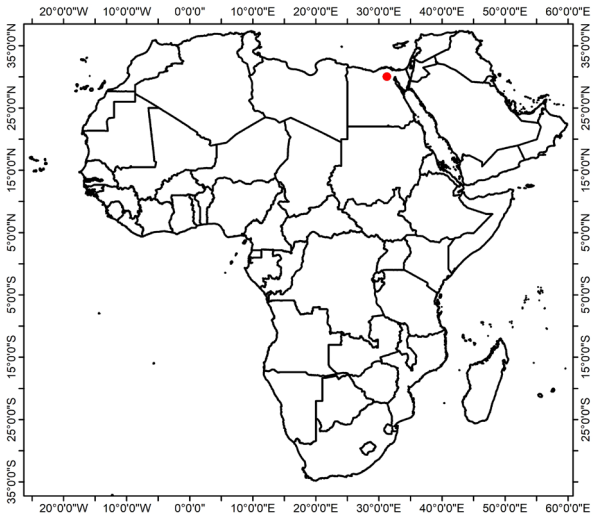


Figure 272. Distribution of *Eptesicus bottae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Egypt, Yemen.

Eptesicus floweri (de Winton, 1901)

*1901. *Glauconycteris Floweri* de Winton, Ann. Mag. nat. Hist., ser. 7, 7 (37): 46. Publication date: 1 January 1901. Type locality: Sudan: 12 mi (18 km) S from Khartoum, on White Nile: Wad Marium [ca. 15 25 N 32 25 E] [Goto Description]. Holotype: BMNH 1903.2.7.14: ad ♂, skin and skull. Collected by: Mrs. Anderson and H.F. Witherby; collection date: 12 May 1900; original number: 35. - Comments: de Winton (1901b: 45) mentions Mr. H.F. Witherby as collector and the late Dr. John Anderson as aquirer.

1908. *S[cabrifer] floweri:* G.M. Allen, Bull. Mus. comp. Zool., 52 (3): 46. (Name Combination)

1915. *Rhinopterus lowei* Thomas, Ann. Mag. nat. Hist., 8, 15 (90): 559. Publication date: 1 June 1915. Type locality: Sudan: Blue Nile province: Sennaar, 20 mi (30 km) above [ca. 15 35 N 33 38 E, 450 m] [Goto Description]. Holotype: BMNH 1915.3.6.70: ad ♂, skull and alcoholic. Collected by: Willoughby P. Lowe; collection date: 13 December 1913.

1918. *Scabrifer floweri:* Wettstein, Denkschr. k. Akad. Wiss. Wien, Math.-Naturw. Kl., 94: 651. (Name Combination)

1939. *Rhinopterus floweri:* G.M. Allen, Bull. Mus. comp. Zool., 83: 97. (Name Combination)

1969. *Eptesicus (Rhinopterus) floweri:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 166. (Name Combination)

1971. *Eptesicus (Rhinopterus) lowei:* Hayman and Hill, Mammals of Africa: Chiroptera, 45. (Name Combination)

1974. *Eptesicus floweri:* Seal and Makey, ISIS Mammalian Taxonomic Director, ???. (Name Combination, Current Combination)

? *Eptesicus (Rhinopterus) floweri lowei:* (Name Combination)

TAXONOMY:
Includes *lowei*; see Bræstrup (1935b: 92); but also see Hayman and Hill (1971).

COMMON NAMES:
Czech: netopýr Flowerův. English: Horn-skinned Pipistrelle Bat, Flower's Pipistrelle Bat, Horn-skinned Bat, Sudan Horn-skinned Bat, Lesser Sudan Horn-skinned Bat, Sudan Serotine, Horn-skinned Serotine. French: Sérotine de Flower, Sérotine du Soudan. German: Chagrin Fledermaus, Warzen-Breitflügelfledermaus.

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a broad range of non-threatened habitats, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008ah; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008ah; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Jacobs *et al.*, 2004at; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species (Jacobs *et al.*, 2008ah; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ah) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, and it is not known if the species is present within any protected areas. Further studies are needed into the distribution and natural history of this poorly known species.

GENERAL DISTRIBUTION:
Eptesicus floweri has been recorded from Mali (Timbuktu) and Sudan (all records within a 200-mile radius of Ed Dueim) and Mahmûdé Lake, Wilaya Hodh Ech Chargui in Mauritania.

Native: Mali (Koopman, 1975); Mauritania (Padial and Ibáñez, 2005: 240); Sudan (Bræstrup, 1935b; Koopman, 1975).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:



Figure 273. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1903.2.7.14, holotype of *Glauconycteris floweri* de Winton, 1901.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

POPULATION:
Structure and Density - It is known from very few specimens.
Trend - 2008 - Stable (Jacobs *et al.*, 2008ah; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Mauritania, Sudan.

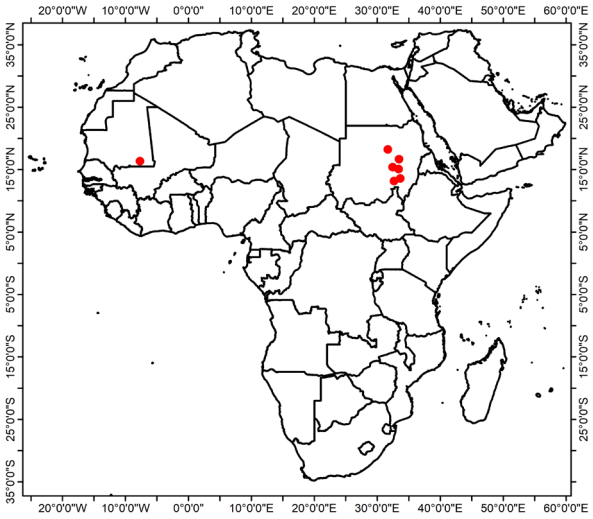


Figure 274. Distribution of *Eptesicus floweri*

Eptesicus hottentotus (A. Smith, 1833)

*1833. *Vespertilio Hottentota* A. Smith, S. Afr. Quart. J., ser. 2, 1 (2): 59. Publication date: November 1833. Type locality: South Africa: Cape province: Uitenhage [ca. 33 45 S 25 25 E] [Goto Description]. - Comments: Type locality restricted to Uitenhage (from Uitenhage and Albany) by Ellerman *et al.* (1953): see Meester *et al.* (1986: 57).

1835-1841. *Vespertilio megalurus* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe. Tome Seconde, 2: 206. Publication date: 1835 - 1841. Type locality: South Africa: "Interior of South Africa" [Goto Description]. - Comments: Type specimen: RMNH.

1849. *Vespertilio minutus* A. Smith, Illustrated Zoology of South African Mammals, pl. 51 and text. - Comments: Preoccupied by *Vespertilio minutus* Montagu, 1808 and *Vespertilio minuta* Temminck, 1840.

1855. *V[espertilio] Smithii* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 747, footnote. Publication date: 28 September 1855. Type locality: South Africa: "South Africa". - Comments: .
1855. *Vespertilio (Vesperus) megalurus:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 747. (Name Combination)
1855. *Vespertilio smithii* Wagner, Supplementband 5. In: Schreber, J.C.D. von: Die Säugethiere in Abbildungen nach der Natur, mit Beschreibungen, 747 [Goto Description].
1860. *Cateorus megalurus:* Kolenati, Monographie der Europäischen Chiroptern, 20. (Name Combination)
1878. *Vesperugo (Vesperus) megalurus:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 199. (Name Combination)
1878. *Vesperugo (Vesperus) smithii:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 198. - Comments: Dobson (1878) considered it to be a synonym of *Vesperugo (Vesperus) capensis*. (Name Combination)
1887. *Vesperus megalurus:* Jentink, Mus. Hist. nat. Pays-Bas, Leyden, 275. (Name Combination)
1897. *Vesperugo (Eptesicus) megalurus:* Thomas, Proc. zool. Soc. Lond., 1896, IV: 791. (Name Combination)
1901. *Vespertilio (Eptesicus) megalurus:* Sclater, Mammals of South Africa, 123. (Name Combination)
1924. *E[pteisuc] smithii:* Roberts, Ann. Transv. Mus., 10: 60.
1931. *Eptesicus megalurus:* Hewitt, A guide to the Vertebrate fauna of the Eastern Cape Province, 23. (Name Combination)
1938. *Scotophilus angusticeps* Shortridge and Carter, Ann. S. Afr. Mus., 32 (4): 282. Publication date: July 1938. Type locality: South Africa: Western Cape province: 10 mi (16 km) N Citrusdal: Hex River Estate [33 30 S 19 35 E, 100 m] [Goto Description]. Holotype: KM 1984: ad ♀. Collected by: Captain Guy Chester Shortridge and T. Donald Carter; collection date: 28 December 1937; original number: 1937. Presented/Donated by: ?: Collector Unknown. Cotype: KM 1985: ad ♀. Collected by: Captain Guy Chester Shortridge and T. Donald Carter; collection date: 3 January 1938; original number: 3308. Presented/Donated by: ?: Collector Unknown.
1939. *Eptesicus smithii:* G.M. Allen, Bull. Mus. comp. Zool., 83: 87. (Name Combination)
1942. *Eptesicus megalurus pallidior* Shortridge, Ann. S. Afr. Mus., 36: 37. Type locality: South Africa: NW Cape province: Klein Namaqualand, Orange River: Goodhouse [ca. 28 54 S 18 15 E, 300 ft] [Goto Description]. - Comments: Holotype (ad F, orig nr. 1157) possibly in the collection of the BMNH or KM.
1946. *E[ptesicus] h[ottentotus] hottentotus:* Roberts, Ann. Transv. Mus., 20 (4): 305. (Name Combination)
1946. *Eptesicus hottentotus bensoni* Roberts, Ann. Transv. Mus., 20 (4): 305. Type locality: Malawi: Ncheu [=Ntcheu] [14 49 S 34 38 E, 1 100 m] [Goto Description]. Holotype: TM 9167: ad ♂, skin and skull. Collected by: Constantine ("Con") Walter Benson; collection date: 31 October 1939; original number: 94.
1951. *Eptesicus hottentotus angusticeps:* Roberts, Mammals of South Africa, 551. (Name Combination)
1951. *Eptesicus hottentotus hottentotus:* Roberts, Mammals of South Africa, 86. (Name Combination)
1951. *Eptesicus hottentotus pallidior:* Roberts, Mammals of South Africa, 86. (Name Combination)
1953. *Eptesicus (Eptesicus) hottentotus bensoni:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 76. (Name Combination)
1953. *Eptesicus (Eptesicus) hottentotus hottentotus:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 76. (Name Combination)
1953. *Eptesicus (Eptesicus) hottentotus pallidior:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 76. (Name Combination)
1953. *Eptesicus (Eptesicus) hottentotus:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 76. (Name Combination)
1954. *Eptesicus hottentotus:* Ellerman, Ann. Univ. Stellenbosch, 30 A (1): 32. (Name Combination, Current Combination)
1969. *Eptesicus serotinus hottentotus:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 214. (Name Combination)

1986. *Eptesicus hottentotus portavernus* Schlitter and Aggundey, Cimbebasia, (A) 8 (20): 172, fig. 5. Publication date: 14 February 1986. Type locality: Kenya: Rift Valley province: Naivasha district: 20 km S, 14 km W Naivasha: Hell's Gate Canyon (=Njorowa Gorge) [00 54 S 36 19 E] [Goto Description]. Holotype: CM 89000: ad ♂, skin and skull. Collected by: Dr. Duane Albert Schlitter; collection date: 30 September 1985; original number: 6906. See Schlitter and Aggundey (1986: 172).

1986. *Eptesicus hottentotus protavernus:* Schlitter and Aggundey, Cimbebasia, (A) 8 (20): 174. (Lapsus)

1994. *E[ptesicus (Eptesicus)] h[ottentotus] portavernus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 120. (Name Combination)

2003. *Eptesicus (Cnephaeus) hottentotus:* Hoofer and Van Den Bussche, Acta Chiropt., 5 (Suppl.): 38. (Name Combination)

Taxonomy:



Figure 275. *Eptesicus hottentotus* (TM 48193) caught at Farm Schaapplaats, Free State, South Africa.

Revised by Schlitter and Aggundey (1986), who described a new subspecies from Kenya - *Eptesicus hottentotus portavernus*. Besides the nominate form and the newly described subspecies, their work recognised one other subspecies *E. h. bensoni* (Roberts, 1946), but not *E. h. pallidior* (Shortridge, 1942), which they synonomised with the nominate subspecies (Schlitter and Aggundey, 1986). Simmons (2005: 455) recognised the same subspecies. An analysis of specimens from southern Africa showed support for the synonomization of *E. h. pallidior*, but also indicated that either the subspecies delineation between *E. h. hottentotus* and *E. h. bensoni* is also not as distinct, or the distribution of *E. h. bensoni*, described from Malawi, requires revision (Kearney, 2005). Although the distribution of *E. h. bensoni* in Meester *et al.* (1986: 57) included parts of South Africa, as well as Mozambique, Zimbabwe and Malawi, Hayman and Hill (1971) listed only Malawi and Zambia, and the subspecies was not included in the list of mammals from South Africa by Roberts (1951, 1954). Included in the subgenus *Cnephaeus* by Hoofer and Van Den Bussche (2003: 38).

Based on mitochondrial and nuclear DNA analyses, Juste *et al.* (2013: 449) retain two subspecies: *R. h. hottentotus* and *R. h. pallidior*, but they only included material from South Africa.

Common Names:

Afrikaans: Langstert-dakvlermuis. Chinese: 长尾棕蝠. Czech: netopýr hotentotský. English: Long-tailed Serotine Bat, Hottentot Serotine Bat, Long-tailed Greater Serotine Bat, Long-tailed House Bat, Hottentot bat. French: Sérotine hottentote, Sérotine des maisons à longue queue, Sérotine hottentote. German: Hottentotten-Breitflügelfledermaus, Capische Trugfledermaus. Portuguese: Morcego caseiro Hottentot.

Etymology of common name:

The colloquial name is derived from the fact that the tail of this species is much longer than in its sister taxa (see Smithers, 1983; Skinner and Smithers, 1990: 108; Taylor, 2005).

Similar Species:

Has been confused with *Scotophilus* (Roberts, 1946; 1951: 86; 1954: 86; Kearney and Seamark, 2004), although *E. hottentotus* has bicoloured hair and two upper incisors, while *Scotophilus* has single coloured hair and one upper incisor.

Palaeontological or archaeological records:

Butler (1978) reported as *Eptesicus* cf. *hottentotus* (Smith) from the early Pleistocene deposits at Olduvai. *E. hottentotus* was found from the upper Pleistocene at Border Cave and possibly the late Holocene at Nkupe, South Africa (Avery, 1991: 6). Further South African Pleistocene (Wonderwerk) and Holocene (Blinkklipkop) findings were reported by Avery and Avery (2011: 19).

Conservation status:

Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs and Cotterill, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs and Cotterill, 2008a; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs and Cotterill, 2004a; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Watson *et al.*, 2016). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species (Jacobs and Cotterill, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs and Cotterill (2008a) [in IUCN (2009)] indicate that *E. hottentotus* has been recorded from several protected areas in South Africa, and presumably is present in protected areas within other parts of the species range. Further studies are needed into the distribution of this species.

GENERAL DISTRIBUTION:
Eptesicus hottentotus is largely a Southern African species ranging from southern Angola in west, through parts of Namibia, South Africa, southern Lesotho, Botswana, Zimbabwe, Mozambique, Malawi and Zambia, with a single record as far north as southwestern Kenya.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 813,384 km^2. In the RSA, its distribution is best predicted by geology (Babiker Salata, 2012: 50).

Native: Angola (Crawford-Cabral, 1966: 137; 1989; Feiler, 1990; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562; Taylor *et al.*, 2018b: 63); Kenya (Schlitter and Aggundey, 1986; Kearney *et al.*, 2008b); Lesotho (Lynch, 1994: 196; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562); Malawi (Kershaw, 1922b: 182; Roberts, 1946: 305;Happold *et al.*, 1988; Ansell and Dowsett, 1988: 38; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562); Mozambique (Smithers and Lobão Tello, 1976: 60; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562; Monadjem *et al.*, 2010c: 382); Namibia (Griffin, 1999: 30; Rautenbach *et al.*, 1993: 93; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562); South Africa (Shortridge and Carter, 1938: 282; Shortridge, 1942: 38; Roberts, 1951: 86; 1954; Rautenbach *et al.*, 1981b; Rautenbach and Espie, 1982; Herselman and Norton, 1985: 100; Rautenbach *et al.*, 1993: 93; Lynch, 1994; Taylor, 1998; Watson, 1998; Avery, 1991: 6; Kearney and Seamark, 2004; Seamark and Brand, 2005: 8; Seamark and Kearney, 2007: 4; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562); Zambia (Ansell, 1960a: 20; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562); Zimbabwe (Peterson and Nagorsen, 1975; Cotterill, 1996a: 78; Kearney *et al.*, 2008b; Monadjem *et al.*, 2010d: 562).

GEOGRAPHIC VARIATION:
See also the section on "Taxonomy". *E. h. bensoni* is smaller than either *E. h. hottentotus* or *E. h. portavernus* (Schlitter and Aggundey, 1986). *E. h. bensoni* is darker in colour, "tawny olive" (Roberts, 1946), than *E. h. portavernus* (Schlitter and Aggundey, 1986), and *E. h. hottentotus* (Roberts, 1946: 305). Morphometric analysis of cranial size supported the synonomization of *E. h. pallidior* with the nominate species (Schlitter and Aggundey, 1986; Kearney, 2005), which had been described on the basis of the paler colour, "rufous-buff" (Shortridge, 1942), that is found in specimens from the Northern Cape and Namibia. Although, colour is darker in specimens from Taung in the North West Province of South Africa (Herselman and Norton, 1985: 100), and in specimens from Angola - "gold brownish" (Crawford-Cabral, 1966; 1989: 19). Relative to *E. h. hottentotus*, *E. h. portavernus* has a deeper braincase and shorter palatal length (Schlitter and Aggundey, 1986).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
For a general description of overall size, and pelage and membrane colour see Temminck (1840), Sclater (1901: 126), Shortridge and Carter (1938: 282), Shortridge (1942), Roberts (1946), Smithers (1983), Skinner and Smithers (1990: 108), Taylor (2000), Taylor (2005: 318). For a general description of the ear and tragus see Temminck (1840), Sclater (1901: 126), Smithers (1983), Skinner and Smithers (1990: 108), Taylor (2000), Taylor (2005: 318).

Schoeman and Jacobs (2002: 157) reported the following parameters for 6 specimens from the Algeria Forestry Station (RSA): Fa: 48.9 ± 1.4 mm, Wing area: 173.7 ± 14.1 cm^2, Wing span: 33.0 ± 0.5 cm, Wing loading: 10.3 ± 1.6 N/m^2, and aspect ratio: 6.3 ± 0.6.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
For a general description of the skull, see Shortridge and Carter (1938: 282), Roberts (1946). For a general description of the teeth, see Sclater (1901: 126).

DETAILED MORPHOLOGY:
Baculum - See Hill and Harrison (1987) and Kearney *et al.* (2002).
Dental - See Menu (1985; 1987).

SEXUAL DIMORPHISM:
An analysis of specimens from southern Africa showed no significant difference between the sexes in 12 cranial and dental, and eight external measurements, but females were significantly larger than males by 5.21 and 6.78 percent respectively for forearm and third metatarsal lengths (Kearney, 2005).

ECHOLOCATION:
Based on a single room-flown individual the call was recorded as a short duration (2 - 4 msex), broad-band (20 - 54 kHz) call with a dominant frequency of 28 - 32 kHz, and harmonic components (Taylor, 2000: 89). The call frequency, outside the sensitivity range of moths, is suggested to have evolved in response to moth hearing (Schoeman and Jacobs, 2002). These authors (p. 157) also reported the call type to be a low duty echolocation dominated by frequency modulated calls, with a F_{peak}: 31.8 ± 1.0 kHz.

Taylor *et al.* (2013b: 17) recorded the following parameters for 3 *E. hottentotus* calls from Soutpansberg, South Africa: F_{max}: 60.6 ± 8.23 (54.0 - 69.8) kHz, F_{min}: 30.1 ± 1.74 (28.2 - 31.6) kHz, F_{knee}: 35.2 ± 1.48 (34.2 - 36.9) kHz, F_{char}: 32.2 ± 1.75 (30.4 - 33.8) kHz, duration: 3.1 ± 0.86 (2.6 - 4.1) msec.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg area (RSA): F_{min}: 28 - 32 khz, F_{char}: 30 - 34 kHz, F_{knee}: 34 - 37 kHz, Slope: 367 - 773 OPS, duration: 3 - 4 msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003), Stadelmann *et al.* (2004b), Eick *et al.* (2005) and Matthee *et al.* (2006).
Karyotype - Results of all analyses, based on specimens from Zimbabwe (Peterson and Nagorsen, 1975), Namibia and Limpopo Province in South Africa (Rautenbach *et al.*, 1993: 93), and the Western Cape Province in South Africa (Kearney *et al.*, 2002: 59), agreed the diploid number is $2n$ = 50, with 24 pairs of acrocentric autosomes, hence a fundamental number of FN = 48. The X chromosome is a medium-sized submetacentric, and the Y a small acrocentric (Peterson and Nagorsen, 1975; Rautenbach *et al.*, 1993: 93; Kearney *et al.*, 2002: 59).
Protein / allozyme - See Morales *et al.* (1991) for results from ten specimens from Namibia.

HABITAT:
Often associated with mountainous country, in close proximity to water (see references under "Habits"). Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *E. hottentotus* activity was not significantly, nor positively influenced by size of wetland, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body.

HABITS:
In Angola specimens collected from Capolopopo were "performing sweeping flights over a water tank, apparently catching insects" (Crawford-Cabral, 1989: 19), as was also noted by Roberts, 1951: 87) for individuals observed at Eronga Mountain in Namibia. In Mozambique a single specimen was mistnetted in the Zambezi Valley northwest of Tete (Smithers and Lobão Tello, 1976: 60). Specimens collected at Goodhouse in the Northern Cape Province of South Africa were shot "whilst 'planing' very slowly in wide circles around a cattle kraal, to which they were attracted by a swarm of flies" (Shortridge, 1942: 38). Shortridge (1942: 38) also observed them to be weak fliers, coming out at late dusk after *Cistugo* and *Sauromys*. In 1985, near Buxton in the North West Province of South Africa, some 11 years after this species had been taken from a roost at the entrance to an old mine tunnel (see below under "Roost"), three females were netted flying out of the tunnel, two at 20h45, and another at 21h40, while a male was caught returning at 23h30 (James, 1986: 219). The first specimen of this bat caught in the northern part of the Kruger National Park in South Africa was mistnetted after sunset in a figtree forest on the banks of the Luvuvhu River (Rautenbach and Espie, 1982: 112). In the Free State Province of South Africa a specimen was netted at Sterkfontein Dam in "well-wooded, broken country with patches of marshy open grassland" (Watson, 1998). A specimen from Ithala Game Reserve in northern KwaZulu-Natal Province of South Africa was netted over a river with well-wooded banks (Rautenbach *et al.*, 1981b: 24). At Rocherpan in the Western Cape Province of South Africa specimens were netted flying low over a marsh (Herselman and Norton, 1985: 100). In the Cederberg region of the Western Cape Province of South Africa specimens were netted, in January and February between 20h45-21h52, at the edges of water bodies (Seamark and Brand, 2005: 8). In Lesotho specimens were netted over grassy banks adjacent to rivers in mountainous terrain, at Malealea the species was caught in October at 20h30 (Lynch, 1994: 197).

ROOST:
In Zimbabwe a specimen was found "clinging to a wall in an open building with a corrugated iron roof" (Smithers and Lobão Tello, 1976: 60), and at Marandellas "hanging on the wall of a squash court" (Smithers and Wilson, 1979: 45). Specimens from Taung in the North West Province of South Africa were taken (between 1976 - 1979)

from a hollow in rocks at the entrance to an old mine tunnel inhabited by *Miniopterus schreibersii* (Herselman and Norton, 1985: 100).

DIET:
Insectivorous (Smithers, 1983; Skinner and Smithers, 1990: 108; Taylor, 2005: 318). Schoeman and Jacobs (2002) identified tympanate moths in the diet of individuals from the Western Cape Province of South Africa.

From the Algeria Forestry Station (RSA) Schoeman and Jacobs (2002: 157) reported the following prey groups based on 67 faecal pellets from 6 bats (in volume percent): Coleoptera (88.3 ± 9.0), Diptera (4.5 ± 9.0), Hemiptera (1.5 ± 3.0), and unknown (1 ± 2).

PREDATORS:
Avery *et al.* (2005: 1054) found this species to be present in pellets from *Tyto alba* in South Africa.

Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - Shortridge (1942:38) indicated this bat was not plentiful around Goodhouse in the Northern Cape of South Africa and only observed half a dozen individuals. In other instances specimens have either been found singly or in groups of two to five (Smithers and Wilson, 1979; Herselman and Norton, 1985: 100; Smithers, 1983; Watson, 1998).
Trend - 2008 - Unknown (Jacobs and Cotterill, 2008a; IUCN, 2009).

PARASITES:
Ectoparasite - *Pteracarus pusillus* (Fain, 1978: 78).

VIRUSES:
Paramyxoviridae
Mortlock *et al.* (2015: 1841) reported that one of two examined South African *E. hottentotus* specimens tested positive for *Paramyxovirus* sequences.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested one individual brain, by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

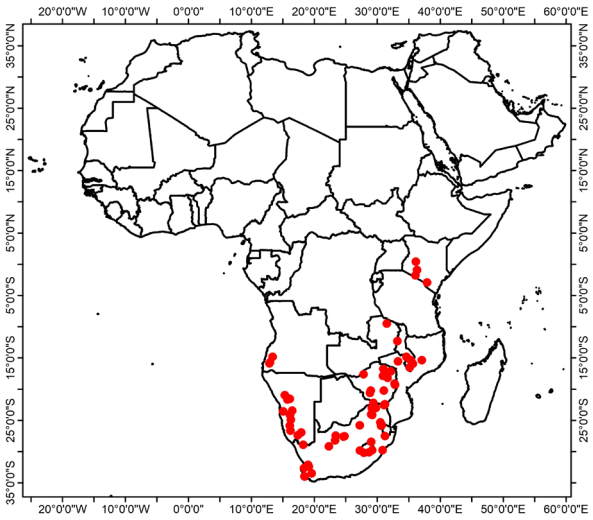


Figure 276. Distribution of *Eptesicus hottentotus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe.

Eptesicus isabellinus (Temminck, 1840)

*1835-1841. *Vespertilio isabellinus* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe, 2: 205, pl. 52, fig. 1, 2. Publication date: 1835 - 1841. Type locality: Libya: near Tripoli [ca. 32 58 N 13 12 E] [Goto Description]. - Comments: Considered a valid subspecies by Horácek *et al.* (2000: 124). Considered a valid species of *serotinus* by Benda *et al.* (2004b: xx), and Mayer *et al.* (2007: Additional file 1) based on mitochondrial DNA analyses.
Dalhoumi *et al.* (2017b: 142) indicate that the original specimens were collected by J. F. H. Clifford Cocq van Breugel.

1855. *Vespertilio (Vesperus) isabellinus:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 746. (Name Combination)

1860. *Meteorus isabellinus:* Kolenati, Monographie der Europäischen Chiroptern, 20. (Name Combination)

1880. *Vesperugo (Vesperus) serotinus, Sous-espèce A, Vesperus isabellinus:* Dobson, Bull. Soc. zool. France, 5: 234. (Name Combination)

1885. *Vesperugo serotinus isabellinus:* Lataste, Act. Soc. Linn. Bordeaux, 39: 189. (Name Combination)

1887. *Vesperugo isabellinus:* Lataste, Catalogue critique des Mammifé apélagiques sauvages de Tunisie, 2. Publication date: 1887. (Name Combination)
1897. *[Vesperugo (Vesperus) serotinus] Var. Gabonensis* Trouessart, Catalogus Mammalium tam viventium quam fossilium, nov. ed 1, 1: 108. Publication date: 1897. Type locality: Gabon: "Gaboon" [Goto Description]. Holotype: BMNH 1873.4.16.19:. - Comments: The type specimen came allegedly from 'Gabon', Africa, but actually is almost certainly from Kashmir or N India (see Hayman and Hill, 1971: 44; Ibáñez and Valverde, 1985; Corbet and Hill, 1992: 131). However, see also Grubb (2004: 92); who indicates that Gabon might not be rejected. Based on *V. s.* var. *a* of Dobson, 1878: 192 (see Corbet and Hill, 1992: 131). Considered a subspecies by Corbet and Hill (1992), but not attributable to any subspecies according to Simmons (2005). Grubb (2004: 92) indicates it might be a junior synonym of *pachyomus* or a senior synonym of *platyops*.
1904. *Vespertilio Boscai* Cabrera, Mem. Soc. Esp. Hist. Nat., 2: 265, pl. 3, figs. 5, 6, 8. Type locality: Spain: Alicante, Muchamiel.
1905. *Vespertilio (Eptesicus) serotinus isabellinus:* Trouessart, Caus. sci. Soc. zool. France, 1 (10): 369. (Name Combination)
1905. *Vespertilio (Eptesicus) serotinus:* Trouessart, Caus. sci. Soc. zool. France, 1 (10): ???. (Name Combination)
1909. *Eptesicus serotinus isabellinus:* Satunin, Mitt. Kauk. Mus., 4: 297. - Comments: However, this is not *isabellinus* Temminck, 1835-1841, but *isabellinus* Blyth, 1851. (Name Combination)
1937. *Eptesicus isabellinus:* Laurent, Mammalia, 1: 153. (Name Combination, Current Combination)
1938. *[Eptesics] serotinus gaboensis:* Frechkop, Exploration du Parc National Albert, 52. (Lapsus)
1939. *Eptesicus serotinus gabonensis:* Allen, Bull. Mus. comp. Zool., 83: 87. (Name Combination)
1939. *Eptesicus serotinus isabellinus:* G.M. Allen, Bull. Mus. comp. Zool., 83: 87. - Comments: First use for *isabellinus* Temminck, 1835-1841. (Name Combination)
1942. *Eptesicus [(Eptesicus)] isabellinus:* Tate, Bull. Am. Mus. Nat. Hist., 80: 275. (Name Combination)
1951. *Eptesicus isabellinus isabellinus:* Ellerman and Morrison-Scott, 156. (Name Combination)
1962. *E[ptesicus] gabonensis:* Basilio, La vida animal en la Guinea Española, 182. (Name Combination)
1971. *Eptesicus (Eptesicus) serotinus isabellinus:* Hayman and Hill, Mammals of Africa: Chiroptera, 44. (Name Combination)
2013. *Eptesicus isabellinus boscai:* Juste, Benda, Garcia-Mudarra, and Ibáñez, Zool. Scr., 42 (5): 447. Publication date: 19 May 2013. (Name Combination)
? *Eptesicus (Amblyotus) isabellinus:* (Name Combination)
? *Eptesicus serotinus boscai:* (Name Combination)

TAXONOMY:
Recent genetic studies (Ibañez *et al.*, 2006; Mayer *et al.*, 2007; García-Mudarra *et al.*, 2009) support the specific status of this serotine which occurs sympatrically with *E. serotinus* in the Iberian Peninsula.

Le Berre (1990: 102) considers *Eptesicus isabellinus* to be a synonym of *Eptesicus bottae* (see also comments under that species).

The study of five nuclear genes and the mitochondrial cytochrome *b* gene led Artyushin *et al.* (2018: 471) to the conclusion that *E. serotinus* and *E. isabellinus* form a monophyletic clade, but with significant genetic differences, which confirm the species status of the later taxon.

The status of *gabonensis* still remains unclear. Although originally described by Trouessart (1897: 108) from Gabon, Hayman and Hill (1971: 44) and Ibáñez and Valverde (1985: 242) suggest it almost certainly originated from Kashmir or Northern India. Kock (1969a: 162) considered it to be senior synonym of *Eptesicus platyops*, which is supported by Grubb (2004: 92), who discussed this in detail (and who indicates that Gabon might not be rejected as country of origin). Pending further analyses, we retain *gabonensis* in the synonymy of *Eptesicus isabellinus*.

COMMON NAMES:
Albanian: Serotinë Isabeline. Armenian: Իզաբելլայի մաշկեղ. Azerbaijani: İzabel gönlücə. Basque: Baratze-saguzar isabeldar. Belarusian: Кажан ізабэлавы. Bosnian: Izabelin šišmiš.

Breton: Serotin melenwenn. Bulgarian: Изабелинов прилеп. Castilian: Murciélago hortelano pardo, Murciélago hortelano mediterráneo. Catalan: Ratpenat dels graners meridional. Croatian: Izabelin noćnjak. Czech: Netopýr tripolitánský. Danish: Isabellasydflagermus. Dutch: Isabelvleermuis. English: Isabelline Serotine Bat, Meridional serotine. Estonian: Ibeeria nahkhiir. Finnish: Vaaleaetelänlepakko. French: Sérotine isabelle, Vespertilion isabelle, Sérotine isabelline. Frisian: Isabelkleurde lette flearmûs. Galician: Morcego das hortas meridional. Georgian: ტყის მეგვიანე. German: Isabellfledermaus, Isabell-Breitflügelfledermaus, isabellfarbenen Abendfledermaus. Greek: Ωχρή τρανονυχτερίδα. Hungarian: Izabella-késeidenevér. Irish Gaelic: Ialtóg isibéalach. Italian: Serotino isabellino. Latvian: Izabellas sikspā rnis. Lithuanian: Izabelos šikšnys. Luxembourgish: Isabel-Fliedermaus. Macedonian: Изабелов лилјак. Maltese: Serotin tas-Sider Pallidu. Montenegrin: Kraljičin slijepi miš. Norwegian: Isabellaflaggermus. Polish: Mroczek pustynny. Portuguese: Morcego-hortelão-claro. Rhaeto-Romance: Serotin isabellin. Romanian: Liliacul cu aripi late mediteranean. Russian: Кожан изабелловый. Serbian: Магребски поноћњак [= Magrebski ponoć njak]. Scottish Gaelic: Ialtag isibealach. Slovak: večernica tripolitánska. Slovenian: Kraljičin poznik. Swedish: Isabellfladdermus. Turkish: Izabel Geniş kanatlı Yarasası. Ukrainian: Лилик ізабеліновий. Welsh: Ystlum adain-lydan llwydfelyn.

SIMILAR SPECIES:
Santos *et al.* (2014: 158) indicate that *E. isabellinus* and *E. serotinus* have an extensive niche overlap, indicating that they explore very similar conditions. Each species thrives in a specific biogeographical zone, *E. serotinus* in Atlantic climates and *E. isabellinus* in Mediterranean areas, but considering the large niche overlap it is quite possible that competition may occur if prey resources are limited in contact zones.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Gunnell *et al.* (2015a: 13) report on a right distal humerus from the Olduvai Gorge (Tanzania), which they assigned to cf. *E. isabellinus*.

CONSERVATION STATUS:
Global - Assessed as as part of *Eptesicus serotinus* which is very widespread (most of Europe) and abundant species. Global and regional population trends are difficult to determine, as the species is decreasing in some range states (sometimes dramatically) whilst increasing in others. Overall, it is not believed to approach the threshold for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, it is evaluated as Least Concern (LC ver 3.1, 2001; Hutson *et al.*, 2008h; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [as part of *Eptesicus serotinus*] (Hutson *et al.*, 2008h; IUCN, 2009).

MAJOR THREATS:
Sherwin *et al.* (2012: 174) report the aerial hawking feeding style and the long-distance disperal of *E. serotinus* in Europe and NW Africa to be important risk factors related to climatic change.

CONSERVATION ACTIONS:
No specific conservation actions known (Hutson *et al.*, 2008h; IUCN, 2009).

GENERAL DISTRIBUTION:
Eptesicus isabellinus has been recorded from North Africa and the Iberian Peninsula.

Native: Algeria; Libya; Morocco (Benda *et al.*, 2010a: 157; El Ibrahimi and Rguibi Idrissi, 2015: 363 [as "*Eptesicus serotinus (= E. isabellinus)*"]); Portugal; Spain; Tunisia (Dalhoumi *et al.*, 2014: 53; 2016b: 867).

GEOGRAPHIC VARIATION:
The populations from the Iberian Peninsula, Morocco and western Algeria are assigned to *E. isabellinus boscai* by Juste *et al.* (2013: 443), whereas those from the remaining part of Algeria, Tunisia and western Libya are assigned to *E. i. isabellinus*. However, they do indicate (p. 450) that the specimens from western Libya seem to form a supported, separate clade.

SEXUAL DIMORPHISM:
In a year-round study in Tunisia, Dalhoumi *et al.* (2016a: 157) found adult females to be significantly heavier than males.

ECHOLOCATION:
Benda *et al.* (2010a: 163) report for 23 Moroccan specimens a start frequency of 35.1 ± 1.0 (33.7 - 36.3) kHz, a maximum energy frequency of 26.9 ± 0.7 (25.8 - 28.3) kHz, an end frequency of 23.3 ± 0.8 (22.4 - 24.2), with a duration of 9.7 ± 2.8 (5.6 - 16.3) ms, and an inter-pulse interval of 244.2 ± 66.7 (128.5 - 362.7) msec.

Also from Morocco, Disca *et al.* (2014: 226) indicate that the type of call is FM-QFC, with the following parameters: F_{start}: 42.3 ± 13.0 kHz, F_{end}:

25.3 ± 1.5 kHz, F_{peak}: 27.4 ± 2.2 kHz, bandwidth: 17.0 ± 11.6 kHz, duration: 11.5 ± 3.0 msec.

In Tunisia, Dalhoumi *et al.* (2016b: 867; 2017b: 143) reported FM/QCF calls with a short constant frequency at 18.5 - 27.1 kHz and maximum energy at 21.7 - 30.3 kHz (25.3 ± 2.0 kHz).

MOLECULAR BIOLOGY:
DNA - See Ibañez *et al.* (2006), Mayer *et al.* (2007), García-Mudarra *et al.* (2009), Juste *et al.* (2009).
Karyotype - Baker *et al.* (1974) reported 2n = 50, aFN = 48, X = submetacentric for specimens from Tunisia.
Protein / allozyme - Unknown.

HABITAT:
In the Iberian Peninsula, Lisón *et al.* (2014: 59) found that *E. isabellinus* is primarily found near water courses, scrublands, and zones with high primary productivity. Non-irrigated croplands are avoided, and no preferences were found for human settlements or irrigated croplands. The preference for water bodies was also confirmed in Tunisia by Dalhoumi *et al.* (2017b: 149).

HABITS:
In Spain, Lisón and Calvo (2014: 99) found that the activity of this species increases with high temperatures, showing the highest activity in June.

ROOST:
Benda *et al.* (2014c: 46) reported solitary males to roost in the ruined Roman town of Leptis Magna (Libya), and additional specimens were found in fissures in ceilings and walls of other ruins. Kelm *et al.* (2015: 27) indicate that this species' roosts are mostly found in anthropogenic structures. Dalhoumi *et al.* (2017b: 142) also mentions rock crevices, tree holes and bridges.

DIET:
Benda *et al.* (2014c: 51) examined four sets of faecal pellets and three digestive tracts from Libya *E. isabellinus* and found primarily ants (Hymenoptera: Formicoidea) and beetles (Coleoptera: mostly Scarabaeidae and Cerambycidae, but also Carabidae, Curculionidae, Staphylinidae, and Tenebrionidae). A set of five pellets from one animal was dominated by moths (Lepidoptera).

POPULATION:
Structure and Density - *Eptesicus isabellinus* is the most common bat species in northwest Algeria and Libya (Hutson *et al.*, 2008h; IUCN, 2009).
Trend - 2008 - Unknown [as part of *E. serotinus* (Hutson *et al.*, 2008h; IUCN, 2009)].

LIFESPAN:
In southern Spain, Papadatou *et al.* (2010: 925) followed six colonies over a period varying between 8 and 26 years and found a mean annual survival probability of 0.71.

REPRODUCTION AND ONTOGENY:
Baker *et al.* (1974: 701) mentions four lactating females collected on 5 June 1973. In Tunisia, Dalhoumi *et al.* (2017b: 141) captured pregnant females from April to June (one even in August) and lactating females from May to June.

Benda *et al.* (2014c: 48) refer to a record of two juvenile females made by Hanák and Elgadi (1984) in the spring of 1978 from Janzur (Libya), and to a non-volant juvenile they observed at Sabratha on 28 May 2002.

PARASITES:
Benda *et al.* (2014c: 52) reported the following parasites from Libya:
Argasidae: *Argas vespertilionis* (Latreille, 1802),
Ischnopsyllidae: *Ischnopsyllus intermedius* (Rothschild, 1898)

From Algeria, Bendjeddou *et al.* (2013: 325) reported the Nycteribiid *Phthiridium biarticulatum* Hermann, 1804 from "*E. serotinus*": Bendjeddou *et al.* (2017: 15) added the following species: Siphonaptera:*Nycteridopsylla longiceps* Rothschild, 1908, *Ischnopsyllus intermedius* (Rothschild, 1898); Heteroptera: *Cimex pipistrelli* Jenyns, 1839, *Cacodmus vicinus* Horváth, 1934; Arachnida: *Argas transgariepinus* White, 1846.

VIRUSES:
Coronaviridae - Coronaviruses
Betacoronavirus
Kohl and Kurth (2014: 3112) reported this virus from Spain.

Papillomaviridae – Papillomaviruses
García-Pérez *et al.* (2014: 100) pointed out that there is no strict species specificity in papillomaviruses as they found DNA from EserPV2 and EserPV3 in pharyngeal swaps of both *Eptesicus serotinus* and *E. isabellinus*.

Rhabdoviridae
"Various European bat lyssaviruses" were reported from various European countries by Kohl and Kurth (2014: 3114).

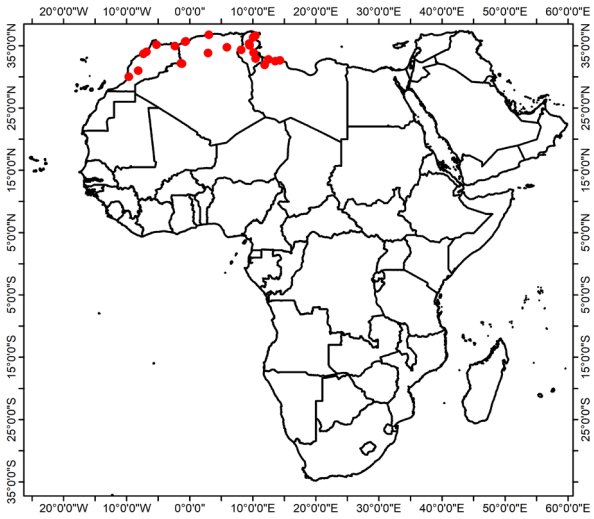


Figure 277. Distribution of *Eptesicus isabellinus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Libya, Morocco, Tunisia.

Eptesicus platyops (Thomas, 1901)

*1901. *Vespertilio platyops* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 31. Publication date: 1 July 1901. Type locality: Nigeria: Western region: Lagos [06 27 N 03 23 E] [Goto Description]. Holotype: BMNH 1888.5.17.3: ad ♀, skull and alcoholic. Presented/Donated by: George Edward Dobson. - Etymology: From the Greek "*platyops*" for broad-faced or flat-faced.

1939. *Eptesicus platyops:* G.M. Allen, Bull. Mus. comp. Zool., 83: 86. (Name Combination, Current Combination)

1969. *Eptesicus serotinus platyops:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 214. (Name Combination)

1980. *Eptesicus (Eptesicus) platyops:* Corbet and Hill, A world list of mammalian species, 69. (Name Combination)

1994. *E[ptesicus (Eptesicus)] s[erotinus] platyops:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 120. (Name Combination)

TAXONOMY:
Considered a subspecies of *E. serotinus* by Ibáñez and Valverde (1985) and Koopman (1994: 120), but no comparison with *E. bottae* was made.

COMMON NAMES:
Czech: netopýr nigerijský. English: Lagos Serotine Bat, Flat-faced Serotine Bat, Lagos Serotine. French: Sérotine à grands yeux, Sérotine de Lagos. German: Lagos-Breitflügelfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Schlitter, 2008a; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Schlitter, 2008a; IUCN, 2009). 2004 - DD ver 3.1 (2001) (IUCN, 2004; Schlitter, 2004e). 1996 - VU (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not known (Schlitter, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008a) [in IUCN (2009)] reports that it is not known if the species is present in any protected areas and additional surveys are needed to try to locate and study a population of this species.

GENERAL DISTRIBUTION:
Eptesicus platyops is a poorly known West African species known only from a few specimens. It is known from the type locality at Lagos in Nigeria, from specimens from the island of Bioko (Equatorial Guinea) (although these specimens may not have originated on Bioko) and from an unspecified locality in Senegal (Schlitter, 2008a). Senegal specimens were collected around 1900 (Happold, 1987).

Native: Nigeria (Happold, 1987).

Presence uncertain: Equatorial Guinea [= Bioko]; Senegal (Happold, 1987).

POPULATION:
Structure and Density - There is no good information on the population abundance or size of this bat (Schlitter, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Schlitter, 2008a; IUCN, 2009).

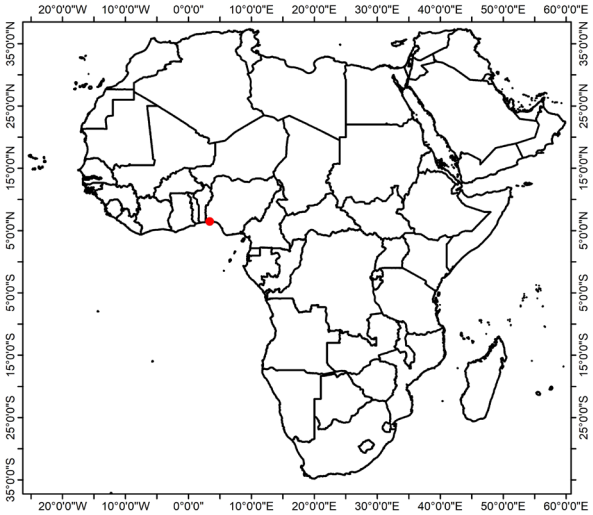


Figure 278. Distribution of *Eptesicus platyops*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Nigeria, Senegal.

Genus ***Glauconycteris*** Dobson, 1875

1867. *Chalinolobus* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 1866: 680. - Comments: in part. Type species: *Vespertilio tuberculatus* Forster, 1844 [= *Chalinolobus tuberculatus* (Forster, 1844: 62)], by monotypy (see Jackson and Groves, 2015: 271).

*1875. *Glauconycteris* Dobson, Proc. zool. Soc. Lond., 1875, III: 383. Publication date: October 1875. - Comments: Type species: *Kerivoula poensis* Gray, 1842. - Etymology: From the Greek "*γλαυκός*", meaning gray and "*γλαυκός*", meaning bat, referring to the fur, which is light gray or cream-colored at the tips (see Palmer, 1904: 295). Rambaldini (2010: 252) indicates that the Greek "glaucos" means bluish gray. Lanza *et al.* (2015: 349) indicate that the first part of the name is a feminine Latin adjective *glàuca*, meaning "glaucous, blue-green". (Current Combination)

2013. *Niumbaha* Reeder, Helgen, Vodzak, Lunde and Ejotre [Goto Description]. - ZooBank: EDF16BEE-0749-41BC-AE19-BAE130BE58F8.

TAXONOMY:
Bronner *et al.* (2003) state that although occasionally treated as a subgenus of *Chalinolobus* (Koopman, 1971; Swanepoel *et al.*, 1980; Koopman, 1982; Meester *et al.*, 1986; Koopman, 1993a; Taylor, 1998: 49; Wilson and Cole, 2000), *Glauconycteris* has often been considered as a distinct genus (Allen, 1939a; Roberts, 1951; Ellerman *et al.*, 1953; Hayman and Hill, 1971; Corbet and Hill, 1980, 1992). Despite some superficial cranial resemblance, the marked difference in baculum morphology (Hill and Harrison, 1987) and karyotypic properties (Rautenbach *et al.*, 1993). Ansell and Dowsett (1988), Volleth and Heller (1994) and Eger and Schlitter (2001: 1) support the recognition of these taxa as discrete genera (N. Simmons in litt.). *Glauconycteris* is thus represented in the southern African subregion by a single species, *G. variegata* (butterfly bat), while *Chalinolobus* is extralimital (Australia).

Hassanin *et al.* (2017: 1) analysed the *Cytb* and RAG2 data of the various members of this genus and distinguished three lineage in the small sized species: the "*poensis*" (*G. poensis, G. alboguttata, G. argentata* and *G. egeria*); the "*beatrix*" group (*G. beatrix* and *G. curryae*); and the "*humeralis*" group (*G. humeralis* and *G. atra*).

Known species of the genus *Glauconycteris*: ***alboguttata*** J. A. Allen, 1917; ***argentata*** (Dobson, 1875); ***beatrix*** Thomas, 1901; ***curryae*** Eger and Schlitter, 2001; ***egeria*** Thomas, 1913; ***gleni*** Peterson and Smith, 1973; ***humeralis*** J. A. Allen, 1917; ***kenyacola*** Peterson, 1982; ***machadoi*** Hayman, 1963; ***poensis*** (Gray, 1842); ***superba*** Hayman, 1939; ***variegata*** (Tomes, 1861).

COMMON NAMES:
Czech: motýlí netopýři. English: Butterfly Bats, Lobe-lipped Bats, Silvered Bats, Blue-grey Bats, Dobson's Bats, Glauconycterids. French: Glauconyctères, Murins à bajoues. German:

Schmetterlingsfledermäuse. Italian: Glauconittèridi. Glauconictèridi.

Glauconycteris alboguttata J.A. Allen, 1917

*1917. *Glauconycteris alboguttatus* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 449, text-fig. 7 B. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Medje [02 25 N 27 18 E, 800 m] [Goto Description]. Holotype: AMNH 49317: ad ♀, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 14 March 1914; original number: 2351. - Etymology: From the Latin "*alboguttata*" meaning white spotted.
? *Chalinolobus alboguttatus:* (Name Combination)
? *Glauconycteris alboguttata:* (Current Combination, Current Spelling)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: netopýr pruhovaný. English: Allen's Butterfly Bat, Striped Butterfly Bat, White-spotted Butterfly Bat, Allen's Striped Bat. French: Glauconyctère à gorge blanche, Murin à bajoues d'Allen, Barbastelle d'Allen. German: Gestreifte Schmetterlingsfledermaus.

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution (that is likely to be even wider than is currently known), extensive available habitat, presumed large overall population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008c; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008c; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004e; IUCN, 2004). 1996 - VU [assessed as *Chalinolobus alboguttatus*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are poorly known (Jacobs *et al.*, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008c) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed into the species distribution, natural history and threats.

GENERAL DISTRIBUTION:
Glauconycteris alboguttata is distributed in Central Africa where it has been recorded from Cameroon and the Democratic Republic of the Congo. The range is poorly known, and it may be distributed more widely (Jacobs *et al.*, 2008c).

Native: Cameroon; Congo (Bates *et al.*, 2013: 323 - 1st record); Congo (The Democratic Republic of the).

HABITAT:
This species is associated with lowland tropical moist forest (Jacobs *et al.*, 2008c).

POPULATION:
Structure and Density - It is generally considered to be rare, however, there have been few recent surveys within the species range (Jacobs *et al.*, 2008c; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008c; IUCN, 2009).

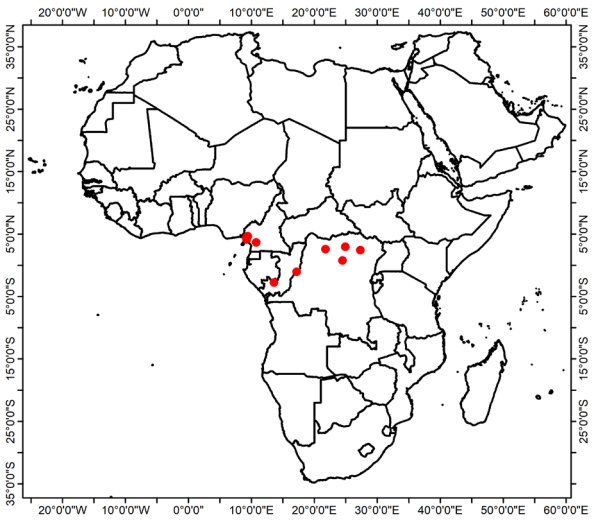


Figure 279. Distribution of *Glauconycteris alboguttata*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo, Congo (Democratic Republic of the).

Glauconycteris argentata (Dobson, 1875)

*1875. *Chalinolobus argentatus* Dobson, Proc. zool. Soc. Lond., 1875, III: 385. Publication date: October 1875. Type locality: Cameroon: Western province: Mount Cameroon [04 13 N 09 11 E] [Goto Description]. Holotype: BMNH 1871.7.10.5: ad ♀, alcoholic (skull not removed). Purchased (see Dobson (1878: 254). - Etymology: From the feminine Latin adjective *argentàta*, meaning "silvery", referring to the "beautiful dark silvery gray" (Dobson, 1875c: 386) of the terminal third of the dorsal hairs (see Lanza *et al.*, 2015: 351).

1889. *Chalinolobus congicus* Noack, Zool. Jb. Syst., 4: 223, pl. 2, fig 1; pl. 5, fig 66 - 68. Publication date: 28 February 1889. Type locality: Congo (Democratic Republic of the): Bas Congo province: near mouth of Congo River, Banana Creek: Netonna [05 58 S 12 27 E] [Goto Description]. Lectotype: SMF 2516: ad ♂, skull only. Collected by: P. Hesse. Mertens (1925: 22) considers this specimen to be a lectotype rather than "the" type. Paralectotype: SMF 11850: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 11851: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 11852: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 11853: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 11854: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 11855: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 2517: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 2518: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 2519: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 2520: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 2521: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. Paralectotype: SMF 2522: Collected by: P. Hesse. Presented/Donated by: ?: Collector Unknown. - Comments: Noack (1889: 22) refers to 8 specimens in alcohol 4 ♂♂ and 4 ♀♀, collected in April - May, by P. Hesse).

? *Glauconycteris argentata:* (Name Combination, Current Combination, Current Spelling)

? *Glauconycteris argentatus:* (Name Combination, Alternate Spelling)

TAXONOMY:
See Simmons (2005).

Monadjem *et al.* (2016y: 368) collected a *Glauconycteris* specimen in the Mount Nimba area, which looked very similar to this species in measurements and colouration but differed from it by the colouration of its wings (not pale). They also indicated that as *G. argentata* has not been found west of Cameroon, their specimen might represent an undescribed species. Tentatively, they assigned their specimen to *G.* cf. *argentata*.

COMMON NAMES:

Chinese: 银彩蝠. Czech: netopýr stříbrný. English: Common Butterfly Bat, Silvery Butterfly Bat, Silvered Butterfly Bat, Silvered Bat. French: Glauconyctère argentée, Murin à bajoues argenté, Barbastelle argentée. German: Silberne Schmetterlingsfledermaus. Italian: Glauconitterìde argentàta, Glauconicterìde argentàta.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008d; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008d; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004g; IUCN, 2004). 1996 - LR/lc [assessed as part of *Chalinolobus argentatus*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
Glauconycteris argentata is threatened in the western and eastern parts of its range by deforestation resulting from logging activities, and the conversion of land to agricultural use (Jacobs *et al.*, 2008d; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008d) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further studies are needed into the distribution, natural history and threats to this little recorded species.

GENERAL DISTRIBUTION:
Glauconycteris argentata is widespread in Central and East Africa. It ranges from Cameroon and Equatorial Guinea (Rio Muni), into the Democratic Republic of the Congo, Rwanda, Burundi, Uganda, Kenya, Tanzania and possibly northern Malawi, with the southernmost record from northwestern Angola. The range is not well-known, and the species is expected to be distributed more widely than is currently known.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 562); Burundi (Hayman *et al.*, 1966); Cameroon; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 562); Equatorial Guinea (Jones, 1971); Gabon (1st record: Peereboom *et al.*, 2012 3); Kenya (Aggundey and Schlitter, 1984); Malawi (Ansell and Dowsett, 1988: 39; Monadjem *et al.*, 2010d: 562); Rwanda (Baeten *et al.*, 1984); Tanzania (Stanley and Goodman, 2011: 43).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

ECHOLOCATION:
Peereboom *et al.* (2012: 4) report the following values: F_{min}: 28.42 - 34.45 (31.59 ± 1.48) kHz; F_{max}: 77.95 - 101.60 (89.16 ± 7.11) kHz, F_{peak}: 40.26 - 47.14 (43.96 ± 1.8) kHz, duration: 2.0 - 3.0 (2.4 ± 0.31) msec; first harm: 81.82 - 104.60 (94.04 ± 8.55), and interpulse interval: 24 - 128 (55 ± 34) msec.

From Kenya, López-Baucells *et al.* (2017: 24) reported some different values: F_{min}: 16.32 - 40.62 (35.20 ± 3.11) kHz, F_{max}: 41.37 - 75.09 (56.45 ± 9.40) kHz, F_{peak}: 36.19 - 44.77 (40.38 ± 1.68) kHz, duration: 0.7 - 8.52 (4.03 ± 1.86) msec, slope: -48.51 - -0.69 (-5.28 ± 6.19) kHz/ms.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Unknown.
Protein / allozyme - Unknown.

HABITAT:
Recorded from lowland tropical moist forest and moist savanna habitats.

ROOST:
At Uzungwa Scarp Forest Reserve, Tanzania, Trentin and Rovero (2011: 51) reported a group of 10 females and their young to roost underneath the leaves of palm trees.

POPULATION:
Structure and Density - This is a rarely recorded, poorly known species (Jacobs *et al.*, 2008d; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008d; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Trentin and Rovero (2011: 51) observed about 10 adult females with young in December 2005 at Uzungwa Scarp Forest Reserve, Tanzania.

VIRUSES:
Phenuiviridae
Phlebovirus
de Jong *et al.* (2011: 11), Luis *et al.* (2013: Suppl.), and Willoughby *et al.* (2017: Suppl.) report the occurrence of Rift Valley fever virus.

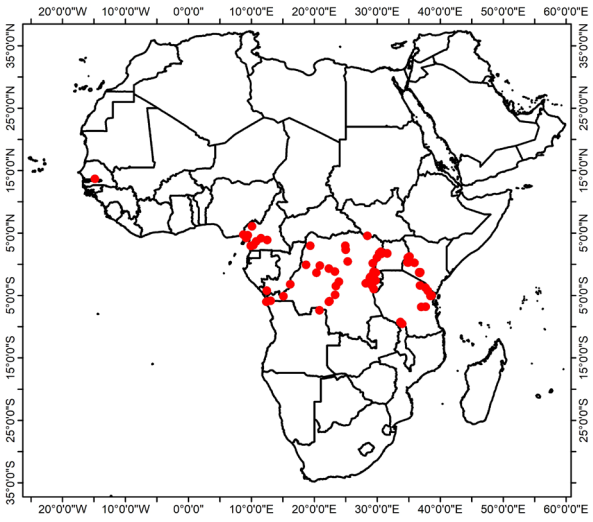


Figure 280. Distribution of *Glauconycteris argentata*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Burundi, Cameroon, Congo, Congo (Democratic Republic of the), Kenya, Rwanda, South Sudan, Tanzania, The Gambia, Uganda.

Glauconycteris atra Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, 2017

*2017. *Glauconycteris atra* Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, J. Zool. Syst. Evol. Res., xxx (x): 6, fig. 2. Publication date: 22 August 2017. Type locality: Congo (Democratic Republic of the): Tshopo province: Yaengo [00 20 56 N 24 28 55 E, 400 m] [Goto Description]. Holotype: MNHN ZM-2016-2792: ad ♀, skull and alcoholic. Collected by: Alexandre Hassanin, Guy-Crispin Gembu Tungaluna, Prescott Musaba Akawa, Raphaël Colombo, Tamás Görföl and

Vuong Tam Tu; collection date: 5 December 2013; original number: K13-215. Presented/Donated by: ?: Collector Unknown. - Etymology: Atra refers to the colour of the pelage, which is dark and gloomy (blackish brown) (see Hassanin *et al.*, 2017: 6).

COMMON NAMES:
English: Blackish Butterfly Bat. French: Glauconyctère sombre. German: Dunkle Schmetterlingsfledermaus.

GENERAL DISTRIBUTION:
Known only from three localities in the riparian zone on the left bank of the Congo River (DRC).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the).

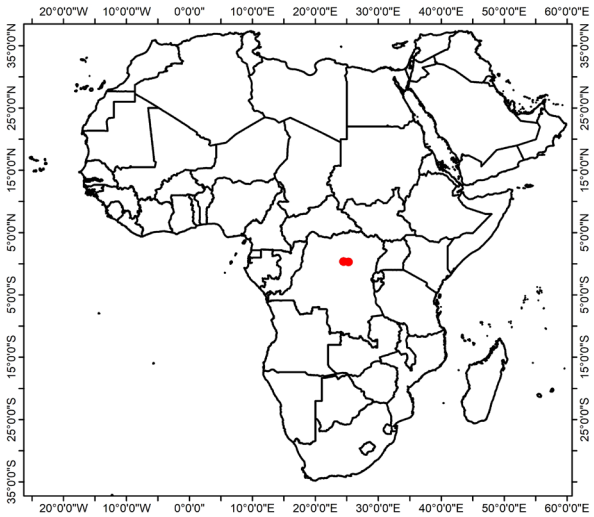


Figure 281. Distribution of *Glauconycteris atra*

Glauconycteris beatrix Thomas, 1901

*1901. *Glauconycteris beatrix* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (45): 256. Publication date: 1 September 1901 [Goto Description]. Holotype: BMNH 1898.5.4.19: ♀. Collected by: George Latimer Bates Esq. Collection date: January 1898. - Comments: Equatoria Guinea: Rio Muni, Benito River, 15 mi. (24 km) from mouth. (Grubb *et al.* (1998: 89) mention "Benito River, French Congo, fifteen miles from mouth [Mbini River, in Equatorial Guinea]". (Current Combination)

1998. *Glauconycteris beatrix beatrix:* Grubb, Jones, Davies, Edberg, Starin and Hill, Mammals of Ghana, Sierra Leone and The Gambia, 89.

? *Chalinolobus beatrix:* (Name Combination)

TAXONOMY:
Koopman (1993a: 199) included *humeralis*; see Koopman (1971: 7, 8), but see Simmons (2005).

COMMON NAMES:
Czech: netopýr rovníkový. English: Beatrix Bufferfly Bat, Beatrix's Bat. French: Glauconyctère de Béatrix, Murin à bajoues de Béatrice, Barbastelle de Béatrix. German: Kleine Schmetterlingsfledermaus. Spanish (Castillian): Murciélago Mariposa.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1, 2001) in view of its wide distribution, presumed large population (especially in Central Africa), and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008e; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Jacobs *et al.*, 2004f; IUCN, 2004). 1996 - LR/nt [assessed as *Chalinolobus beatrix*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is threatened by general habitat loss, often resulting from logging activities and the conversion of land to agricultural use (Jacobs *et al.*, 2008e; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008e) [in IUCN (2009)] suggest that this species has been recorded from a number of protected areas and further studies are needed into the distribution, natural history and threats to this little-known bat.

GENERAL DISTRIBUTION:
Glauconycteris beatrix is distributed in West and Central Africa. It ranges from Côte d'Ivoire in the west, through Ghana and Nigeria to Cameroon and Equatorial Guinea (Rio Muni and Bioko), with scattered records from Gabon, Central African

Republic, Angola and the Democratic Republic of the Congo.

Native: Angola (Eger and Schlitter, 2001; Monadjem *et al.*, 2010d: 562); Cameroon; Central African Republic (Heller *et al.*, 1994; Lunde *et al.*, 2001: 537); Congo (Bates *et al.*, 2013: 324 - 1st authenticated record); Congo (The Democratic Republic of the) (Monadjem *et al.*, 2010d: 562); Côte d'Ivoire; Equatorial Guinea; Gabon; Ghana; Guinea-Bissau (Rainho and Ranco, 2001: 69); Nigeria (Happold, 1987).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Sanborn (1953: 166) reports a male specimen, collected in Gabon, which looks very similar to the description of *G. beatrix*, but has a small tuft of white hairs on each shoulder, but he also indicates that this character is sometimes variable, as was already mentioned by Hayman and Jones (1950: 762).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
In their study on the reversibility of the mandibular symphyseal fusion, Scott *et al.* (2012: 2943) mention that in this species the symphyse is unfused with smooth surfaces.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Heller *et al.* (1994: 6).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Volleth and Heller (2008) reported 2*n* = 22, FN = 40, only bi-armed chromosomes and an autosome-X translocation for a female from the Democratic Republic of Congo. Porter *et al.* (2010) report for Gabon 2*n* = 22, with all chromosomes being distinctly biarmed, with ten pairs are metacentric or slightly submetacentric and one pair (the smallest) is subtelocentric. 2 *n* = 22 was also reported by Volleth and Eick (2012: 167), who also mention a segment number of 24.
Protein / allozyme - Unknown.

HABITAT:
This species is generally associated with lowland tropical moist forest (Happold, 1987).

ROOST:
There appears to be little information available on the roosting habits of this species, but presumably it can be found within hollow trees and dense vegetation (Jacobs *et al.*, 2008e).

POPULATION:
Structure and Density - This appears to be a rare, or at least a rarely recorded, species (Jacobs *et al.*, 2008e; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008e; IUCN, 2009).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - One fecal sample, collected in Febuary 2008 in Ghana, tested negative for coronavirus (CoV) RNA (Pfefferle *et al.*, 2009).

Paramyxoviridae
Drexler *et al.* (2012a: Suppl. Table S1) indicated that the single specimen they examined from Ghana did not test positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

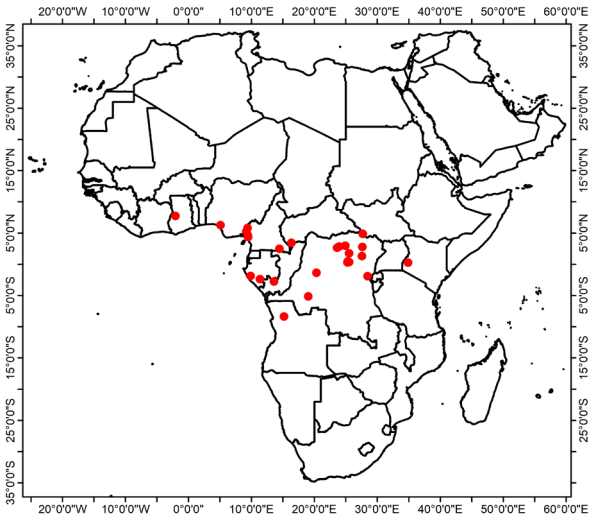


Figure 282. Distribution of *Glauconycteris beatrix*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Kenya, Nigeria, South Sudan, Uganda.

Glauconycteris cf. beatrix Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, 2017

2017. *G[lauconycteris] cf. beatrix:* Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, J. Zool. Syst. Evol. Res., xxx (x): 7. Publication date: 22 August 2017.

TAXONOMY:
In their study on the multilocus phylogeny of *Glauconycteris* specimens from the DRC, Hassanin *et al.* (2017: 7) found a number of specimens in the collection of the ROM that were identified as *G. beatrix* but scored very different in their analyses as compared to other specimens assigned to this species. Their scores were much more like those of *G. curryae*, which seemed to be related to the length of the tail and the skull profile. Their analyses of the mitochondrial tree (*CO1, Cytb* and *12S* genes), however, showed these specimens not to be directly related to either *beatrix* or *curryae*, but closer to *humeralis*. Further investigation is necessary to elucidate this problem.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Côte d'Ivoire.

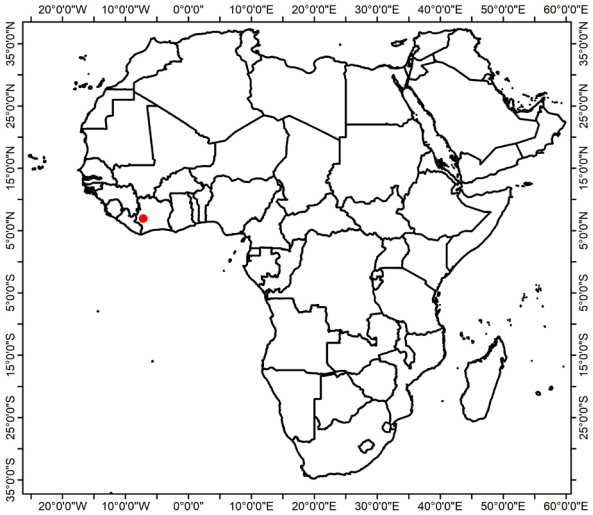


Figure 283. Distribution of *Glauconycteris* cf. *beatrix*

Glauconycteris cf. humeralis Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, 2017

2017. *G[lauconycteris] cf. humeralis:* Hassanin, Colombo, Gembu, Merle, Tu, Görföl, Musaba Akawa, Csorba, Kearney, Monadjem and Ing, J. Zool. Syst. Evol. Res., xxx (x): 6. Publication date: 22 August 2017.

TAXONOMY:
For their study on the multilocus phylogeny of *Glauconycteris* specimens from the DRC, Hassanin *et al.* (2017: 6) used data collected from two specimens from the Central African Republic, which were originally identified as *G. humeralis*. Their analyses indicated that these specimens were quite different from the other *humeralis* included and suggested that they might represent a new species. Unfortunately, however, these two animals were released after the biopsy was taken. Therefore, Hassanin *et al.* (2017: 16) did not describe this species as new.

Glauconycteris curryae Eger and Schlitter, 2001

2001. *Glauconycteris curryae:* Eger, Acta Chiropt., 3 (2): 248. (Current Combination, Emendation, Current Spelling)
*2001. *Glauconycteris curryi* Eger and Schlitter, Acta Chiropt., 3 (1): 2, figs 1 - 4. Type locality: Cameroon: Bipindi, 10 km W [03 05 N 10 25 E, ca. 300 m] [Goto Description]. Holotype: ROM 56243: ad ♀, skin and skull. Collected by: Randolph L. Peterson, Robert M. Glen and Philip Imbayi; collection date: 19 February 1970. Note: netted over a pool in a vast stand of bamboo, by a river (see Eger and Schlitter (2001: 2). - Etymology: Named in honour of Noreen Curry, in recognition of her interest in bats and her support of Royal Ontario Museum field research in Africa and bat education at the ROM (see Eger and Schlitter, 2001).
? *Chalinolobus curryi:*

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: netopýr konžský. English: Curry's Butterfly Bat, Curry's Bat. French: Glauconyctère de Curry. German: Currys Schmetterlingsfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) since it has only recently been described, and there is still very little information on its extent of occurrence, status, threats and ecological requirements (Schlitter, 2008b; IUCN, 2009).

Assessment History -

2008 - DD ver 3.1 (2001) (Schlitter, 2008b; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Schlitter, 2004f; IUCN, 2004).

MAJOR THREATS:
The threats to this species are not known (Schlitter, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008b) [in IUCN (2009)] suggests that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed into the distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Glauconycteris curryae is a Central African species, known only from southern Cameroon, Gabon and a single locality in the Democratic Republic of the Congo (Yalosemba North of the River).

Native: Cameroon; Congo (The Democratic Republic of the), Gabon.

HABITAT:
This species has been recorded from lowland tropical moist forest and swamp forest (Schlitter, 2008b).

POPULATION:
Structure and Density - Unknown (Schlitter, 2008b; IUCN, 2009).
Trend - 2008 - Unknown (Schlitter, 2008b; IUCN, 2009).

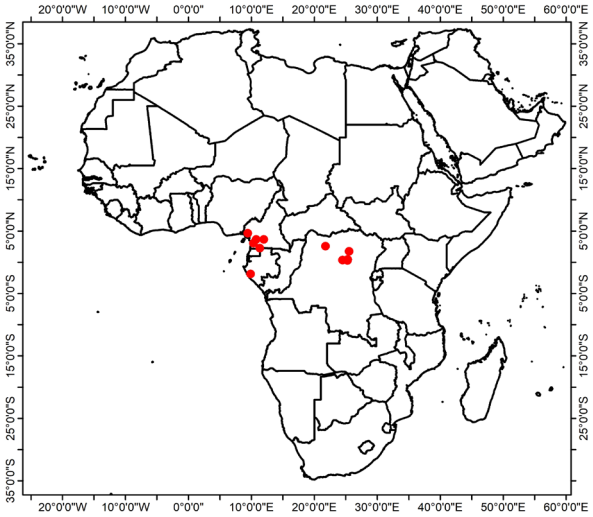


Figure 284. Distribution of *Glauconycteris curryae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Gabon.

Glauconycteris egeria Thomas, 1913

*1913. *Glauconycteris egeria* Thomas, Ann. Mag. nat. Hist., ser. 8, 11 (61): 144. Publication date: 1 January 1913. Type locality: Cameroon: Western province: Bibundi [04 15 N 08 58 E] [Goto Description]. Holotype: BMNH 1912.12.13.3: ♂. Original number: 22. Presented/Donated by: Prof. E. Lampe (Wiesbaden Museum). (Current Combination)
2015. *Chalinolo busegeria:* Carr et al., Ecosystem profile, 18. Publication date: 31 December 2015. (Lapsus)
? *Chalinolobus egeria:* (Name Combination)
? *Chalinolobus egerius:* (Name Combination)
? *G[lauconycteris] cf egeria:*

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: netopýr bibundinský. English: Bibundi Bufferfly Bat, Bibundi Bat. French: Glauconyctère de Bibundi, Murin à bajoues de Bibundi, Barbastelle du Bibundi. German: Bibundi Schmetterlingsfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Jacobs *et al.*, 2008f; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008f; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004n; IUCN, 2004). 1996 - LR/lc [concern assessed as *Chalinolobus egeria*] (Baillie and Groombridge, 1996: 137).

MAJOR THREATS:
The threats to this species are not known (Jacobs *et al.*, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008f) [in IUCN (2009)] report that it has been recorded from the Dzanga-Sangha Special Dense Forest Reserve in the Central

African Republic (Lunde *et al.*, 2001), and may be present in additional protected areas. Further field surveys are needed to better determine the distribution, natural history and possible threats to this little-known bat.

GENERAL DISTRIBUTION:
Currently only been recorded from three localities. The type locality is Bibundi in the Western Province of Cameroon (Thomas, 1913b); three individuals (as *G.* cf. *egeria*) were collected from Dzanga-Sangha Special Dense Forest Reserve in the Central African Republic (Lunde *et al.*, 2001); the species indicated as being present in western Uganda by Koopman (1993a: 199), although further details are needed of the collection site in this country (Jacobs *et al.*, 2008f; IUCN, 2009).

Native: Cameroon (Thomas, 1913b); Central African Republic (Lunde *et al.*, 2001).
Presence uncertain: Uganda (Koopman, 1993a; Simmons, 2005: 487).

HABITAT:
Lunde *et al.* (2001) recorded three specimens (allocated to *G.* cf. *egeria*) collected in dense secondary tropical lowland forest and along a forest road.

POPULATION:
Structure and Density - This species is known from very few specimens (Jacobs *et al.*, 2008f; IUCN, 2009).
Tend - 2008- Unknown (Jacobs *et al.*, 2008f; IUCN, 2009).

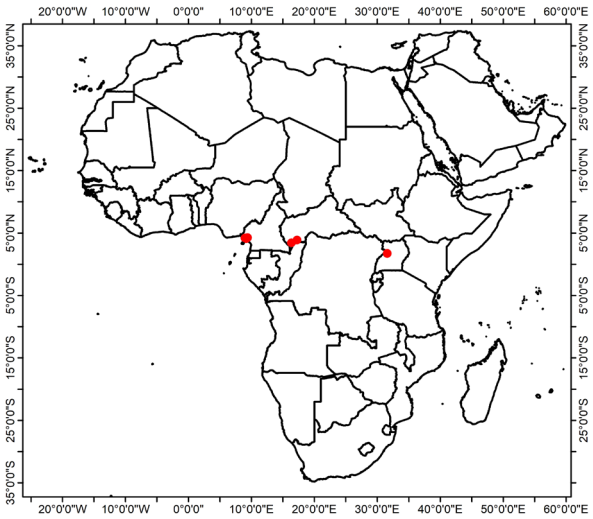


Figure 285. Distribution of *Glauconycteris egeria*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Central African Republic, Uganda.

Glauconycteris gleni Peterson and Smith, 1973

*1973. *Glauconycteris gleni* Peterson and Smith, Life Sci. Occ. Pap., R. Ont. Mus., 22: 3, figs 1 - 4. Publication date: 17 August 1973. Type locality: Cameroon: near Lomie [ca. 03 10 N 13 37 E] [Goto Description]. Holotype: ROM 57125: ad ♀, skin and skull. Collected by: Robert M. Glen and V.N. Ngam; collection date: 16 June 1970. - Etymology: In honour of Mr. Robert Glenn, Nairobi, Kenya, who collected the holotype, assisted in the collection of the Uganda series of the new species, and who has been a field companion extraordinaire. (see Peterson and Smith, 1973: 1). (Current Combination)
? *Chalinolobus gleni:* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: netopýr Glenův. English: Glen's Butterfly Bat, Glen's Wattled Bat. French: Glauconyctère de Glen, Murin à bajoues de Glen, Barbastelle de Glen. German: Glens Schmetterlingsfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Jacobs *et al.*, 2008g; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008g; IUCN, 2009). 2004 - VU D1 ver 3.1 (2001) (Jacobs *et al.*, 2004m; IUCN, 2004). 1996 - LR/nt [assessed as *Chalinolobus gleni*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
It is presumably threatened in parts of its range by logging and the conversion of forest habitat to agricultural use (Jacobs *et al.*, 2008g; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008g) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species. It is not known if the species is present within any protected areas. Additional studies are needed into the

distribution, abundance, general ecology and potential threats to this species.

GENERAL DISTRIBUTION:
Glauconycteris gleni is a poorly known species and has only been recorded from the three localities in Africa. The type locality 'near Lomie' in Cameroon, from a single site in western Uganda and Tanzania (1st record: Stanley and Foley, 2008: 119).

Native: Cameroon, Tanzania (Stanley and Foley, 2008: 119); Uganda.

HABITAT:
This poorly known bat is associated with lowland tropical moist forest.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Jacobs *et al.*, 2008g; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008g; IUCN, 2009).

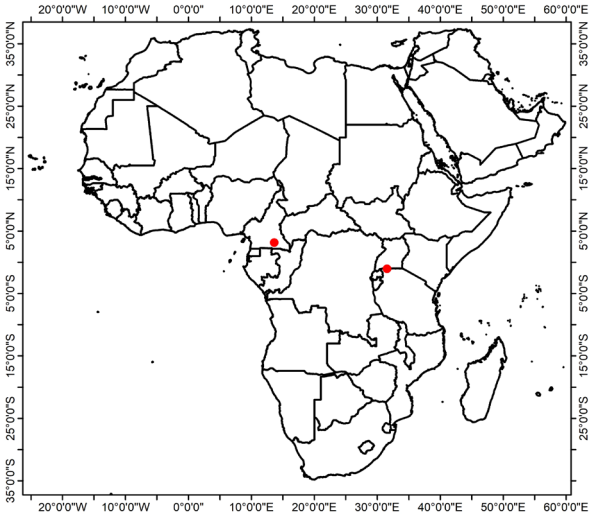


Figure 286. Distribution of *Glauconycteris gleni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Tanzania.

Glauconycteris humeralis J.A. Allen, 1917

*1917. *Glauconycteris humeralis* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 448, text-fig. 7 A. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Medje [02 25 N 27 18 E, 800 m] [Goto Description]. Holotype: AMNH 49013: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 7 September 1910; original number: 956. (Current Combination)
? *Chalinolobus humeralis:* (Name Combination)
? *Glauconycteris beatrix humeralis:* (Name Combination)

TAXONOMY:
Included in *beatrix* by Koopman (1993a: 199), considered a subspecies of *beatrix* by Eger and Schlitter (2001), but considered a valid species by Simmons (2005).

COMMON NAMES:
Chinese: 花蝶蝠. Czech: netopýr medžeský. English: Allen's Spotted Bat. French: Glauconyctère tachetée. German: Gefleckte Schmetterlingsfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Schlitter, 2008c; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Schlitter, 2008c; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Schlitter, 2004k; IUCN, 2004).

MAJOR THREATS:
The threats to this species are not known. It may be threatened within parts of its range by deforestation resulting from logging and mining activities, and the conversion of forest to farmland (Schlitter, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008c) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed into the distribution, natural history and threats to this poorly known forest species.

GENERAL DISTRIBUTION:
Native: Congo (The Democratic Republic of the) (Stephan *et al.*, 1987: 71; Heller *et al.*, 1994: 6; Eger and Schlitter, 2001: 7); Tanzania (Stanley and Foley, 2008: 119); Uganda.
Presence uncertain: Kenya (Aggundey and Schlitter, 1984).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Schlitter, 2008c; IUCN, 2009).
Trend - 2008 - Unknown (Schlitter, 2008c; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Congo (Democratic Republic of the), Kenya, Tanzania, Uganda.

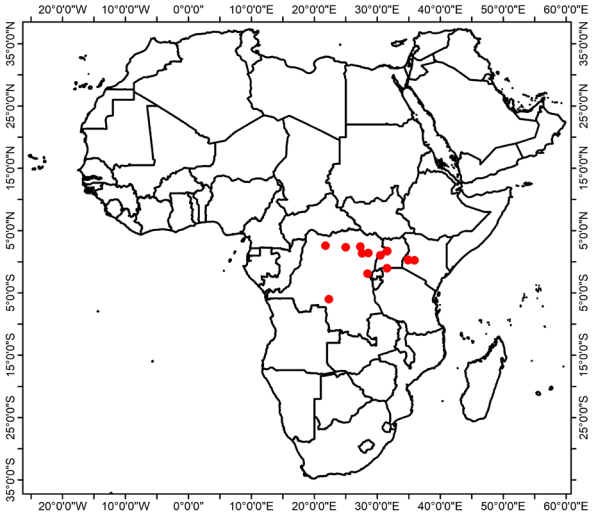


Figure 287. Distribution of *Glauconycteris humeralis*

Glauconycteris kenyacola Peterson, 1982

*1982. *Glauconycteris kenyacola* Peterson, Can. J. Zool., 60: 2521, figs 1 - 4. Type locality: Kenya: Coast province: on Galole road: Garsen, 8.5 km N [02 12 S 40 05 E] [Goto Description]. Holotype: ROM 71305: ad ♀, skin and skull. Collected by: Judith L. Eger and Robert M. Glen; collection date: 30 December 1970. - Etymology: From the geographical scientific Latin substantive *Kènya* and the Latin suffix -còla (-còla) "denoting one who inhabits", i.e. the species is an inhabitant of Kenya (see Peterson, 1982: 2522; Lanza *et al.*, 2015: 355. (Current Combination)
? *Chalinolobus kenyacola:* (Name Combination)
? *Chalinolobus kenyacolus (?):* (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Chinese: 肯尼亚蝶蝠. Czech: netopýr keňský. English: Kenyan Butterfly Bat, Kenyan Wattled Bat, Kenya Barbastelle. French: Glauconyctère du Kenya, Murin à bajoues du Kenya, Barbastelle du Kenya. German: Kenya-Schmetterlingsfledermaus. Italian: Glauconitterìde keniòta, Glauconicterìde keniòta.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Jacobs *et al.*, 2008h; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008h; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004l; IUCN, 2004). 1996 - DD [assessed as *Chalinolobus kenyacola*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are unclear. If it is associated with coastal forest habitats, it is likely to be threatened by extraction of wood and conversion of land to agricultural use (Jacobs *et al.*, 2008h; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008h) [in IUCN (2009)] report that it is not known if this species is present in any protected area. There is a need for additional field surveys to better understand the distribution, natural history and possible threats to this little-known species.

GENERAL DISTRIBUTION:
Glauconycteris kenyacola has only been recorded from the type locality of 'Galole Road, 8.5 km north of Garsen, Coast Province, Kenya' (Peterson, 1982).

Native: Kenya (Peterson, 1982; Aggundey and Schlitter, 1984).

POPULATION:
Structure and Density - This species is known only from the type collection (Jacobs *et al.*, 2008h; IUCN, 2009)..

Trend - 2008 - Unknown (Jacobs *et al.*, 2008h; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Kenya.

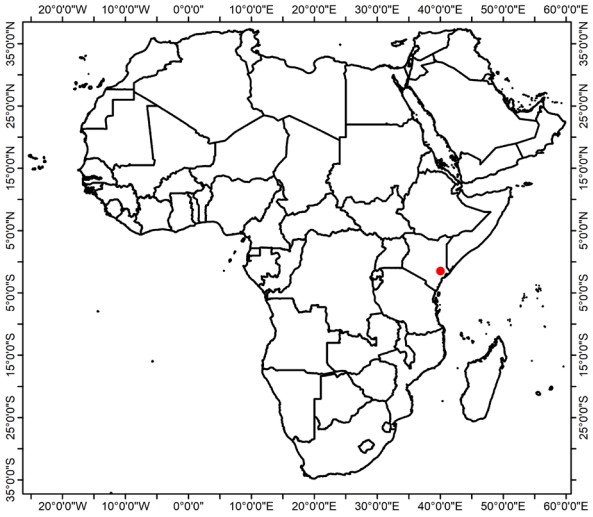


Figure 288. Distribution of *Glauconycteris kenyacola*

Glauconycteris machadoi Hayman, 1963

*1963. *Glauconycteris machadoi* Hayman, Publ. Cult. Comp. Diamantes Angola, Lisboa, 66: 107. Type locality: Angola: Lac Calundo [11 48 S 20 52 E]. Holotype: BMNH 1962.2074:. (Current Combination)
? *Chalinolobus machadoi:* (Name Combination)

TAXONOMY:
Included in *variegata* as a melanistic population by Koopman (1993a: 200), but considered a valid species by Simmons (2005).

COMMON NAMES:
Czech: netopýr Machadův. English: Machado's Butterfly Bat. French: Glauconyctère de Machado. German: Machados Schmetterlingsfledermaus.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Schlitter, 2008d; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Schlitter, 2008d; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Schlitter, 2004d; IUCN, 2004).

MAJOR THREATS:
The threats to this species are not known (Schlitter, 2008d; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008d) [in IUCN (2009)] reports that this species does not appear to be present in a protected area. Further taxonomic studies are needed for this species, as is field research into the distribution, natural history and possible threats to this little-known species.

GENERAL DISTRIBUTION:
Glauconycteris machadoi has only been recorded from the type locality of 'Lac Calundo'. in eastern Angola (see Rambaldini, 2010: 252).

Native: Angola (Hayman, 1963).

POPULATION:
Structure and Density - It is known only from the holotype (Schlitter, 2008d; IUCN, 2009).
Trend - 2008 - Unknown (Schlitter, 2008d; IUCN, 2009).

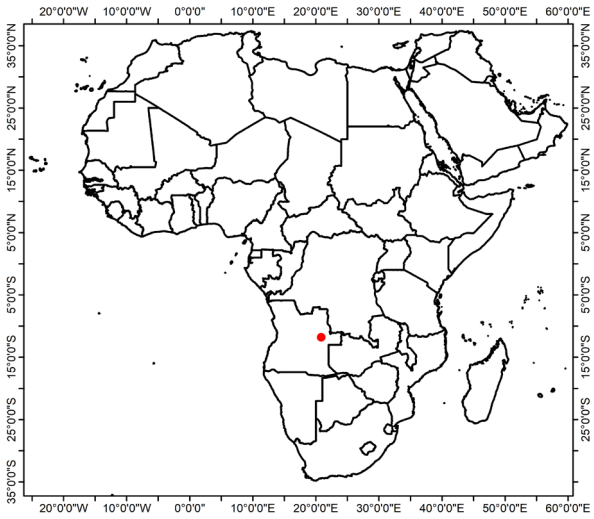


Figure 289. Distribution of *Glauconycteris machadoi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola.

Glauconycteris poensis (Gray, 1842)

*1842. *Kerivoula poensis* Gray, Ann. Mag. nat. Hist., [ser. 1], 10 (65): 258. Publication date: 1 December 1842. Type locality: Nigeria: Lower Niger River: Abo [=Aboh] [05 33 N 06 32 E]. Holotype: BMNH 1842.11.4.33:. - Comments: Type locality originally "Fernando Po", but in reality Abo, Lower Niger: see Allen and Thomson, Exp. Niger, 2: 479, 1848 in Allen, 1939a: 88, Grubb *et al.*, 1998: 89). Dobson (1878: 256) mentions an ad skull, as type presented by T. Thompson, Esq. R.N., originating from Fernando Po.

1868. *Vesperus (Hesperoptenus) kraussii* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 638. Publication date: 1868. Type locality: Nigeria: S Nigeria: Yoruba. - Comments: Type specimen: SMNH ???, ad ♀ (see Dobson, 1878: 255). (Name Combination)

? *Chalinolobus poensis:* (Name Combination)

? *Glauconycteris poensis:* (Name Combination, Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: netopýr abonský. English: Abo Butterfly Bat, Abo Bat. French: Glauconyctère d'Abo, Murin à bajoues d'Abo, Barbastelle d'Abo. German: Abo-Schmetterlingsfledermaus, Westafrikanische Nachtfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008l; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004k; IUCN, 2004). 1996 - LR/nt [assessed as *Chalinolobus poensis*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
It is presumably threatened in parts of its range by habitat loss resulting from logging and similar activities (Jacobs *et al.*, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008l) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected area. Further field surveys are needed to better determine the distribution of this species, and to gather additional information on the natural history of this little-known bat.

GENERAL DISTRIBUTION:
Glauconycteris poensis is largely distributed in West and Central Africa, with a possible record from northeastern Tanzania. It ranges from Senegal in the west, through much of West Africa to Cameroon, Equatorial Guinea (the island of Bioko) and the Democratic Republic of the Congo in Central Africa.

Native: Benin (Capo-Chichi *et al.*, 2004: 162); Cameroon; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966); Côte d'Ivoire; Equatorial Guinea (Bioko); Ghana (Jeffrey, 1975; Decher and Fahr, 2007: 20); Guinea (Fahr *et al.*, 2006a: 74); Guinea-Bissau (Rainho and Ranco, 2001: 68); Liberia (Koopman, 1989b; Koopman *et al.*, 1995; Monadjem and Fahr, 2007: 50); Nigeria (Happold, 1987); Senegal; Sierra Leone; Tanzania (Stanley and Foley, 2008: 119); Togo.
Presence uncertain: Kenya.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Hayman and Jones (1950) mention a large variation in shoulder spots and flank stripes in individuals from Sierra Leone, sometimes being asymmetrical (a spot on one shoulder only). During their study of *Glauconycteris*, Hassanin *et al.* (2017: 16) never found asymmetrical spots in *G. poensis*, and they therefore caution the statement by Hayman and Jones (1950) and indicate that the specimens from Sierra Leone should be re-examined to confirm their identification.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Heller *et al.* (1994: 6).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Porter *et al.* (2010) report for Gabon $2n = 22$, with all chromosomes being distinctly biarmed, with ten pairs are metacentric or slightly submetacentric and one pair (the smallest) is subtelocentric. The lack of chromosomal heteromorphism in the male suggests a neo-XY sex determining system in this species.
Protein / allozyme - Unknown.

HABITAT:
Associated with lowland tropical moist forest (Happold, 1987).

In the Mount Nimba area, Monadjem *et al.* (2016y: 368) found this species widely present in forested habitats, in degraded secondary forests as well as on the edge of a small village, at altitudes between 450 and 880 m.

ROOST:
Roost in holes in trees, on the fronds of coconut palms, and presumably in similar vegetation (Rosevear, 1965; Jeffrey, 1975; Happold, 1987).

POPULATION:
Structure and Density - Colonies are formed of small groups of animals, up to eight individuals. While the species is generally rare, it is considered to be one of the more common forest species of the genus *Glauconycteris* (Jacobs *et al.*, 2008l; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008l; IUCN, 2009).

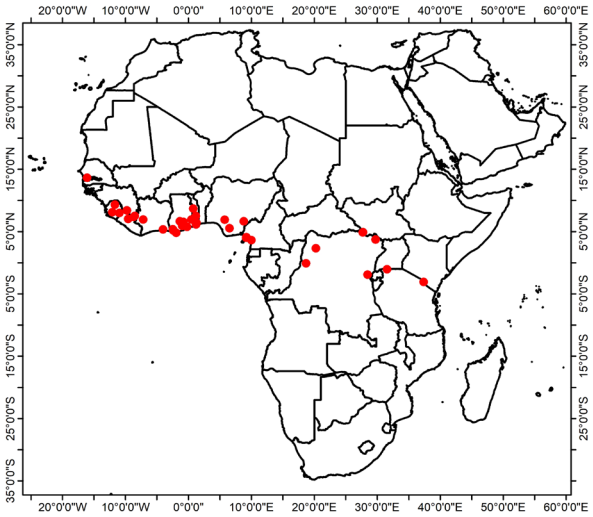


Figure 290. Distribution of *Glauconycteris poensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Cameroon, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Liberia, Nigeria, Senegal, Sierra Leone, South Sudan, Tanzania, Togo.

Glauconycteris superba Hayman, 1939

*1939. *Glauconycteris superba* Hayman, Ann. Mag. nat. Hist., ser. 11, 3 (14): 219, figs 1 - 2. Publication date: 1 February 1939. Type locality: Congo (Democratic Republic of the): Oriental province: Ituri District: about 30 mi (45 km) ENE of Medje: Pawa [02 32 N 27 40 E] [Goto Description]. Holotype: RMCA 14765: ad ♂, skull and alcoholic. Collected by: Dr. Albert Dubois. Hayman (1939: 220) mentions that this specimen is probably a male as the sexual organs were cut away by Dr. Dubois when preparing the specimen. (Current Combination)

1947. *Glauconycteris superba sheila* Hayman, Ann. Mag. nat. Hist., ser. 11, 13 (103): 503 (for 1946). Publication date: 7 August 1947. Type locality: Ghana: Central province: Oda district: Oda [05 55 N 00 56 W] [Goto Description]. Holotype: BMNH 1947.10: ad ♀, skull and alcoholic. Collected by: George Soper Cansdale; collection date: 6 December 1946;

original number: 807. - Etymology: In honour of Mrs. Cansale, wife of the collector (see Hayman, 1947c: 550).
2013. *Niumbaha superba:* Reeder, Helgen, Vodzak, Lunde and Ejotre. (Name Combination)
? *Chalinolobus superbus:* (Name Combination)

TAXONOMY:
See Simmons (2005).

Reeder *et al.* (2013: 93) proposed to place *superba* into a separate, new genus: *Niumbaha* Reeder, Helgen, Vodzak, Lunde and Ejotre, 2013 as they found most external features to be different from *Glauconycteris sensu stricto*. However, as this view is not yet confirmed, we tentatively retain this species in the genus *Glauconycteris*.

Using *Cytb* and RAG2 data, Hassanin *et al.* (2017: 1) found that *superba* is a sister-group of *G. variegata*, which seems to confirm that *Niumbaha* should probably be considered a synonym of *Glauconycteris*.

COMMON NAMES:
Czech: netopýr iturijský. English: Superb Butterfly Bat, Pied Butterfly Bat, Pied Bat, Badger bat. French: Glauconyctère pie, Murin à bajoues pie, Barbastelle bariolée. German: Schwarz-Weiße Schmetterlingsfledermaus, Große Schmetterlingsfledermaus.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr *et al.*, 2008; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Fahr *et al.*, 2008; IUCN, 2009). 2004 - VU B2ab(iii) ver 3.1 (2001) (Fahr *et al.*, 2004; IUCN, 2004). 1996 - VU [assessed as *Chalinolobus superbus*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
As it has only been recorded from closed forest, it may be threatened by deforestation due to general logging and conversion of land to agricultural use (Fahr *et al.*, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr *et al.* (2008) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species. It may be protected within the Ituri Forest, although this needs to be confirmed. There is a need for further directed field surveys to better determine the distribution, natural history and possible threats to this species.

GENERAL DISTRIBUTION:
Recorded from Côte d'Ivoire (locality not given) (Peterson and Smith, 1973); from Oda in Oda Province, Ghana (Hayman, 1947c; Grubb *et al.*, 1998); and from the Ituri Forest in northeastern Congo (Hayman, 1939; Hayman *et al.*, 1966). It has previously been reported to occur in Uganda, however, this is now considered to be in error. It may be present in Sierra Leone, however, it has yet to have been recorded in this country (Grubb *et al.*, 1998).
In 2013, two new records were reported: one from the Democratic Republic of the Congo (Gembu Tungaluna *et al.*, 2013), and one from South Sudan (Reeder *et al.*, 2013).

Native: Congo (The Democratic Republic of the) (Hayman, 1939; Hayman *et al.*, 1966; Gembu Tungaluna *et al.*, 2013); Côte d'Ivoire (Peterson and Smith, 1973); Ghana (Hayman, 1947c; Grubb *et al.*, 1998), South Sudan (Reeder *et al.*, 2013)
Presence uncertain: Sierra Leone (Grubb *et al.*, 1998).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Based on a series of 10 specimens, Ing *et al.* (2016: 479) found that both males and females have the same coloration pattern: three white markings on the head; a large white ruff on the throat, which is disconnected from two large white lateral stripes; and two white spots on the shoulders. One specimen had three shoulderspots. They also have four white stripes on the back. Around the sexual organs, the white colour is not pure, but yellowish, possibly the result of polution by bodily fluids.

Based on the Fa (47.5 mm) and Tibia (21.3 mm), Ing *et al.* (2016: 482) suspect that the holotype of *G. superba* is rather a female than "probably a male" as indicated by Hayman (1939).

SEXUAL DIMORPHISM:
On a series consisting of four ♀♀ and six♂♂, Ing *et al.* (2016: 479) found the females to be 5 % larger (Fa, Tib and 5th finger) and 10 % heavier than males.

ECHOLOCATION:
Ing *et al.* (2016: 481) found that the bats emitted sounds alternating between two distinct frequencies: **A**: range: 20.5 - 57.0 kHz, F_{min}: 22.9 ± 1.4 (20.5 - 25.1) kHz, F_{max}: 36.8 ± 6.6 (29.1 -

57.0) kHz, $F_{max\ energy}$: 25.7 ± 2.2 (22.4 - 30.9) kHz, bandwidth: 13.8 ± 6.3 (5.9 - 32.6) kHz, duration: 5.6 ± 1.9 (3.1 - 9.6) ms; and **B**: range: 27.3 - 73.3 kHz, F_{min}: 29.8 ± 1.3 (27.3 - 31.3) kHz, F_{max}: 57.0 - 13.5 (38.8 - 73.3) kHz, $F_{max\ energy}$: 33.0 ± 3.0 (28.8 - 38.2) kHz, bandwith: 27.1 ± 13.2 (9.1 - 43.3) kHz, duration: 6.4 ± 1.8 (4.0 - 10.1) ms. The B type of call is produced when the wing beat becomes constant.

HABITAT:
This species is associated with 'heavy' or closed lowland tropical moist forest (Rosevear, 1965; Hayman and Hill, 1971).

Based on wing measurements, however, Ing *et al.* (2016: 482) found that *G. superba* has long wings, which are adapted for high-speed flight. The high wing loading values, furthermore, indicate low manoeuvrability. These are features which are generally found in bats flying in uncluttered or open space, i.e., above the canopy.

HABITS:
After being released, the bats flew at speeds of about 1 to 9 m/s (average 4 - 6 m/s) (Ing *et al.*, 2016: 482).

POPULATION:
Structure and Density - It is currently known only from three specimens. It is very rare, or at least rarely collected (Hayman and Hill, 1971; Grubb *et al.*, 1998).
Trend - 2008 - Unknown (Fahr *et al.*, 2008; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Two of the four females that were captured on Mbiye island (DRC) by Ing *et al.* (2016: 479) in December 2013 were lactating.

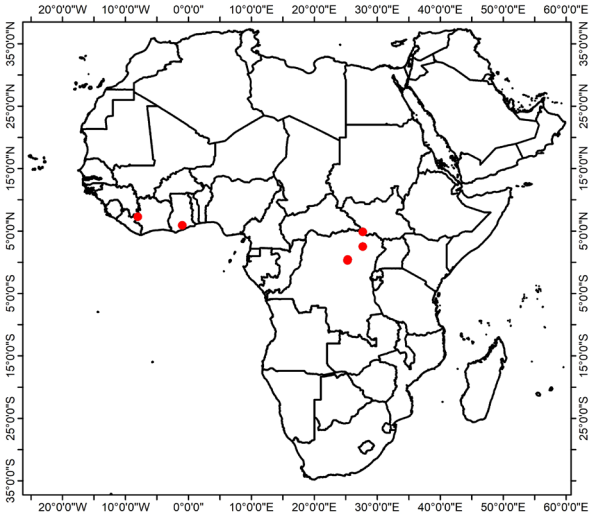


Figure 291. Distribution of *Glauconycteris superba*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, South Sudan.

Glauconycteris variegata (Tomes, 1861)

*1861. *Scotophilus variegatus* Tomes, Proc. zool. Soc. Lond., 1861, I: 31, 36. Publication date: May 1861. Type locality: Namibia: Ovamboland: about 32 km west of Ondongwa: Otjoro [=Otjihoro] [ca. 17 54 S 15 38 E] [Goto Description]. Syntype: BMNH 1907.1.1.437: skin and skull. Collected by: 1 Anderson; collection date: 1 December 1859. See Tomes (1861b: 39). Syntype: BMNH 1907.1.1.438: skin and skull. Collection date: 1 December 1859. See Tomes (1861b: 39). Syntype: ZMB 3033: ♂, skin and skull. Collected by: Andersson; collection date: 1 December 1859. See Turni and Kock (2008). - Comments: For details about the type locality, see Shortridge (1934), Meester *et al.* (1986: 54). - Etymology: From the feminine scientific Latin adjective *variegàta*, meaning "variegated", referring to the dark reticular pattern on the wings (see Lanza *et al.*, 2015: 356).

1905. *Glauconycteris papilio* Thomas, Ann. Mag. nat. Hist., ser. 7, 15 (85): 77. Publication date: 1 January 1905. Type locality: Uganda: Entebbe [00 04 N 32 28 E, 3 800 ft] [Goto Description]. Holotype: BMNH 1899.8.4.14: ♀, skin and skull. Collected by: F.J. Jackson Esq. Collection date: 10 April 1895. Presented/Donated by: F.J. Jackson Esq. Thomas (1905a: 77), who also mentions specimens from "Gambaga, Gold Coast (Giffard), and Tette, Zambesi (Boyd Alexander)".

1915. *Glauconycteris phalæna* Thomas, Ann. Mag. nat. Hist., 8, 15 (90): 560. Publication date: 1 June 1915. Type locality: Sudan: White Nile province: Malakal district: Fashoda, near [09 50 N 32 00 E] [Goto Description]. Holotype: BMNH 1915.3.6.67: ad ♀. Collected by: Willoughby P. Lowe; collection date: 27 January 1914; original number: 71. - Etymology: From the Greek for moth (see Jaeger, 1972).

2015. *Glauconycteris variegate:* Gunnell, Butler, Greenwood and Simmons, Am. Mus. Novit., 3846: 34. Publication date: 16 December 2015. (Lapsus)

? *Chalinolobus (Glauconycteris) variegata:* (Name Combination, Alternate Spelling)

? *Chalinolobus (Glauconycteris) variegatus:* (Name Combination)

? *Chalinolobus variegatus:* (Name Combination)
? *Glauconycteris variegata papilio:* (Name Combination)
? *Glauconycteris variegata variegata:* (Name Combination)
? *Glauconycteris variegata:* (Name Combination, Current Combination)
? *Glauconycteris variegatus:* (Name Combination, Alternate Spelling)

TAXONOMY:
Koopman (1971: 6; Koopman, 1993a: 200) included *machadoi*, and believed it to be a melanistic mutant population, but see Simmons (2005).

COMMON NAMES:
Afrikaans: Vlindervlermuis. Chinese: 彩蝶蝠. Czech: netopýr motýlí. English: Variegated Butterfly Bat, Butterfly Bat, Leaf-winged bat. French: Glauconyctère papillon, Murin à bajoues papillon, Chauve-souris réticulée, Chauve-souris papillon. German: Genetzte Schmetterlingsfledermaus. Italian: Glauconitterìde variegàta, Glauconicterìde variegàta. Portuguese: Morcego borboleta.

ETYMOLOGY OF COMMON NAME:
The colloguial name may be derived from the dark reticulated pattern on the wings, which has led to their being called leaf-winged bats (Taylor 2005). Although it is said that they resemble a large butterfly in flight, they are by no means butterfly-like in this respect (Taylor, 2005).

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Rambaldini (2010: 255) refers to Avery (1991), who mentioned finding fossil remains in very late Holocene layers at Border Cave, KwaZulu Natal.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008j; IUCN, 2009; Rambaldini, 2010: 256).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008j; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004j; IUCN, 2004). 1996 - LR/lc [assessed as *Chalinolobus variegatus*] (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) [assessed as (Schoeman *et al.*, 2016c).2004 - NT ver 3.1 (2001) [assessed as *G. variegatus*] (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
In view of the species wide range and availability of extensive suitable habitat, there are no major threats to this species. This species is threatened in parts of its range by habitat loss resulting from logging activities and the conversion of land to agricultural use (Jacobs *et al.*, 2008j; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008j) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. In view of the species wide distribution it is presumably present in some protected areas.

GENERAL DISTRIBUTION:
Glauconycteris variegata is widely, but patchily, recorded throughout much of sub-Saharan Africa. It ranges from Senegal and The Gambia in West Africa, through West and Central Africa to Ethiopia and Somalia in the east, from here it ranges south through East Africa and southern Africa, being recorded as far south as northeastern South Africa.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 976,983 km^2.

Rambaldini (2010: 254-255) confirms that there are no records from the central regions of The Democratic Republic of the Congo, northern Congo Republic, northeastern Gabon, Equatorial Guinea, and the southern parts of Cameroon, Nigeria and Benin. Furthermore, it seems missing from the coastal areas of southwestern Ghana, Côte d'Ivoire, Liberia and Sierra Leone.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 562); Benin (Capo-Chichi *et al.*, 2004: 162); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 562); Burkina Faso (Kangoyé *et al.*, 2012: 6025; 2015a: 618); Cameroon; Chad; Congo; Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 562); Ethiopia (Yalden *et al.*, 1996; Lavrenchenko *et al.*, 2004b: 137); Gabon; Gambia; Ghana; Kenya; Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988; Happold and Happold, 1997b: 821; Monadjem *et al.*, 2010d: 562); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 562; Monadjem *et al.*, 2010c: 383); Namibia (Cotterill,

2004a: 262; Monadjem *et al.*, 2010d: 562); Nigeria (Happold, 1987); Rwanda; Senegal; Somalia; South Africa (Monadjem *et al.*, 2010d: 562); Sudan (Koopman, 1975); Swaziland; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 62); Zambia (Ansell, 1957; Ansell, 1969; Ansell, 1973; Ansell, 1974; Monadjem *et al.*, 2010d: 562); Zimbabwe (Monadjem *et al.*, 2010d: 563).

DENTAL FORMULA:
$^{2113}/_{3123}$ = 32.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

SEXUAL DIMORPHISM:
Rambaldini (2010: 253) indicates that females are slightly larger than males in body dimensions, but not in weight.

ECHOLOCATION:
Rambaldini (2010: 255) mentions that the echolocation vocalizations are high-intensity, frequency-modulated calls typically starting from 70 kHz and ending at 30 kHz, and are sometimes including a 2nd harmonic, and rarely a 3rd one.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 18, FN = 32, BA = 16, a medium sized subtelocentric X chromosome, and a small metacentric Y chromosome, for specimens from South Africa.
Protein / allozyme - Unknown.

HABITAT:
Glauconycteris variegata is an inhabitant ot savannah, woodland, or open country–bushveldt habitats (see Rambaldini, 2010: 255).

ROOST:
Thatched roofs of abandoned huts and among dense vegetation (Allen *et al.*, 1917; Ansell and Dowsett, 1988; Taylor, 1998).

DIET:
Glauconycteris variegata eats airborne prey, primarily soft-bodied insects such as moths (see Kingdon, 1974; Fenton *et al.*, 1977a).

POPULATION:
Structure and Density - Colonies of this species are small, and there are believed to be less than 10,000 individuals in total (Jacobs *et al.*, 2008j; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008j; IUCN, 2009, Rambaldini, 2010: 256).

REPRODUCTION AND ONTOGENY:
Anciaux de Faveaux (1970) in Rambaldini (2010: 255) indicates that this species is monoestrus, but that the seasonal reproductive cycle can change across its range. Kingdon (1974) reported sexually active males from southern Uganda in July and October, whereas Monard (1935) did not find any sexually active adults in July in Angola. Lang and Chapin (1917b) reported pregnant females from the Democratic Republic of the Congo in March. From Zimbabwe, Smithers and Wilson (1979) reported pregnant females in August.

Bernard and Cumming (1997) [in Krutzsch (2000: 116)] suggested that *H. caffer* poses some kind of a problem as it is clearly monoestrous in some parts of its range but possibly bimodally or continuously polyoestrous in other parts.

PARASITES:
BACTERIA
Dietrich *et al.* (2016b: 3) found one out of three bats tested positive for *Rickettsia* in Rocktail Bay (RSA). Also from the RSA, Dietrich *et al.* (2018a: 4) reported the presence of *Leptospira kirschneri*.

Protozoa
Kassahun *et al.* (2015: 168) examined eight Ethiopian *G. variegata* specimens and found one of them (from Bedele) to be infected by *Leishmania* parasites.

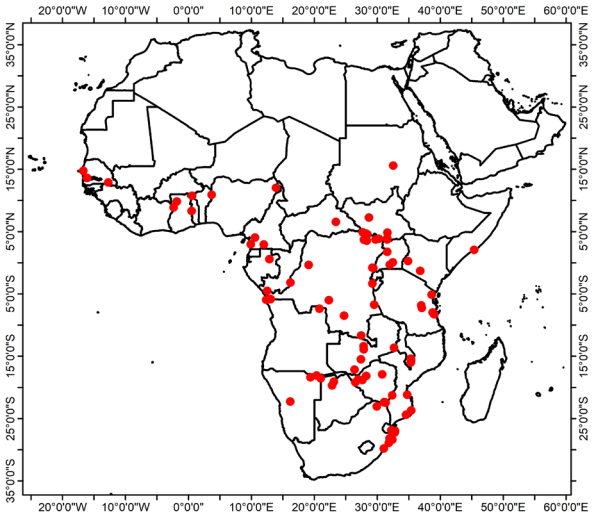


Figure 292. Distribution of *Glauconycteris variegata*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Benin, Botswana, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Gabon, Ghana, Kenya, Malawi, Mozambique, Namibia, Nigeria, Senegal, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Genus ***Hypsugo*** Kolenati, 1856

*1856. *Hypsugo* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Type species: *Vespertilio savii* Bonaparte, 1837. - Etymology: From the Greek "*υψι*", (hýpsi) meaning "on high" or "aloft" and the ending -"ugo" (as in *Nannugo* and *Vesperugo*) (see Palmer, 1904: 343). Lanza *et al.* (2015: 380) suggest the following "From the neuter Greek substantive "*ύψος*" (hýpsos) "height" + the suffix *-ugo* of the feminine Latin substantive *vesperùgo* 'evening star', i.e. a bright planet (as Venus), seen in the western sky after sunset, corresponding to the Latin 'stella matutina', the planet Venus, appearing first in the nocturnal sky and disappearing first from the morning one. By extension *Vesperugo* has assumed also the meaning of 'bat'; hence *Hypsugo* means 'mountain bat' as *H. maurus* Kolenati, 1856 a synonym of *savii*, was collected in the central chain of Alps". (Current Combination)

1993. *Ypsugo:* Ariagno, Le Bièvre, 13: 118. (Lapsus)

TAXONOMY:

Meester *et al.* (1986: 50) mention *Vespertilio maurus* Blasius (=*Vespertiio savii* Bonaparte) and *Vesperugo kraschenikovii* Eversmann as type species, but this was fixed to *Vespertilio savii* Bonaparte by Wallin (1969: 329), see Corbet and Hill (1992: 133).

Helbig *et al.* (2010: 168) suggest that *Hypsugo* is actually a para- or polyphyletic group, which would become monophyletic if the African forms are transferred to the genus *Nycticeinops*.

Monadjem *et al.* (2016y: 369) mention an undescribed species, belonging to the genus *Hypsugo* from the Mount Nimba area in Liberia.

Known species of the genus *Hypsugo*: *affinis* (Dobson, 1871) – Cambodia, NE Burma (=Myanmar), Yunnan, SE Tibet (China), N India, Nepal, Sri Lanka; *alaschanicus* Bobrinskii, 1926 – Mongolia, China, Russian Far East to Korea and Tsushima Isl (Japan) (Simmons, 2005: 489); ***anchietae*** (de Seabrae, 1900); *anthonyi* (Tate, 1942) – Burma (Simmons, 2005: 489); *arabicus* (Harrison, 1979) – Oman, Iran (Simmons, 2005: 489); ***ariel*** (Thomas, 1904); *bodenheimeri* (Harrison, 1960) – Israel, Saudi Arabia, southern Yemen, Oman (Yemen) (Simmons, 2005: 490); *cadornae* (Thomas, 1916) – northeastern India, Burma, Thailand, Vietnam, Laos (Simmons, 2005: 490); ***crassulus*** (Thomas, 1904); ***eisentrauti*** (Hill, 1968); *imbricatus* (Horsfield, 1824) – Java, Kangean Isl, Bali and Lesser Suda Isls, Borneo (Simmons, 2005: 490); *joffrei* (Thomas, 1915) – northern Burma (Simmons, 2005: 490); *kitcheneri* (Thomas, 1915) – Borneo (Simmons, 2005: 491); ***lanzai*** Benda, Al-Jumaily, Reiter and Nasher, 2011; *lophurus* (Thomas, 1915) – Burma Peninsular (Simmons, 2005: 491); *macrotis* (Temminck, 1840) – western Malaysia, Sumatra, Bali and adjacent small islands (Simmons, 2005: 491); *mordax* (Peters, 1867) – Java, Philippines; ***musciculus*** (Thomas, 1913); *petersi* (A. Meyer, 1899) – Borneo, Sulawesi, Buru and Ambon (Molucca Islands), Philippines (Luzon, Mindanao); *pulveratus* (Peters, 1871) – Szechwan, Yunnan, Hunan, Kiangsu, Fukien (China), Hong Kong, Thailand, Laos, Vietnam (Simmons, 2005: 491); *savii* (Bonaparte, 1837) – France, Portugal, Spain, Italy, southern Switzerland, Austria, eastern Hungary, Balkan countries, Morocco, Crimea and Caucasus, Turkey, Lebanon, Syria, Israel, Iran, Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan, Tajikistan, Afghanistan to northern India and Burma (Simmons, 2005: 491); *vordermanni* (Jentink, 1890) – Belitung Isl (Indonesia), Borneo (Sarawak, Malaysia) (Simmons, 2005: 492).

COMMON NAMES:

Czech: skalní netopýři. English: Mountain Pipistrelle Bats. French: Vespères. Italian: Ipsùghi.

Hypsugo anchietae (Seabra, 1900)

1900. *V[esperugo] Anchietæ:* Bocage, Bull. Mus. natn. Hist. nat., Paris, 6: 164. (Name Combination, Alternate Spelling)

*1900. *Vesperugo Anchieta* Seabra, J. Sci. mat. phys. nat., ser. 2, 6 (21): 26. Publication date: August 1900. Type locality: Angola: Cahata [12 20 S 14 50 E] [Goto Description]. Paratype: MNHN ZM-MO-1900-538: ad ♀, skull and alcoholic. Collected by: José Alberto de Oliveira Anchieta. Number 211 in Rode (1941: 246). Syntype: BMNH 1906.1.3.1: ad ♀, skull and alcoholic. - Etymology: This species is named after Mr Anchieta, a Portuguese

national, who was a prolific collector of zoology material in Angola in the 1860's and who has numerous reptiles, birds and mammals named after him (Taylor, 2005).

1935. *Pipistrellus anchietae:* Monard, Arq. Mus. Bocage, 6: 31. (Name Combination, Current Spelling)
1953. *Pipistrellus (Pipistrellus) anchietai:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination, Alternate Spelling)
1965. *Pipistrellus anchietai:* Koopman, Am. Mus. Novit., 2219: 30. (Name Combination)
1987. *[Attalepharca] anchietae:* Menu, Palaeovert., 17 (3): 126. (Name Combination)
1987. *Pipistrellus (Hypsugo) anchietae:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 273. (Name Combination)
1993. *Pipistrellus (Hypsugo) anchietai:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 219. (Name Combination)
1994. *H[ypsugo] anchietae:* Heller, Volleth and Kock, Senckenb. biol., 74 (1/2): 1. (Name Combination, Current Combination)
2001. *P[ipistrellus] (Hypsugo) anchieta:* Kock, Senckenb. biol., 81 (1/2): 279. (Name Combination)
2002. *Hypsugo anchietae:* Kearney, Volleth, Contrafatto and Taylor. (Name Combination)
2017. *Hypsugo anehietai:* Gunnell, Smith and Smith, PLoS ONE, 12 (3): Suppl.. Publication date: 8 March 2017. (Lapsus)
2019. *L[aephotis] anchietae:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)
? *Hypsugo cf. anchietae:*
? *Pipistrellus (Hypsugo) anchieta:* (Name Combination, Alternate Spelling)

TAXONOMY:



Figure 293. *Hypsugo anchietae* (ECJS-119/2009) caught in the Okavango, Botswana.

The oldest name for this species may be *bicolor*; see Koopman (1975: 404). Koopman (1994: 114) mentions this species as *P. bicolor* in the subgenus *Pipistrellus*. Incorrect original spelling as *anchieta*, corrected to *anchietae* by Seabra (1900b: 120).

COMMON NAMES:
Afrikaans: Anchieta-vlermuis. Czech: netopýr Anchietův. English: Anchieta's Pipistrelle, Anchieta's Bat, Miombo pipistrelle. French: Vespère d'Anchieta, Pipistrelle du Miombo, Pipistrelle d'Anchieta. German: Anchietas Zwergfledermaus, Anchietas Pipistrelle.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, it occurs in a number of protected areas, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008ap; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus anchietae*] (Jacobs *et al.*, 2008ap; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004aq; IUCN, 2004). 1996 - VU [assessed as *Pipistrellus anchietai*] (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016i). 2004 - NT ver 3.1 (2001) [assessed as *Pipistrellus anchietae*] (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species, although further research is needed to confirm this (Jacobs *et al.*, 2008ap; IUCN, 2009).

Trend - 2008 - Unknown (Jacobs *et al.*, 2008ap; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ap) [in IUCN (2009)] report that it is present in a number of protected areas in Zimbabwe and South Africa. Further studies are needed into the distribution, natural history and possible threats to this species.

GENERAL DISTRIBUTION:
Hypsugo anchietae is largely a southern African species which ranges from Angola in the west, through southern Democratic Republic of the Congo, and from here south into Zambia, Zimbabwe, and eastern South Africa. It could be more widespread in southern Africa than is currently understood (Skinner and Chimimba, 2005). The species has recently been recorded from Madagascar for the first time, where it was collected from four localities (Kirindy Forest [CFPF]; Sept Lacs; Parc National de Kirindy-Mitea; Parc National de Zombitse-Vohibasia) (Bates *et al.*, 2006: 319).

South of 8° S, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 987,832 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 563; Taylor *et al.*, 2018b: 60); Botswana (Monadjem *et al.*, 2010d: 563); Congo (The Democratic Republic of the); Madagascar (Bates *et al.*, 2006: 319); Mozambique (Monadjem *et al.*, 2010d: 563); South Africa (Koopman, 1994: 114; Kearney and Taylor, 1997: 54; Monadjem *et al.*, 2007c as *H. cf. anchietae*; Monadjem *et al.*, 2010d: 563); Swaziland (Monadjem *et al.*, 2010d: 563); Zambia (Ansell, 1973; Monadjem *et al.*, 2010d: 563); Zimbabwe (Monadjem *et al.*, 2010d: 563).
Presence uncertain: Namibia (Cotterill, 2004a: 261).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

ECHOLOCATION:
Schoeman and Waddington (2011: 291) mention a peak frequency of 55.9 ± 0.3 kHz and a duration of 2.1 ± 0.1 msec for specimens from Durban, South Africa.

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotypic - Rautenbach *et al.* (1993) and Kearney *et al.* (2002) both reported 2*n* = 26, FN = 32, BA = 8, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from South Africa.
Protein / allozyme - Unknown.

HABITAT:
In southern Africa, the species primarily occurs in Savanna (85 %) and Coastal mosaic (10 %) habitats (Cooper-Bohannon *et al.*, 2016: Table S2).

POPULATION:
Structure and Density - It is a locally common species in southern Africa. Very few specimens are currently known from Madagascar (Jacobs *et al.*, 2008ap; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008ap; IUCN, 2009).

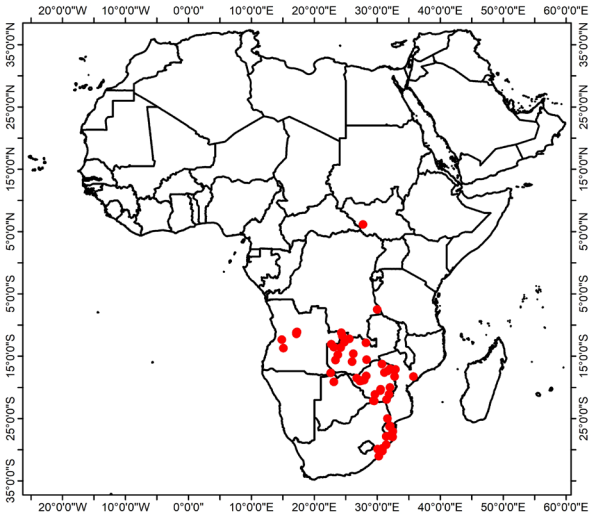


Figure 294. Distribution of *Hypsugo anchietae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Botswana, Congo (Democratic Republic of the), Ethiopia, Mozambique, South Africa, South Sudan, Swaziland, Zambia, Zimbabwe.

Hypsugo ariel (Thomas, 1904)

*1904. *Pipistrellus ariel* Thomas, Ann. Mag. nat. Hist., ser. 7, 14 (80): 157. Publication date: 1 August 1904. Type locality: Sudan: Kassala province: Wadi Alagi [ca. 22 N 35 E, 2 000 ft] [Goto Description]. Holotype: BMNH 1904.11.4.7: ad ♀, skin and skull. Collected by: Arthur M. MacKilligan; collection date: 12 August 1903; original number: 28. See Qumsiyeh (1985: 54).
1966. *Pipistrellus (Pipistrellus) ariel:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 171. (Name Combination)
1987. *Pipistrellus (Hypsugo) ariel:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 281. (Name Combination)
1991. *Pipistrellus ariel ariel:* Harrison and Bates, Mammals of Arabia, 92. (Name Combination)

2000. *Hypsugo ariel:* Horácek, Hanák and Gaisler, Bats of the Palearctic region, 126. (Name Combination, Current Combination)

TAXONOMY:
Mentioned in the subgenus *Pipistrellus* by Koopman (1994: 115). Harrison and Bates (1991: 93) assign the Arabian specimens to *P. a. ariel*, although they do not mention any other subspecies. Horácek *et al.* (2000: 126) mention it in the genus *Hypsugo*.

COMMON NAMES:
Arabian: Khaffash. Czech: netopýr pouštní. Dutch: Woestijndwergvleermuis. English: Pygmy Pipistrellus, Ariel Pipistrelle, Egyptian Desert Pipistrelle, Desert Pipistrelle, Fairy Pipistrelle. French: Vespère ariel, Pipistrelle ariel. German: Elfen-Zwergfledermaus, Elfen-Pipistrelle. Hebrew: Atalfon Ariel.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, status and ecological requirements (Benda and Aulagnier, 2008; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) [assessed as *Pipistrellus ariel*] (Benda and Aulagnier, 2008; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Benda, 2004c; IUCN, 2004). 1996 - LR/nt assessed as *Pipistrellus ariel* (Baillie and Groombridge, 1996).

MAJOR THREATS:
Loss of natural habitat because of agricultural intensification. The species is affected by pesticides, although this is not considered a major threat (Z. Amr *pers. comm.*, 2005 [in Benda and Aulagnier (2008) in IUCN (2009))].

CONSERVATION ACTIONS:
Benda and Aulagnier (2008) [in IUCN (2009)] report that no conservation actions are in place. Further research on the taxonomy, population ecology and trends is required and the extent of the range requires further clarification.

GENERAL DISTRIBUTION:
Hypsugo ariel has been recorded from Israel, Jordan and Egypt (including the Sinai) within the Mediterranean (Dietz, 2005). Outside the area the range extends to Saudi Arabia, and Yemen. In Africa it is recorded from northern Sudan (type locality, see Simmons, 2005). Approximately five localities known in northeast Africa, including Egypt and Sudan.

The specimens from Socotra (Yemen) are now considered to belong to a separate species: *Hypsugo lanzai* (see Benda *et al.*, 2011b: 37).

Native: Egypt (Sinai); Israel; Jordan; Palestinian Territory, Occupied; Saudi Arabia; Sudan; Yemen (South Yemen).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:

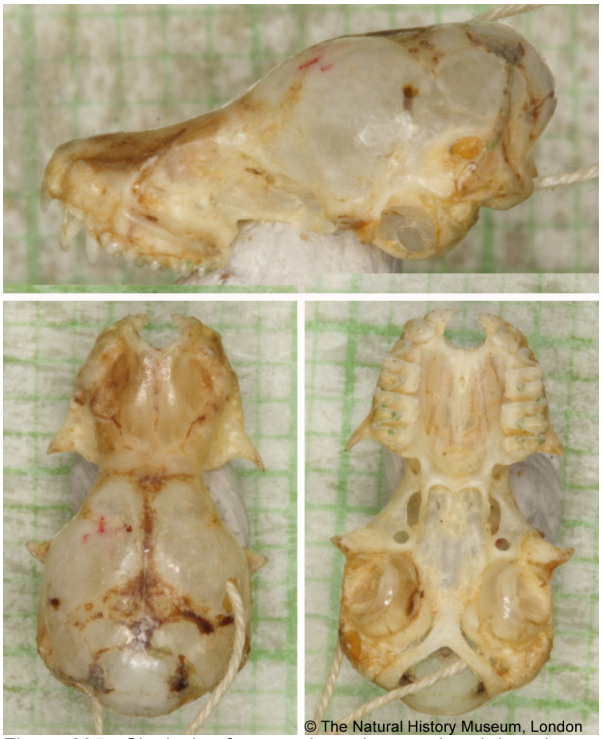


Figure 295. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1904.11.4.7, holotype of *Pipistrellus ariel* Thomas, 1904.

DETAILED MORPHOLOGY:
Baculum - Benda *et al.* (2011b: 38).

ECHOLOCATION:
From Jordan, Benda *et al.* (2010b: 204) reported the following parameters for 129 calls: F_{start}: 58.1 ± 4.1 (47.7 - 75.0) kHz, F_{end}: 43.0 ± 2.1 (30.0 - 47.4) kHz, F_{peak}: 46.4 ± 1.3 (43.4 - 49.0) kHz, Pulse duration: 4.1 ± 0.8 (2.4 - 7.2) msec., and Inter-pulse interval: 81.9 ± 18.9 (45.0 - 193.0) msec.

POPULATION:
Structure and Density - The population is apparently small but is probably stable (Z. Amr *pers. comm.*, 2005 in Benda and Aulagnier (2008) [in IUCN (2009)]).
Trend - 2008 - Unknown (Benda and Aulagnier, 2008; IUCN, 2009). *P. ariel* populations within the Asia Minor and Levant region are unknown

population trend, under predictive climate change scenarios (Bilgin *et al.*, 2012: 433).

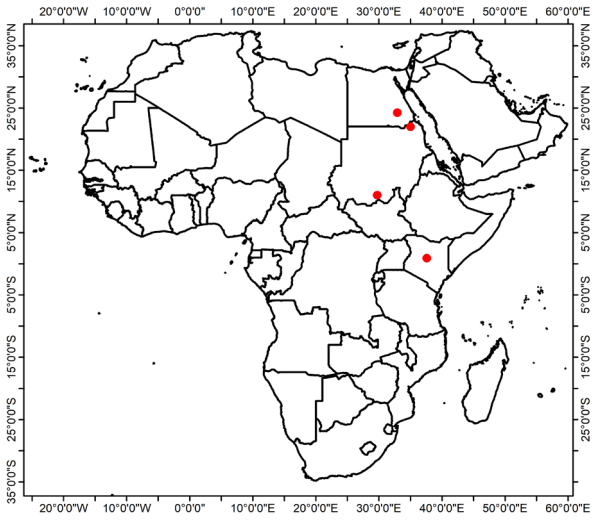


Figure 296. Distribution of *Hypsugo ariel*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: "Africa", Egypt, Kenya, Sudan.

Hypsugo bemainty Goodman, Rakotondramanana, Ramasindrazana, Kearney, Monadjem, Schoeman, Taylor, Naughton and Appleton, 2015

*2015. *Hypsugo bemainty* Goodman, Rakotondramanana, Ramasindrazana, Kearney, Monadjem, Schoeman, Taylor, Naughton and Appleton, Zool. J. Linn. Soc., 173 (4): 992, 1008, figs 9 - 12. Type locality: Madagascar: Province de Toliara: 60 km N Morondava, along the Kirindy River: Kirindy Forest (CNFEREF) [20°4'29.1"S, 44°40'14.4"E, 45 m] [Goto Description].

HABITAT:
Ravelomanantsoa *et al.* (2019: 111) captured this bat in a marshy zone near Ambereny.

DIET:
Rakotondramanana *et al.* (2015: 77) reported the following volume percentages present in the diet of *H. bemainty*: Coleoptera: 14.1 ± 12.56; Hymenoptera: 12.0 ± 14.60; Lepidoptera: 18.6 ± 20.27; Isoptera: 52.0 ± 33.78; Homoptera: 2.2 ± 3.59; Arachnida: 0.5 ± 1.73; Orthoptera: 0.5 ± 1.73. Expressed as frequency percentages, the values are: Coleoptera: 61.7 ± 37.62; Hymenoptera: 53.3 ± 47.74; Lepidoptera: 58.3 ± 48.59; Isoptera: 80.0 ± 39.08; Homoptera: 13.3 ± 23.09; Arachnida: 6.7 ± 23.09; Orthoptera: 6.7 ± 23.09.

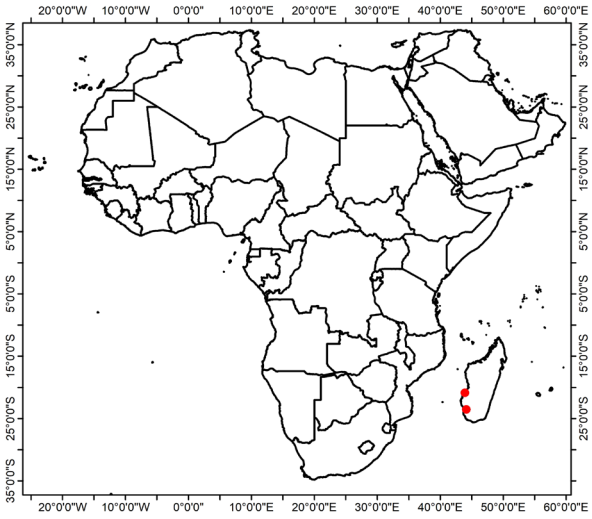


Figure 297. Distribution of *Hypsugo bemainty*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Madagascar.

Hypsugo cf. eisentrauti Hill, 1968

2013. *Hypsugo cf. eisentrauti:* Kerbis Peterhans, Fahr, Huhndorf, Kaleme, Plumptre, Marks and Kizungu, Bonn. Zool. Bull., 62 (2): 189. Publication date: November 2013. (Name Combination)

GENERAL COMMENTS:
As already indicated by Van Cakenberghe and Happold (2013i: 622) *eisentrauti* records from the DRC, Uganda, Kenya and Somalia do not resemble closely to the holotype and paratype of *P. eisentrauti* to be considered respresentatives of this species. Kerbis Peterhans *et al.* (2013: 189) therefore assigned these tentatively to *H.* cf. *eisentrauti*, indicating that they could represent a yet undescribed species.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Congo (Democratic Republic of the), Rwanda, Somalia.

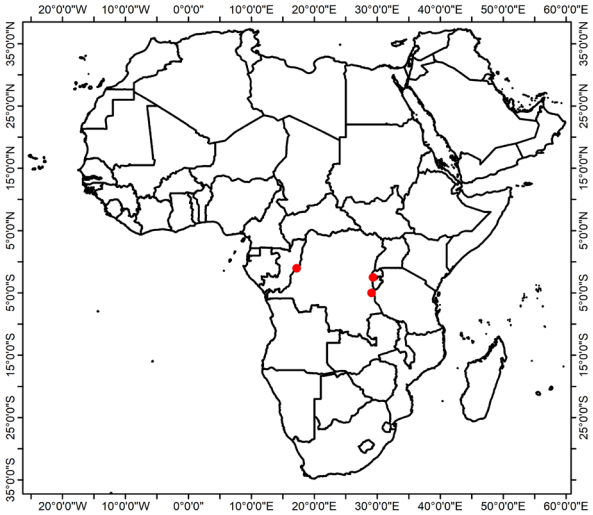


Figure 298. Distribution of *Hypsugo* cf. *eisentrauti*

Hypsugo crassulus (Thomas, 1904)

*1904. *Pipistrellus crassulus* Thomas, Ann. Mag. nat. Hist., ser. 7, 13 (75): 206. Publication date: 1 March 1904. Type locality: Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. Holotype: BMNH 1904.2.8.1: ad ♂, skull and alcoholic. Collected by: George Latimer Bates Esq.

1966. *Pipistrellus (Pipistrellus) crassulus:* Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: 17. (Name Combination)

1972. *Pipistrellus eisentrauti bellieri* De Vree, Rev. Zool. Bot. afr., 85 (3 - 4): 412. Publication date: 30 June 1972. Type locality: Côte d'Ivoire: NW of Abidjan: Adiopodoumé [05 19 N 04 08 W, 0 - 30 m] [Goto Description]. Holotype: RMCA 35686: ad ♀, skin and skull. Collected by: Prof. Dr. Frits De Vree; collection date: 19 November 1969; original number: AX0104. Prepared and labelled in the Laboratoire d'Ecologie (L. Bellier) of the ORSTROM; see De Vree (1972). - Comments: Included in *eisentrauti* by Koopman (1993a: 221), and in *crassulus* by Simmons (2005). Considered a valid species by Fahr *et al.* (2006b: 245).

1987. *[Attalepharca] crassulus:* Menu, Palaeovert., 17 (3): 126. (Name Combination)

1994. *Hypsugo crassulus bellieri:* Heller, Volleth and Kock, Senckenb. biol., 74 (1/2): 1. (Name Combination)

1994. *Hypsugo crassulus:* Heller, Volleth and Kock, Senckenb. biol., 74 (1/2): 1. (Name Combination, Current Combination)

1994. *P[ipistrellus (Pipistrellus)] e[isentrauti] bellieri:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 114.

1994. *P[ipistrellus (Vansonia)] crassulus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 115. (Name Combination)

1998. *P[ipistrellus (Hypsugo)] e[isentrauti] bellieri:* Grubb, Jones, Davies, Edberg, Starin and Hill, Mammals of Ghana, Sierra Leone and The Gambia, 84.

2003. *Nycticeinops eisentrauti:* Hoofer and Van Den Bussche, Acta Chiropt., 5 (Suppl.): 38. - Comments: Although Hoofer *et al.* (2003) believed they were referring to an *eisentrauti* specimen, this was actually a *belieri* (see also the *eisentrauti bellieri* synonym by Grubb *et al.*, 1998).

TAXONOMY:
Mentioned in the genus *Pipistrellus* and the subgenus *Vansonia* by Koopman (1994: 116). Volleth *et al.* (2001: 27) assigned this species to the genus *Hypsugo*. Includes *bellieri*; see Heller *et al.* (1994), Simmons (2005). Hoofer and Van Den Bussche (2003: 38) and Roehrs *et al.* (2011: 26, 31) mentioned "*eisentrauti*" to belong to the genus *Nycticeinops*, but they used a specimen from Côte d'Ivoire which should be assigned to *crassulus bellieri*. However, Monadjem *et al.* (2016y: 369) and Herkt *et al.* (2017: Appendix S9) report that the ecological niches for *crassulus* and *bellieri* differ and that their geographic distributions are

separated by a gap, suggesting that they might represent different species.

COMMON NAMES:

Chinese: 宽首伏翼. Czech: netopýr obtloustlý. English: Broad-headed Pipistrelle Bat, Broad-headed Pipistrelle. French: Vespère à grosse tête, Pipistrelle à grosse tête. German: Breitköpfige Zwergfledermaus, Breitköpfige Pipistrelle. Spanish (Castillian): Pipistrelo.

CONSERVATION STATUS:

Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr, 2008g; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus crassulus*] (Fahr, 2008g; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessed as *Hypsugo crassulus*] (Fahr, 2004o; IUCN, 2004). 1996 - LR/lc [assessed as *Pipistrellus crassulus*] (Baillie and Groombridge, 1996).

MAJOR THREATS:

There appear to be no major threats to this widespread species as a whole (Fahr, 2008g; IUCN, 2009).

CONSERVATION ACTIONS:

Fahr (2008g) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, and it is not known if the species is present within any protected areas. Further studies are needed into the taxonomy, distribution and natural history of this species.

GENERAL DISTRIBUTION:

Hypsugo crassulus has been recorded from Guinea, Liberia and Côte d'Ivoire in the west, from Cameroon, Democratic Republic of the Congo, northern Angola, southern Sudan, Uganda and western Kenya (Kakamega Forest).

Native: Angola; Cameroon; Congo (Bates *et al.*, 2013: 325 - 1st authenticated record); Congo (The Democratic Republic of the); Côte d'Ivoire; Guinea (Decher *et al.*, 2016: 266); Kenya; Liberia; Sudan; Uganda.
Presence uncertain: Nigeria.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:

Tragus: Monadjem *et al.* (2013c: 204) provide a line drawing of tragi of specimen DNSM 13222 from Mount Nimba, Liberia.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:

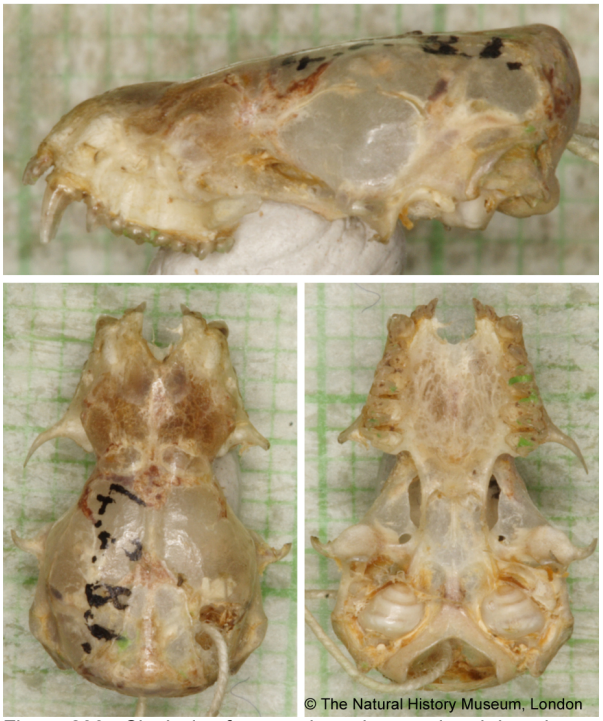


Figure 299. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1904.2.9.1, holotype of *Pipistrellus crassulus* Thomas, 1904.

DETAILED MORPHOLOGY:

Baculum - See Hill and Harrison (1987) and Heller *et al.* (1994: 5). *H. c. bellieri* and *P. nanulus* were much longer in total length than any of the *Neoromicia* species that were examined by Monadjem *et al.* (2013c). The shaft tip of *H. c. bellieri* was distinctly spatulate and dorsoventrally flattened baculum shaft in both species was moderately ventrally curved, ending in a fluted base that was broader in *P. nanulus* (0.71 - 0.82 mm) than in *H. c. bellieri* (0.38 - 0.41 mm) (Monadjem *et al.*, 2013c: 197). Line drawing of dorsal and ventral bacula of specimen DNSM 13222 from Mount Nimba, Liberia are shown in Monadjem *et al.* (2013c: 204).

MOLECULAR BIOLOGY:

DNA - Unknown.
Karyotype - Volleth *et al.* (2001) reported 2*n* = 30, FN = 56, BA = 28, a metacentric X chromosome and a metacentric Y chromosome.
Protein / allozyme - Unknown.

HABITAT:

Monadjem *et al.* (2016y: 369) found this species (as *H. crassulus bellieri*) in old growth forest habitats in the Mount Nimba area.

POPULATION:

Structure and Density - This species has rarely been recorded (Fahr, 2008g; IUCN, 2009).

Trend - 2008 - Unknown (Fahr, Fahr, 2008g; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS: Angola, Cameroon, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Gabon, Ghana, Guinea, Kenya, Liberia, South Sudan, Uganda.

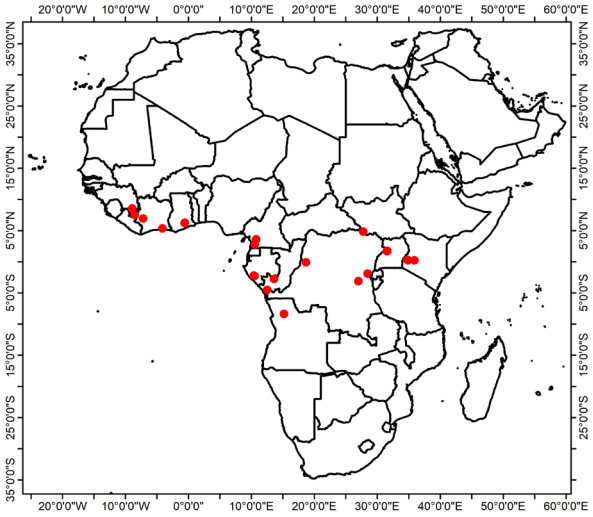


Figure 300. Distribution of *Hypsugo crassulus*

Hypsugo eisentrauti (Hill, 1968)

*1968. *Pipistrellus eisentrauti* Hill, Bonn. zool. Beitr., 19 (1/2): 45. Publication date: 10 April 1968. Type locality: Cameroon: Western province: Rumpi Highlands, Dikume-Balue: Camp V [ca. 04 13 N 09 32 E] [Goto Description]. Holotype: ZFMK 1968.0005: ad ♂, skin and skull. Collected by: Prof. Dr. Martin Eisentraut; collection date: 18 February 1957; original number: 498. See Hill (1968: 45), Thorn *et al.* (2007), Hutterer and Peters (2010: 12). Paratype: BMNH 1967.2129: ad ♀, skin and skull. Collected by: Prof. Dr. Martin Eisentraut; collection date: 30 November 1966; original number: 198. Paratype: ZFMK 1968.0006: ad ♀, skin and skull. Collected by: Prof. Dr. Martin Eisentraut; collection date: 30 November 1966; original number: 198. Presented/Donated by: ?: Collector Unknown. Lager II [=Camp II], ca. 1,100 m; Mount Kupe (see Hutterer and Peters, 2010: 12). - Comments: Thorn *et al.* (2009: 53) situate Camp V at 05 00 N 09 15 E. - Etymology: In honour of Prof. Martin Eisentraut (1902 - 1994), collector of the type specimen.

1971. *Pipistrellus [(Pipistrellus)] eisentrauti:* Hayman and Hill, Mammals of Africa: Chiroptera, 39. (Name Combination)

1972. *P[ipistrellus] e[isentrauti] eisentrauti:* De Vree, Rev. Zool. Bot. afr., 85 (3 - 4): 415. (Name Combination)

1987. *Pipistrellus (Hypsugo) eisentrauti:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 274. (Name Combination)

1994. *Hypsugo eisentrauti:* Heller, Volleth and Kock, Senckenb. biol., 74 (1/2): 1. (Name Combination, Current Combination)

1994. *P[ipistrellus (Pipistrellus)] e[isentrauti] eisentrauti:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 114. (Name Combination)

? *Hypsugo eisentrauti bellieri:*

TAXONOMY:
Koopman (1994: 114) mentions this species as belonging to the subgenus *Pipistrellus*. Volleth *et al.* (2001: 27) assigned this species to the genus *Hypsugo*. Koopman (1993a: 221) included *bellieri*, but see Heller *et al.* (1994), Simmons (2005). Hoofer and Van Den Bussche (2003: 38) and Roehrs *et al.* (2011: 26, 31) include *eisentrauti* in *Nycticeinops*, but they used a specimen from Côte d'Ivoire, which should be assigned to *crassulus bellieri*.

COMMON NAMES:
Czech: netopýr guinejský. English: Eisentraut's Pipistrelle Bat, Eisentraut's pipistrelle. French: Pipistrelle d'Eisentraut, Vespère d'Eisentraut. German: Eisentrauts Zwergfledermaus, Eisentrauts Pipistrelle. Italian: Pipistrèllo di Eisentràut.

CONSERVATION STATUS:
Global - Listed as Data Deficient in view of continuing problems with its taxonomy as well as absence of recent information on its extent of

occurrence, status, ecological requirements and threats. This species is most probably restricted to SW Cameroon. However, there are supposedly records from four other countries. Those records may all be misidentifications. If that is the case, then it is likely that this species has a very restricted range and is probably threatened (Fahr, 2008h; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) [assessed as *Pipistrellus eisentrauti*] (Fahr, 2008h; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Fahr, 2004n; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not well known, but in Cameroon are likely to include encroachment on montane forest by subsistence agriculture (Fahr, 2008h; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008h) [in IUCN (2009)] reports that it is unclear if the species is present within any protected areas. Further studies are needed into the taxonomy, distribution, and threats to this species.

GENERAL DISTRIBUTION:
Hypsugo eisentrauti was initially described from Cameroon, where it has been recorded from localities including the Rumpi Highlands, Mount Kupe and Mount Cameroon. Although there are additional records of this species from Kenya, Somalia, Uganda and from the Democratic Republic of the Congo, it is uncertain that these actually refer to *Hypsugo eisentrauti*.

Confirmation of the possible distribution outside of Cameroon is needed.

Native: Cameroon.

Presence uncertain: Congo (The Democratic Republic of the); Kenya; Somalia; Uganda.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Heller *et al.* (1994: 2).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - Volleth *et al.* (2001) reported 2*n* = 42, FN = 58, BA = 18, a metacentric X and a dot-like Y chromosome for a male specimen from Ruanda.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - The population is little known, but it may be locally common in Cameroon (Fahr, 2008h; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008h; IUCN, 2009).

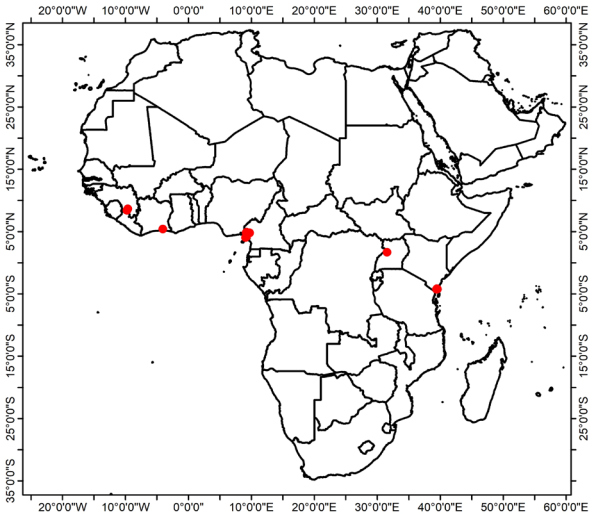


Figure 301. Distribution of *Hypsugo eisentrauti*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Côte d'Ivoire, Guinea, Kenya, Liberia, Uganda.

Hypsugo musciculus (Thomas, 1913)

*1913. *Pipistrellus musciculus* Thomas, Ann. Mag. nat. Hist., ser. 8, 11 (63): 316. Publication date: 1 March 1913. Type locality: Cameroon: Ja River: Bitye [03 13 N 12 22 E, 2 000 ft] [Goto Description]. Holotype: BMNH 1913.2.8.1: ad ♂, skin and skull. Collected by: George Latimer Bates Esq. Collection date: 3 September 1912; original number: 622.
1966. *Pipistrellus (Pipistrellus) musciculus:* Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: 16. (Name Combination)
1987. *Attalepharca musciculus:* Menu, Palaeovert., 17 (3): 128. - Comments: Menu used *Attalepharca* as "groupe collectif" not as genus name. (Name Combination)
1987. *Pipistrellus (Hypsugo) musciculus:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 281. (Name Combination)
? *Hypsugo musciculus:* (Name Combination, Current Combination)

TAXONOMY:
Mentioned in the genus *Pipistrellus* and the subgenus *Pipistrellus* by Koopman (1994: 113).

COMMON NAMES:
Czech: netopýr mechový. English: Mouse-like Pipistrelle Bat, Least Pipistrelle Bat, Mouselike Pipistrelle, Western Africa Pipistrelle. French: Vespère murin, Pipistrelle d'Afrique occidentale, Pipistrelle murine. German: Mäuschen-Zwergfledermaus, Mäuschen-Pipistrelle.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing problems with its taxonomy as well as absence of recent information on its extent of occurrence, status and ecological requirements (Jacobs *et al.*, 2008u; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) [assessed as *Pipistrellus musciculus*] (Jacobs *et al.*, 2008u; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004i; IUCN, 2004). 1996 - LR/nt [assessed as *Pipistrellus musciculus*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not known (Jacobs *et al.*, 2008u; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008u) [in IUCN (2009)] report that it is not known if the species is present within any protected area. Further studies are needed into the taxonomy, distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Hypsugo musciculus has been recorded from a few localities in Ghana, Sierra Leone, southern Cameroon, Gabon, the eastern tip of Congo, and the Democratic Republic of the Congo.

Native: Cameroon; Congo (The Democratic Republic of the); Gabon; Ghana; Sierra Leone.

Bates *et al.* (2013: 339) reject the occurrence of *H. musciculus* in the Republic of Congo as Malbrant and Maclatchy (1949) only suggested it to be 'likely' occurring in that country.

POPULATION:
Structure and Density - The abundance of this species is not well known (Jacobs *et al.*, 2008u; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008u; IUCN, 2009).

Hypsugo savii (Bonaparte, 1837)

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:



Figure 302. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1913.2.8.1, holotype of *Pipistrellus musciculus* Thomas, 1913.

PARASITES:
HEMIPTERA
Cimicidae: *Cacodmus villosus* (Stål) recorded from the Congo (Haeselbarth *et al.*, 1966: 11).

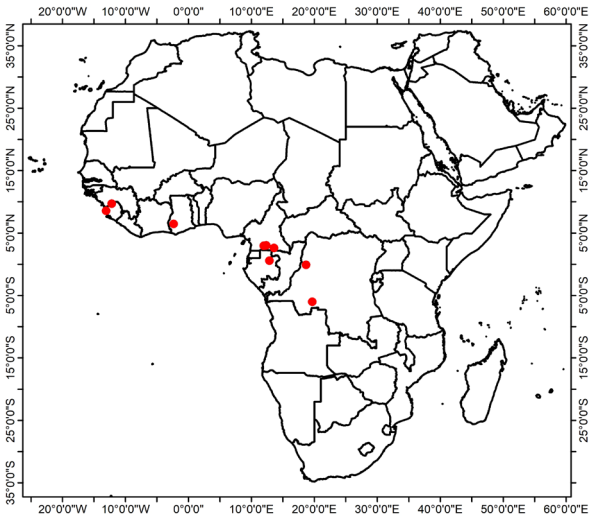


Figure 303. Distribution of *Hypsugo musciculus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Gabon, Ghana, Sierra Leone.

*1837. *Vespertilio Savii* Bonaparte, Iconografia Fauna italiana, 1, fasc. 20 and pl. Publication date: 1837. Type locality: Italy: Tuscany: Pisa [43 43 N 10 24 E]. Holotype: BMNH 1907.1.1.732: sad, partial skeleton. Collected by: Prince Charles Lucien ("Carlo") Jules Laurent Bonaparte. - Etymology: In honour of Gaetano Savi (1769 - 1844) (see Kozhurina, 2002: 17).
1839. *V[esperugo (Vesperus)] Savii:* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 316. (Name Combination)
1853. *V[esperugo] Savii:* Blasius, Arch. Naturgesch. Berlin, 19 (1): 46. (Name Combination)
1855. *Vespertilio (Vesperugo) Savii:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 734. (Name Combination)
1856. *Vesperus (Meteorus) Savii:* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (5): 166. (Name Combination)
1856. *Vesperus Savii:* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (4): 132. (Name Combination)
1859. *Scotophilus darwini* Tomes, Proc. zool. Soc. Lond., 1859, I (OS 27): 70. Publication date: February - June 1859. Type locality: Canary Islands (Spain): La Palma [28 40 N 17 50 W] [Goto Description]. Holotype: BMNH 1907.1.1.423: ad ♀, skull and alcoholic. Presented/Donated by: Charles Robert Darwin. Although Dobson (1878: 219) mentioned it was presented by Rev. R.T. Lowe. Formerly in Tomes collection.
1862. *Vespertilio (Meteorus) Savii:* Koch, Das Wesentliche der Chiroptern, 393. (Name Combination)
1871. *Vesperugo Savi:* Doderlein, Alcune generalita Intorno la Fauna Sicula de Vertebrati, ???. (Name Combination, Lapsus)
1885. *Vesperugo Savii:* Lataste, Act. Soc. Linn. Bordeaux, 39: 190?. (Name Combination)
1887. *Scotophilus darwinii:* Doria, Ann. Mus. civ. Stor. nat. Genova, 4 (2): 71. (Lapsus)
1904. *Vespertilio ochromixtus* Cabrera, Mem. Soc. espan. Hist. nat., 2: 269, pl. 3, fig. 1 and 4. Type locality: Spain: Balearic Islands, Menorca Island. Holotype: MNCN 1.094: ♂. Collected by: ?: Collector Unknown. Presented/Donated by: ?: Collector Unknown. - Comments: Some authors, e.g. Ellerman and Morrison-Scott (1951: 170), Gharaibeh (1997: 95) mention "Sierra de Guadarrama, Madrid, Spain" as type locality, but Ibáñez and Fernández (1989: 41) - explicitly referring to the type specimen - mention Menorca as type locality.
1912. *Pipistrellus savii:* Miller, Catalogue of the mammals of western Europe (Europe exclusive of Russia) in the collection of the British Museum, 219. (Name Combination)
1956. *Pipistrellus savii savii:* Kahmann and Goerner, Mammalia, 20: 358. (Name Combination)
1964. *Pipistrellus savii sevii:* Hanák, Acta Soc. Zool. Bohem., 28 (1): 83. (Lapsus)
1966. *Pipistrellus (Pipistrellus) savii darwini:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 170. (Name Combination)
1966. *Pipistrellus (Pipistrellus) savii savii:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 169. (Name Combination)
1966. *Pipistrellus (Pipistrellus) savii:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 169. (Name Combination)
1971. *Pipistrellus (Hypsugo) savii savii:* Lanza and Azzaroli, Lav. Soc. ital. Biogeog., nov. ser. 1: 698 (for 1970). (Name Combination)
1986. *[Hypsugo] savii:* Horácek and Hanák, Myotis, 23-24: 9. (Name Combination, Current Combination)
1987. *Hypsugo savii:* Menu, Palaeovert., 17 (3): 127. (Name Combination)
1987. *Pipistrellus (Hypsugo) savii:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 281. (Name Combination)
1997. *Pipistrellus savii ochromixus:* Gharaibeh, Systematics, distribution, and zoogeography of mammals of Tunisia, 95. Publication date: December 1997. (Lapsus)
2000. *Hypsugo savii savii:* Horácek, Hanák and Gaisler, Bats of the Palearctic region, 125. (Name Combination)
2002. *H[ypsugo] s[avii] darwini:* Trujillo, Ibáñez and Juste, Rev. suisse Zool., 109 (3): 549. (Name Combination)
2003. *H[ypsugo] savii darwinii:* Pestano, Brown, Suárez, and Fajardo, Mol. Phylogenet. Evol., 26 (1): 57. (Lapsus)
2007. *Hypsugo cf. darwinii:* Mayer, Dietz and Kiefer, Front. Zool., 4: 4. (Name Combination)

? *Pipistrellus savi:* (Name Combination, Lapsus)

TAXONOMY:
Koopman (1994: 114) considers this species to belong to the subgenus *Pipistrellus*. Horácek *et al.* (2000: 125) and Volleth *et al.* (2001: 27) assigned this species to the genus *Hypsugo*.

Based on mitochondrial DNA, Veith *et al.* (2011: 95, 98) report the presence of "*H.* cf. *darwinii*" on Sardinia, Turkey, the Canary Islands, Morocco, and Sicily), but they also indicate that "taxonomic conclusions, which are solely based on mitochondrial genes, may be misleading due to effects such as incomplete lineage sort ing, introgression, and selection on mitochondrial loci". However, as indicated by Puechmaille *et al.* (2012: 226), the mitochondrial data suggest the presence of cryptic species within "*H. savii*", which led these authors to use "*H.* cf. *savii*" for the North African populations.

COMMON NAMES:
Albanian: Pipistrel i Savi-it. Arabian: Khaffash. Armenian: Մաշեղանման փոքրաչղջիկ. Azerbaijani: Savi şəbpərəsi. Basque: Savi saguzar, Savi saguzarra. Belarusian: Нетапыр Саві. Bengali: Savir Chamchika. Bosnian: Savijev šišmiš. Breton: Gousper Savi. Bulgarian: Савиево прилепче. Castilian: Murciélago montañero, Murciélago de montaña. Catalan: Ratpenat muntanyenc, Rat penat muntanyero, Ratapinyada muntayenca. Croatian: Primorski šišmiš. Czech: Netopýr Saviů v, Netopýr alpský. Danish: Savis flagermus. Dutch: Alpendwergvleermuis, Alpenvleermuis, Savi's dwergvleermuis. English: Savi's Pipistrelle, Savi's Pipistrelle Bat. Estonian: Alpi nahkhiir. Finnish: Vuoristopiippa. French: Vespère de Savi, Pipistrelle de Savi. Frisian: Lytse Alpenflearmûs. Galician: Morcego montañeiro, Morcego do monte. Georgian: სავის ღამური. German: Alpenzwergfledermaus, Alpenfledermaus, Alpen-Pipistrelle, herzohrige Abendfledermaus. Greek: Βουνονυχτερίδα. Hebrew: atalefon savi, Atalfon Savi. Hungarian: Alpesi denevér, Nycteris i alpios. Irish Gaelic: Ialtóg Savi. Italian: Pipistrello di Savi. Latvian: Sāvi sikspārnis. Lithuanian: Savio šikšniukas. Luxembourgish: Alpen-Fliedermaus. Macedonian: Савиев лилјак [= Saviev Liljak]. Maltese: Pipistrell ta' Savi. Montenegrin: Savijev slijepi mišić. Norwegian: Klippeflaggermus. Polish: Pzymroczek Saviego. Portuguese: Morcego de Savii. Rhaeto-Romance: Pipistrel da Savi, Pipistrel da las alps. Romanian: Liliacul lui Savi. Russian: Нетопырь кожановидный, Кожановидный нетопырь [= Kozhanovidny netopyr]. Serbian: Дугодлаки сл[ij]епи мишић [= Dugodlaki sl[ij]epi mišić]. Scottish Gaelic: Ialtag Savi. Slovak: Večernica Saviho. Slovenian: Savijev netopir. Swedish: Alpfladdermus. Turkish: Savi'nin Cüce Yarasası. Ukrainian: Нетопир скельний (Саві). Welsh: Ystlum lleiaf Savi.

CONSERVATION STATUS:
Global - The species is widespread and abundant and there is no evidence of population decline. Consequently, it is assessed as Least Concern (LC ver 3.1 (2001)) (Hutson *et al.*, 2008p; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus savii*] (Hutson *et al.*, 2008p; IUCN, 2009).

MAJOR THREATS:
No major threats are known (Hutson *et al.*, 2008p; IUCN, 2009). Water stress and the aerial hawking feeding style are, however, identified as being major risk factors linked with climatic change (Sherwin *et al.*, 2012: 174). Bilgin *et al.* (2012: 434) predict that the range retraction for *H. savii* as a result of climatic change may pose severe threats to its survival as this species has the bulk of its range in the Mediterranean region.

CONSERVATION ACTIONS:
Hutson *et al.* (2008p) [in IUCN (2009)] report that it is protected by national legislation in some range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention in parts of its range where these apply. It is included in Annex IV of EU Habitats and Species Directive. It occurs in protected areas.

GENERAL DISTRIBUTION:
Hypsugo savii has a wide range in the Palaearctic (and marginally in Indomalaya), extending from southern Europe and north Africa (Morocco, Algeria, Tunisia, the Canary Islands of La Palma, Tenerife, La Gomera, Gran Canaria, and El Hierro, and the Cape Verde Islands of Santiago and San Vicente) through the Middle East and the Caucasus to Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan, Tajikistan, Afghanistan and northern India (Horácek and Benda, 2004; Simmons, 2005). It occurs from sea level to 3,000 m.

Bilgin *et al.* (2012) examining climate change scenarios within the Asia Minor and Levant region, predict *H. savii* to have a range contraction, which may pose severe threats to the survival of this species.

Native: Afghanistan; Albania; Algeria; Andorra; Austria; Azerbaijan; Bangladesh; Bosnia and Herzegovina; Bulgaria; Cape Verde Isls (Azzaroli Puccetti and Zava, 1988); China; Croatia; Cyprus; Czech Republic; France [Corse]; Georgia; Gibraltar; Greece [East Aegean Is., Kriti]; Holy See [Vatican City State]; Hungary; India; Iran, Islamic Republic of; Iraq; Israel; Italy [Sardegna, Sicilia]; Japan; Kazakhstan; Korea, Democratic People's Republic of; Korea, Republic of; Lebanon; Monaco; Mongolia; Montenegro; Morocco (Benda *et al.*, 2010a: 157; El Ibrahimi and Rguibi Idrissi, 2015: 362); Palestinian Territory, Occupied; Portugal; Russian Federation; San Marino; Serbia; Slovakia; Slovenia; Spain [Baleares, Canary Is.]; Switzerland; Syrian Arab Republic; Tunisia (Dalhoumi *et al.*, 2014: 53); Turkey; Turkmenistan; Ukraine.
Regionally extinct: Germany.
Vagrant: United Kingdom (Great Britain).
Presence uncertain: Armenia; Bhutan; Macedonia, the former Yugoslav Republic of.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Benda *et al.* (2011b: 38).

Park and Lee (2009: 267) found three types of lingual papillae in Korean specimens: filiform, fungiform, and circumvallate.

SEXUAL DIMORPHISM:
In Italian *H. savii* specimens, Rughetti and Toffoli (2014: 149) found a seasonal variability in body conditions, which was sex dependent. In late spring equal sized (Fa) females were heavier than males, although these differences were small in late summer. Additionally, the female's body mass decreased during late spring and summer most probably as the result of higher energy requirements for lactation. The male's mass did not change during this period.

ECHOLOCATION:
Papadatou *et al.* (2008b: 133) report the following data for 53 Greek specimens: F_{start}: 55.5 ± 10.64 kHz, F_{end}: 33.7 ± 1.43 kHz, F_{peak}: 36.7 ± 1.23 kHz, bandwidth: 8.7 ± 2.18 kHz, duration 6.8 ± 1.57 msec and interpulse interval: 148.5 ± 59.63 msec. For 32 calls from animals from France, Greece and Switzerland, Walters *et al.* (2012: suppl.) present the following numbers: duration: 8.23 ± 3.19 msec, F_{max}: 46.59 ± 12.95 kHz, F_{min}: 32.64 ± 2.26 kHz, bandwidth: 13.95 ± 11.88 kHz, F_{peak}: 34.87 ± 3.15 kHz.
Five calls of animals from Iran had the following values reported by Benda *et al.* (2012a: 182): F_{start}: 42.5 ± 2.1 (40.9 - 45.9) kHz, F_{end}: 36.1 ± 0.3 (35.7 - 36.3) kHz, F_{peak}: 37.4 ± 0.7 (36.7 - 38.4) kHz, duration: 9.4 ± 0.4 (8.8 - 9.7) msec, and interpulse interval: 185.6 ± 4.0 (182.1 - 191.3) msec.

In Morocco, Disca *et al.* (2014: 226) report the type of call for "*Hypsugo* cf. *savii*" as FM-QFC, with the following parameters: F_{start}: 52.7 ± 7.2 kHz, F_{end}: 32.3 ± 0.7 kHz, F_{peak}: 34.0 ± 1.0 kHz, bandwidth: 20.3 ± 6.8 kHz, duration: 6.8 ± 0.7 msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003), Mayer *et al.* (2007), and García-Mudarra *et al.* (2009).

Karyotype - Capanna (1968), Zima (1982) and Volleth *et al.* (2001) reported 2*n* = 44, Fna = 50, BA = 8, a metacentric X and a submetacentric Y chromosome. Rushton (1970: 465) reported 2*n* = 44, FN = 50, X = metacentric, and Y = acrocentric. Arslan and Zima (2014: 13) added that the autosomal complement consists of three large and one small metacentrics, 15 acrocentrics and two dot-like pairs. Capanna and Manfredi Romanini (1971: 474) described the autosomal chromosomes as 3 pairs of metacentric, 1 submetacentric and 17 acrocentrics.

Protein / allozyme - Unknown.

DIET:
Benda *et al.* (2012a: 402 - 403) report the following major food groups for different areas, indicating that this species is an opportunistic feeder:
* Lepidoptera, Diptera, Hymenoptera and Neuroptera (Switzerland);
* Homoptera, Heteroptera and smaller representatives of Lepidoptera (Balkans and West Turkestan);
* Formicoidea, Heteroptera, Coleoptera and Lepidoptera (Syria);
* Coleoptera and Formicoidea (Turkey);
* Auchenorrhyncha, small Lepidoptera, Coleoptera (mainly Staphilinidae), nematoceran Diptera (Chironomidae, Culicidae), Sternorrhyncha (Aphididae), Neuroptera (Chrysopidae, Hemerobiidae), Heteroptera, Hymenoptera (small Apocrita), and Trichoptera (Iran: Fars);
* Small Lepidoptera, Neuroptera (Chrysopidae), Sternorrhyncha (Aphididae), Heteroptera, Coleoptera,and nematoceran Diptera (Culicidae) (Iran: Khorasan).

POPULATION:
Structure and Density - In the western part of its range it generally occurs at low densities and is restricted by its habitat requirements, but it is abundant in some European areas bordering the Mediterranean. Summer maternity colonies usually number 20 - 70 females. In the Canary

Islands it is the commonest bat species. In the eastern part of its range population size and trends are not known (Molur *et al.*, 2002).
Trend - 2008 - Stable (Hutson *et al.*, 2008p; IUCN, 2009). *H. savii* populations within the Asia Minor and Levant region are predicted to have a stable population trend, under climate change scenarios (Bilgin *et al.*, 2012: 433).

PARASITES:
In Italy, Voyron *et al.* (2011: 193) reported *Aspergillus sydowii* and *Cladosporium cladosporioides* (Fungi) from live *H. savii* specimens.

In Algeria, Bendjeddou *et al.* (2013: 325) found *Rhipicephalus sanguineus* (Latreille, 1806) (Arachnidae: Ixodida: Ixodidae). The following ectoparasites were reported by Bendjeddou *et al.* (2017: 15): Siphonaptera: *Ischnopsyllus octactenus* (Kolenati, 1856); Heteroptera: *Cimex pipistrelli* Jenyns, 1839; Arachnida: *Argas transgariepinus* White, 1846.

VIRUSES:
Coronaviridae:
Alphacoronavirus
This virus was reported by Kohl and Kurth (2014: 3112) from Italy.
Betacoronavirus
Kohl and Kurth (2014: 3112) reported this virus from Spain and Italy.

Orthomyxoviridae
Despite sampling and testing of 2 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

Rhabdoviridae
"Various European bat lyssaviruses" were reported by Kohl and Kurth (2014: 3114) from various European countries.

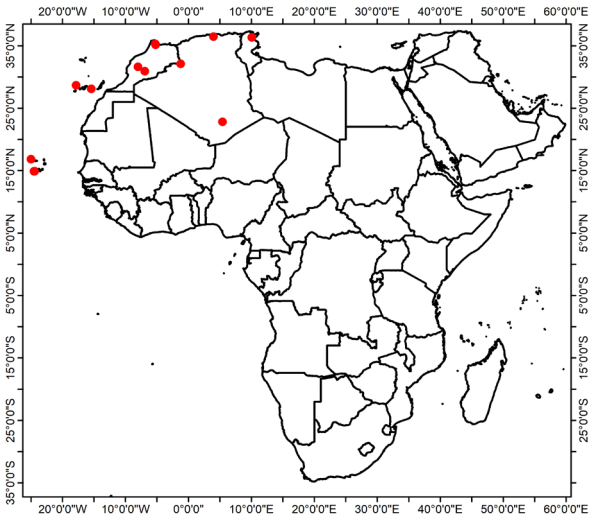


Figure 304. Distribution of *Hypsugo savii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, Canary Islands (Spain), Cape Verde, Italy, Morocco, Spain, Tunisia.

Genus ***Laephotis*** Thomas, 1901

*1901. *Læphotis* Thomas, Ann. Mag. nat. Hist., ser. 7, 7 (41): 460. Publication date: 1 May 1901 [Goto Description]. - Comments: Type species: *Læphotis Wintoni* Thomas, 1901. - Etymology: From the Greek "*laephotis*" meaning cloaked, veiled. Although, a note in the description of the genus suggested the name meant "sail" in Greek (Thomas, 1901d: 460). Palmer (1904: 359) mentions it as from the Greek "*λαίφος*", meaning sail and "*οὖς*" or "*ὠτός*", meaning ear, referring to the large ears. Gardner (2005: 184) considers this name to be masculine (*Leaph* = sail + *ot* = ear(ed) + is (Latin third declension ending).
? *Laephotis:* (Current Spelling)

TAXONOMY:
The genus *Laephotis* was considered monotypic with two subspecies). But Peterson (1971b) introduced *wintoni* and *angolensis* as distinct species, while Setzer (1971) described two further species, *namibensis* and *botswanae*. However, inter-specific relations remain unresolved largely because specimens are few and in scattered collections (Kock and Howell, 1988, Stanley and Kock, 2004). Several specimens from South Africa were assigned to *L. wintoni* and *L.* cf. *wintoni* on the basis of multivariate analyses (Rautenbach and Nel, 1978b, Watson, 1990a, Kearney and Taylor, 1997). Given the distance of South African localities from other populations of *L. wintoni* in Kenya and Ethiopia, this identification was considered with some scepticism and not followed by Honacki *et al.* (1982) or Andrianaivoarivelo *et al.* (2007). Specimens described by Rautenbach and Nel (1978b) were subsequently provisionally placed with *L. namibensis* (Skinner and Smithers, 1990: 105). Kock and Howell (1988) and Stanley and Kock (2004) identified several cases where specimens identified as *L. angolensis* have been re-identified as *L. botswanae* or *L.* cf. *angolensis*. Morphometric analyses that included palatal and post-palatal measurements (Kearney and Seamark, 2005) allowed the distinction of *L.*

botswanae and *L.* cf. *angolensis* from other species of *Laephotis*, and suggested the assignment of specimens from KwaZulu Natal previously identified as *L.* cf. *wintoni* to *L. botswanae*. However, the distinction between *L. wintoni* and *L. namibensis* was not confirmed and still remains to be clarified (Kearney and Seamark, 2005).
In his initial description of the genus *Laephotis*, Thomas (1901d) suggested the genus was most closely allied to *Vespertilio*. Tate (1942) considered *Laephotis* the closest relative of the Neotropical big-eared genus, *Histiotus*, which in turn was considered an offshoot of *Eptesicus*. However, the ears in *Laephotis* are not as greatly enlarged as in *Histiotus*, nor are they connected across the forehead (Hayman and Hill, 1971). On geographic grounds, Williams and Mares (1978) doubted the association with *Histiotus*. Hill (1974a) considered *Laephotis* an independent offshoot of *Eptesicus*.

Placed in tribe Vespertilionini by Hill and Harrison (1987) on basis of baculum morphology and retained in that tribe by Simmons (2005).

In a cladistic analysis of bacular morphology *Laephotis* nested within *Neoromicia* (Kearney *et al.*, 2002). The molecular results of Stadelmann *et al.* (2004b) support this, and those of Hoofer and Van Den Bussche (2003) would be similar, if the suggestion that *nanus* is moved to the genus *Neoromicia*, as indicated by chromosomal analysis and bacular morphology (Kearney *et al.*, 2002), had been followed.

Although considered monotypic by Hayman and Hill (1971), four species are currently recognised (Simmons, 2005); *L. angolensis* Monard, 1935, *L. botswanae* Setzer, 1971, *L. namibensis* Setzer, 1971, and *L. wintoni* Thomas, 1901, see review by Jobling (1939). Specimens of this rarely caught bat, from the Western Cape Province in South Africa, were initially identified as *Laephotis wintoni* (Rautenbach and Nel, 1978b), and then later as *Laephotis namibensis* (Skinner and Smithers, 1990). This change in species identification has led to considerable confusion in the literature (Honacki *et al.*, 1982; Corbet and Hill, 1991; Koopman, 1994; Bronner *et al.*, 2003; Jacobs *et al.*, 2005; Simmons, 2005). Separation of *L. namibensis* and *L. wintoni* using morphometric analyses of cranial and dental characters, which include Hill (1974a)'s palatal and post-palatal measurements, that Stanley and Kock (2004) found useful in the separation of *L. botswanae* and *L. wintoni*, remains problematic (Kearney and Seamark, 2005).

Bacular studies have also failed to show differences between some species of *Laephotis* (Kearney *et al.*, 2002). Monadjem *et al.* (2010d: 430) suggests that molecular studies may be necessary to sort out the current confusion over species limits within this genus.

Without mentioning a reason, Taylor and Tuttle (2019: 282, 283) transferred all of the *Neoromicia* species (as well as *Hypsugo anchietae*) to the genus *Laephotis*.

Known species of the genus *Laephotis*: ***angolensis*** Monard, 1935; ***botswanae*** Setzer, 1971; ***namibensis*** Setzer, 1971; ***wintoni*** Thomas, 1901.

COMMON NAMES:
Czech: de Wintonovi netopýři. English: Long-eared Bats, African Long-eared Bats, Tropical Long-eared Bats. French: Oreillards d'Afrique, Noctophiles, Chauves-souris à longues oreilles. German: Afrikanische Langohrfledermäuse. Italian: Lefòti.

GENERAL DISTRIBUTION:
A small genus with four species, endemic to Africa south of the Sahara (Kearney, 2013a: 578).

BIOGEOGRAPHY:
A fairly wide range of biotic zones and habitats are exploited by this genus: the Somalia Masai Bushland, Zambezian Woodland, the Southern Rainforest—Savanna Mosaic (marginally), Afromontane Afroalpine, Highveld, South West Arid and South West Cape BZs (Kearney, 2013a: 579).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
The genus *Laephotis* is distinguished from all other African vespertilionid in part by the relatively long ears (> 16.5 mm, almost half the length of the FA) and large triangular tragus (Monadjem *et al.*, 2010d: 430). Distinguishing the four species of *Laephotis* from each other is not currently possible on external features (Monadjem *et al.*, 2010d: 430). There is a slight difference in mean size between *L. botswanae* and *L. angolensis*, with the former being larger, but this difference may be due to the very small sample size of measured *L. angolensis* (Monadjem *et al.*, 2010d: 430).

DENTAL FORMULA:
$^{2113}/_{3123}$ = 32 (like *Otonycteris* but as in *Glauconycteris*, *Eptesicus*, some *Pipistrellus* and *Mimitellus*) (Kearney, 2013a: 578). The upper and lower premolars are tall teeth, almost the same height as the canines, and this, together with toothwear on the canines, might account for the

suggestion that the canines are extremely reduced (Hayman and Hill, 1971, Kingdon, 1974).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
Kearney and Seamark (2005) identified four cranial measurements based on a multivariate morphometric analysis to separate *L. botswanae* from the other three congeners. The post-palatal measurement of the distance from a line across the rear margins of the third upper molar to the anterior edge of the mesopterygoid fossa is shorter than the distance from the anterior edge of the mesopterygoid fossa to the tips of the pterygoid hamulars in the *L. botswanae*/*L. angolensis* group, but longer in the *L. namibensis*/*L. wintoni* group (Hill, 1974a,Stanley and Kock, 2004, Kearney and Seamark, 2005).

DETAILED MORPHOLOGY:
Bacula- Bacular studies have also failed to show differences between some species of *Laephotis* (Kearney *et al.*, 2002). Monadjem *et al.* (2010d: 430) suggests that molecular studies may be necessary to sort out the current confusion over species limits within this genus.

Laephotis angolensis Monard, 1935

*1935. *Laephotis angolensis* Monard, Arq. Mus. Bocage, 6: 45. Type locality: Angola: 15 km W Dala: Tyihumbwe [=Tschiumbe / Tyiumbwe / Tyhumbwe / Chiu [11 02 S 20 04 E] [Goto Description]. Holotype: MHNC ♀. Collection date: September 1932. - Etymology: Referring to the country where the type specimen was collected. (Current Combination)
? *Laephotis cf. angolensis*
? *Laephotis wintoni angolensis:* (Name Combination)

TAXONOMY:
Described, as a distinct species, from a single specimen, ♀ with damaged skull, but subsequently considered a subspecies of *L. wintoni* (Ellerman *et al.*, 1953, Hayman and Hill, 1971). Although currently treated as a distinct species, the relationship between *L. angolensis* and *L. botswanae* is obscure, partly because specimens of *L. angolensis* are so scarce that variation within this form cannot be assessed (Kearney, 2013b: 580). Peterson (1973) suggests that *L. botswanae* may prove to be a larger, southern race of *L. angolensis*. However, both species occur together in S DR Congo (Setzer, 1971). Several specimens originally considered to represent *L. w. angolensis* were later reassigned to *L. botswanae* (Smithers, 1971, Hill, 1974a).
Laephotis botswanae and *L. angolensis* may be conspecific, which would make the former a larger race of the latter (Peterson, 1971b, Kearney and Seamark, 2005). This possibility is reflected in records of both taxa from southeastern Katanga, DRC (Monadjem *et al.*, 2010d: 430).
Stanley and Kock (2004), being concerned about the correct assigment of the species that is known from very few specimens, referred to specimens in the Natural History Museum, London collection, as cf. *angolensis*. In a morphometric analysis with specimens of the other *Laephotis* taxa, these specimens were distinct from *L. botswanae*, and *L. wintoni* / *L. namibensis*, however, it was suggested this small difference, based on two specimens of *angolensis*, may disappear with the addition of more specimens of both *angolensis* and *botswanae* (Kearney and Seamark, 2005: 85). Peterson (1973: 602) had suggested that "*L. bostwanae* may prove to be a larger, southern race of *L. angolensis*".

No subspecies currently recognized.

COMMON NAMES:
Czech: netopýr angolský. English: Angolan Long-eared Bat. French: Oreillard d'Angola, Chauve-souris à longues oreilles d'Angola, Noctophile d'Angola. German: Angola-Langohrfledermaus.

SIMILAR SPECIES:
Not easily distinguished from other *Laephotis* (Monadjem *et al.*, 2010d: 430, Kearney, 2013b: 580).
Laephotis botswanae - Ventral pelage paler. Tragus broader; posterior margin more angular. Skull longer (GLS: 14.1 - 15.5 mm) and usually broader (GWS: 8.0 - 8.8 mm). Rostrum slightly longer and broader, palate longer (Hill l 974a). and relationship with *L. botswanae* is uncertain.
L. wintoni - Forearm longer (37 - 41 mm). Ears longer (21 - 24 mm) and broader. Skull longer and broader (GLS: 15.6 - 16.3 mm, GWS: 8.8 - 9.5 mm, C-M3: 5.1 - 5.3 mm).
L. namibensis - Forearm usually longer 37.8 (36 - 40 mm). Ears longer (22 - 25 mm). Skull larger (GLS: 16.1 - 17.0 mm, GWS: 8.4 - 9.2 mm, C-M3: 4.8 - 5.4 mm).

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing doubts as to its taxonomic validity as well as absence of recent

information on its extent of occurrence, status, ecological requirements and threats (Jacobs *et al.*, 2008m; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008m; IUCN, 2009). 2004 - NT ver 3.1 (2001) (Jacobs *et al.*, 2004c; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not known (Jacobs *et al.*, 2008m; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008m) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, and it is not known if the species is present within any protected areas. Further studies are needed into the taxonomy, distribution, natural history and potential threats to this poorly known species.

GENERAL DISTRIBUTION:
Laephotis angolensis is known from two localities in Angola (including the type locality of Tyihumbwe [Chiumbe], 15 km west of Dala) and a single locality in the Democratic Republic of the Congo (Mumeme, East of Likasi, Shaba Province). Hill and Carter (1941) suggest that the species may occur throughout eastern Angola, but more sampling is needed here.

Laephotis angolensis is endemic to southern Africa (Kearney and Seamark, 2005). Apparently restricted to the Zambezian Woodland BZ and the southern fringe of the Southern Rainforcst Savanna Mosaic (Kearney, 2013b: 580). *Laephotis angolensis* is known from just four specimens collected at three localities (Kearney and Seamark, 2005) in Angola and SE DR Congo (Peterson, 1973, Setzer, 1971, Hill, 1974a).

Native: Angola (Monard, 1935; Hill and Carter, 1941; Kearney and Seamark, 2005: 87; Monadjem *et al.*, 2010d: 563; Taylor *et al.*, 2018b: 60); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Stanley and Kock, 2004; Kearney and Seamark, 2005: 87 as *L.* cf. *angolensis*); Kearney and Seamark, 2005: 85; Simmons, 2005; Monadjem *et al.*, 2010d: 563).
Presence uncertain: Namibia (Griffin, 1999: 30).

GEOGRAPHIC VARIATION:
None (Kearney, 2013b: 580).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Laephotis angolensis is a small bat with an estimated mass of around 5 - 6 g (Monadjem *et al.*, 2010d: 430), it is very similar in size and appearance to the slightly larger *L. botswanae*, from which it cannot be reliably separated on external characters (Kearney and Seamark, 2005, Monadjem *et al.*, 2010d: 430).
The face is plain, without noseleaf and with tail more or less fully enclosed in interfemoral membrane.
Dorsal pelage yellowish-brown to reddish-brown; hairs distinctly bicoloured (Monadjem *et al.*, 2010d: 430), mid-dorsal hairs ca. 7 mm: basal 5 mm blackish-brown, terminal 2 mm yellowish-brown or reddish-brown (Kearney, 2013b: 580).
Ventral pelage pale grey on chin, paler on throat, becoming cream or white in pelvic region; hairs (except pelvic region) blackish-brown with pale grey, cream or white tip. Ventral hairs in pelvic region pure white (Kearney, 2013b: 580).
The naked skin on muzzle and around eyes is dark brown.
The long ears are dark brown, roughly triangular but very elongated; tip rounded; inner margins almost meeting on forehead but not joined at base. Ears may he held erect above head or (when resting) held sideways at right angles to head (Kearney, 2013b: 580). Ears separated, of medium length for a vespertilionid (15 – 18 mm) and of medium relative length (45 - 46 % of FA, n = 2) (Kearney, 2013b: 580).
Tragus with notch at base of posterior margin as in *L. botswanae*, but diagnostic differences between the tragi of these species, if present, are not known (Kearney, 2013b: 580).
Wings dark brown (Monard, 1935); arm-wing with whitish hind border. Interfemoral membrane medium-brown, more translucent.

DENTAL FORMULA:
$^{2113}/_{3123}$ = 32.
Four upper and five lower cheekteeth and two upper incisors on each side.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
In lateral profile the braincase is slightly flattened, but raises slightly above the rostrum (Monadjem *et al.*, 2010d: 430); rostrum rather narrow; zygomatic arches slender; no sagittal crest; lambdoid crest weakly developed. Skull apparently shorter and usually narrower than in other *Laephotis* but data very limited (GLS: 13.7 13.8 mm; GWS: 6.7, 8.1 mm, n 2). Palatal length 6.1, 6.2 mm (n 2) (cf. > 6.4 mm in *L. botswanae* and *L. wintoni*) (Hill 1974a).
The upper premolar is sharply pointed and rises above the molars (Monadjem *et al.*, 2010d: 430).

DETAILED MORPHOLOGY:
Karyotype - Not recorded (Monadjem *et al.*, 2010d: 430, Kearney, 2013b). Monadjem *et al.* (2010d:

430) suggests the diploid number is likely to be 2n = 34 as in other species of *Laephotis*.

SEXUAL DIMORPHISM:
No information (Kearney, 2013b: 580).

ECHOLOCATION:
The echolocation call of this species has not been recorded (Monadjem *et al.*, 2010d: 430).

HABITAT:
Nothing is currently known on the habitat of *L. angolensis* (Monadjem *et al.*, 2010d: 430, Kearney, 2013b: 580). All records have come from the savanna biome (Kearney and Seamark, 2005: 85).

HABITS:
Nothing else is known about the habits of this species (Kearney, 2013b: 580; Monadjem *et al.*, 2010d: 430).

ROOST:
Nothing is known about the roosting sites (Monadjem *et al.*, 2010d: 430).

DIET:
There is no information on the diet of this species (Monadjem *et al.*, 2010d: 430).

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - The populations abundance is not well known, however, 25 specimens were collected at one locality (Jacobs *et al.*, 2008m; IUCN, 2009). Rare (Kearney, 2013b: 580).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008m; IUCN, 2009).

PARASITES:
ACARI
Ixodidae: *Rhipicephalus simus*, (Anciaux de Faveaux, 1984), although the information is uncertain because the identity of the host still needs to be confirmed (Kearney, 2013b: 580).
Spinturnicidae: *Spinturnix walkei*, (Anciaux de Faveaux, 1984), although the information is uncertain because the identity of the host still needs to be confirmed (Kearney, 2013b: 580).
Macronyssidae: *Steatonyssus* sp., (Anciaux de Faveaux, 1984), although the information is uncertain because the identity of the host still needs to be confirmed (Kearney, 2013b: 580).

HEMIPTERA
Cimicidae: *Cacodmus villosus* (Stâl, 1855) (Kock and Aellen, 1987: 876; Kearney, 2013b: 580).

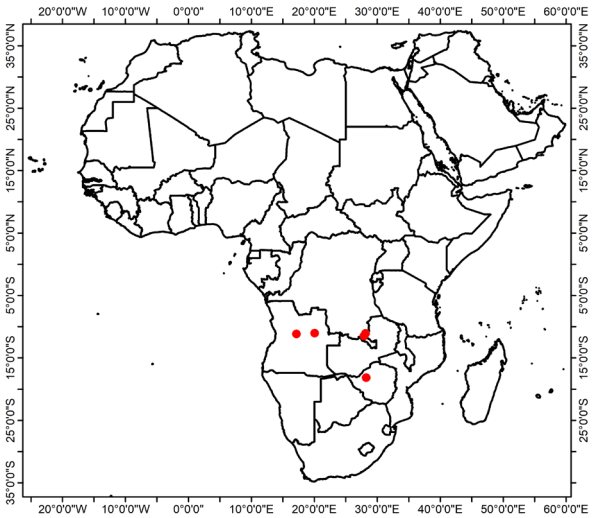


Figure 305. Distribution of *Laephotis angolensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Congo (Democratic Republic of the), Zambia, Zimbabwe.

Laephotis botswanae Setzer, 1971

1957. *Laephotis wintoni angolensis:* Ansell, Ann. Mag. nat. Hist., ser. 12, 10 (115): 538. (Name Combination)

*1971. *Laephotis botswanae* Setzer, Proc. Biol. Soc. Wash., 84 (32): 260, fig. 1b, 1d. Publication date: 4 November 1971. Type locality: Botswana: 50 mi (80 km) W and 12 mi (19 km) S Shakawe [18 21 S 21 52 E] [Goto Description]. Holotype: USNM 425349: ad ♀, skin and skull. Collected by: S.W. Goussard; collection date: 24 May 1967; original number: 691. - Comments: Although Schmidt *et al.* (2008: 35) mention the coordinates of the type locality as 18 32 S 21 05 E. - Etymology: The specimen from which the species was described originated near Shakawe in north-western Botswana (Taylor, 2005). (Current Combination)

1974. *Laephotis wintoni:* Hill, Bull. Br. Mus. (nat. Hist.) Zool., 27 (2): 75. Publication date: 18 July 1974. - Comments: Not of Thomas, 1901. (Name Combination)

? *Laephotis angolensis:* - Comments: Not of Monard, 1935. (Name Combination)

? *Laephotis cf. wintoni:*

TAXONOMY:
The distinction between *L. botswanae* and *L. angolensis* remains obscure and many specimens originally described as *L. angolensis* have been reassigned to *L. botswanae* (Hill, 1974a, Ansell, 1978) or remain of unsettled identity (Fenton and Bell, 1981, Fenton, 1985). Both species occur together in S DR Congo (Setzer, 1971), for this reason Kock and Howell (1988) question the validity of the species status of *botswanae*. As *Laephotis botswanae* and *L. angolensis* may be conspecific, which would make the former a larger race of *L. angolensis* (Peterson, 1971b, Kearney and Seamark, 2005).

In a morphometric analysis with specimens of the other *Laephotis* taxa, *L. bostwanae* was distinct from *L. angolensis* and *L. wintoni*/*L. namibensis*, however, it was suggested the small difference, based on two specimens of *angolensis*, may disappear with the addition of more specimens of both *angolensis* and *botswanae* (Kearney and Seamark, 2005: 85). Peterson (1973: 602) had suggested that "*L. bostwanae* may prove to be a larger, southern race of *L. angolensis*".

No subspecies recognized (Kearney, 2013c: 581).

COMMON NAMES:
Afrikaans: Botswana-langoorvlermuis. Czech: netopýr bečuánský. English: Botswana Long-eared Bat, Botswanan Long-eared Bat. French: Oreillard du Botswana, Chauve-souris à longues oreilles du Botswana, Noctophile du Botswana. German: Botswana-Langohrfledermaus.

SIMILAR SPECIES:
Not easily distinguished from other *Laephotis*, and relationship with *L. angolensis* is uncertain.
Laephotis angolensis - Ventral pelage darker. Tragus narrower, posterior margin less angular. Skull shorter (GLS: 13.7 - 13.8 mm) and usually narrower (GWS: 6.7, 8.1 mm), but data very limited. Rostrum slightly shorter and narrower; palate shorter (Hill, 1974a).
L. wintoni - Forearm on average longer 39.6 (37 - 41) mm). Skull usually larger, GLS: 16.0 (15.6 - 16.3) mm; C-M^3: 5.2 (5.1 - 5.3) mm.
L. namibensis - Skull longer, GLS: 16.1 - 17.0 mm.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Schlitter, 2008e; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Schlitter, 2008e; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Schlitter, 2004c; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Taylor *et al.*, 2016f). 2004 - VU D2 ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Schlitter, 2008e; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008e) [in IUCN (2009)] report that there appear to be no direct conservation measures in place, however, it is possible that given the species wide range, it is present in some protected areas. Further studies are needed into the taxonomy, distribution, abundance and possible threats to this species.

GENERAL DISTRIBUTION:
Laephotis botswanae is near-endemic to southern Africa, occurring marginally beyond this region in the extreme southwest of Tanzania (Kearney and Seamark, 2005). *Laephotis botswanae* is known from several apparently disjunct locations in Southern and East Africa. Known from scattered localities in the Zambezian Woodland BZ and marginally in one part of the Kalahari Desert area in the South-West Arid BZ (Kearney, 2013c: 581). Recorded from Angola, S DR Congo, S Tanzania, Zambia, Malawi, N Botswana, the Caprivi of Namibia, Zimbabwe, South Africa. The most southern record is based on re-identified specimens from Hella-Hella (KwaZulu Natal, South Africa) (Kearney and Seamark, 2005). Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 988,632 km^2.

It has been recorded from Huila in Angola; northeastern Namibia and adjacent Botswana; central and southern Zimbabwe and adjacent northeastern South Africa; northern Zambia and extreme southern Democratic Republic of the Congo; Malawi and Mozambique); and from a single locality in southern Tanzania.

Native: Angola (Kearney and Seamark, 2005: 87; Monadjem *et al.*, 2010d: 563); Botswana (Kearney and Seamark, 2005: 87; Monadjem *et al.*, 2010d: 563); Congo (The Democratic Republic of the) (Kearney and Seamark, 2005: 87; Monadjem *et*

al., 2010d: 564); Malawi (Ansell and Dowsett, 1988; Happold and Happold, 1997a; Kearney and Seamark, 2005: 87; Monadjem *et al.*, 2010d: 564); Mozambique (Monadjem *et al.*, 2010c: 383); Namibia (Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 564); South Africa (Kearney and Seamark, 2005: 87; Simmons, 2005; Monadjem *et al.*, 2010d: 564); Tanzania (Kock and Howell, 1988; Bauer, 1992; Stanley and Kock, 2004: 176; Kearney and Seamark, 2005: 87); Zambia (Ansell, 1960a, Kearney and Seamark, 2005: 87; Monadjem *et al.*, 2010d: 564); Zimbabwe (Cotterill, 1996a; Kearney and Seamark, 2005: 87; Monadjem *et al.*, 2010d: 564).
Presence uncertain: Mozambique.

GEOGRAPHIC VARIATION:
Pelage colour varies according to locality. The dorsal pelage of TM specimens from South Africa are reddish-brown, those from Zimbabwe are paler brown (Kearney, 2013c: 581).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Laephotis botswanae is a small bat with a mass of around 6 - 7 g, plane faced without noseleaf and with tail more or less fully enclosed in interfemoral membrane; four upper and five lower cheekteeth and two upper incisors on each side; ears separated, of medium length for a vespertilionid (17- 22 mm) and of medium relative length (44 - 64 % of FA, n = 22).
Pelage soft, slightly shaggy on rump; mid-dorsal hairs ca. 8 mm.
Dorsal pelage reddish-brown, chocolate brown or pale brown; hairs distinctly bicoloured, basal 6 mm blackish-brown, terminal 2 mm reddish-brown, chocolate brown or pale brown.
Ventral pelage creamy-brown on chin, paler on throat, becoming cream or white in pelvic region; hairs (except in pelvic region) with basal 4 mm blackish-brown, terminal 4 mm creamy-brown, cream or white. Hairs in pelvic region pure white.
The naked skin on muzzle and around eyes is brown.
Ears pale to medium brown, roughly triangular with broad base and rounded tip; reaching well beyond snout when laid forward; inner margins almost meeting on forehead, but not joined. Ears may be held erect above the head or (when resting) held horizontally at right-angles to head (Kearney, 2013c: 581). Wings dark brown; arm-wing usually with whitish hind-border; interfemoral membrane paler and more translucent.

DENTAL FORMULA:
$^{2113}/_{3123}$ = 32.
The upper premolar is sharply pointed and rises above the molars.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
As in all *Laephotis* spp. With braincase slightly flattened (rises slightly above the rostrum); rostrum rather narrow; zygomatic arches slender and weak; no sagittal crest; lambdoid crest weakly developed. Skull on average medium-short and of medium width for the genus (CBS: 14.4 - 15.5 mm; GWS: 8.0 - 8.8 mm). Palatal length 6.7 (6.2 - 7.3) mm, n = 21 (Kearney and Seamark, 2005), CBS: 14.1 - 15.5 mm (Kearney, 2013c: 581). Scott *et al.* (2012: 2943) report that the mandibular symphyse is unfused, with smooth surfaces.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002), which showed no difference to *L. namibensis*.

FUNCTIONAL MORPHOLOGY:
Aspect ratio low; wing-loading very low (Malawi; M. Happold *pers. comm.* in Kearney (2013c: 582)). Flight highly manoeuvrable; turns by banking (minimum radius < 25 cm) and by stalling-and-twisting; individuals were able to sustain flight in a 1 x 1 x 1 m enclosure for up to three circuits/flight (6 bats, 10 flights each; M. Happold *pers. comm.* in Kearney (2013c: 582)). Can take off from ground. Not easily able to climb or scuttle.

SEXUAL DIMORPHISM:
Sexes similar (Monadjem *et al.*, 2010d, Monadjem *et al.*, 2010d: 432, Kearney, 2013c: 581).

ECHOLOCATION:
Pierce *et al.* (2012: 41) report a mean peak frequency of 37.13 ± 2.37 kHz, and a mean bandwidth of 26.43 ± 11.49 kHz, with a duration of 2.68 ± 1.09 ms. Hand-released specimens from Malawi produced slightly longer FM-QCF (quasi-constant frequency) calls that had similar frequency parameters: duration: 4.73 ± 1.10 ms, mean peak frequency: 32.34 ± 1.42 kHz, and mean bandwidth of 29.72 ± 9.62 kHz. The maximum frequency in cluttered space was found to be 48.94 ± 4.6 kHz, as compared with 60.78 ± 9.33 kHz in open space.
Laephotis botswanae produces LD-FM echolocation calls with an intermediate peak frequency (33 kHz), broad bandwidth (22 kHz), and intermediate duration (5 ms). Besides the fundamental, the second and third harmonics are often present on the spectrogram (Fenton and Bell, 1981; also see Fenton and Thomas (1980).
Search-phase call-shape (Malawi) (a) steep FM/ QCF and (b) smooth steep/shallow FM (six bats recorded as released, one tethered; M. Happold *pers. comm.* in Kearney (2013c: 582). Start-frequency 60 - 72 kHz; end-frequency 29 - 33 kHz; peak- frequency 29 - 33 kHz; call-duration ca. 3 -

5 ms (155 calls). (b) Start- frequency 47 - 49 kHz; end-frequency 32 - 33 kHz; call-duration 15 ms (12 calls). Fenton and Bell (1981) reported calls from *Laephotis* of uncertain identity from Zimbabwe (see above) for which call-shape (based on one illustrated call) was angular steep/shallow FM; start- frequency 55 kHz; end-frequency 32 kHz; peak-frequency 33 kHz; maximum call-duration 5 ms. Although call shapes differed, the peak-frequency was the same in calls from Malawi and Zimbabwe, suggesting that the bats in both localities represent *L. botswanae* (Kearney, 2013c: 582).

Taylor *et al.* (2013b: 17) recorded two *L. botswanae* calls in Waterberg, South Africa, with the following parameters: F_{max}: 51.6 (50.3 - 53.0) kHz, F_{min}: 32.0 (31.8 - 32.2) kHz, F_{knee}: 35.6 (35.3 - 35.8) kHz, F_{char}: 33.0 (32.8 - 33.3) kHz, duration: 3.0 (2.9 - 3.1) msec. In the Mapungubwe National Park (RSA), Parker and Bernard (2018: 57) recorded 20 calls with F_{char}: 31.46 ± 1.47 kHz, F_{max}: 53.20 ± 7.20 kHz, F_{min}: 30.75 ± 1.28 kHz, F_{knee}: 37.38 ± 1.77 kHz, duration: 6.49 ± 2.68 msec and 6.79 ± 2.71 calls/sec.

3 calls recorded by Adams and Kwiecinski (2018: 4) had the following characteristics: F_{char}: 38.8 ± 0.7 kHz, F_{max}: 68.5 ± 0.5 kHz, F_{min}: 37.9 ± 0.9 kHz, duration: 2.2 ± 0.3 msec.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 34,FN = 50, BA = 18, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from South Africa.
Protein / allozyme - Unknown.

HABITAT:
Most specimens have been caught in mist-nets, usually over or close to water, in riverine woodland or woodland savanna (Monadjem *et al.*, 2010d: 435, Kearney, 2013c: 582). Their association with rocky outcrops has been noted in some localities (Herholdt, 1989, Cotterill, 1996a). In Malawi, recorded near streams, and lakes in montane and sub montane evergreen forest at 1520 - 1700 m, from miombo woodland near sub-montane rainforest at 1350 - 1500 m, from mosaic of miombo woodland, farmland and riverine woodland near rocky hills, dams, streams and marshes at 1000 m, and in ornamental gardens in the town of Zomba (800 900 m), with rocky hills nearby (Happold and Happold, 1997b).

Found in both savanna (75 % of specimen records) and grassland biomes (25 % of specimen records) (Kearney and Seamark, 2005: 85). However, since all the grassland biome records are from high altitude localities in Malawi (Happold and Happold, 1997b), it was suggested the identification of the specimens from Malawi should be confirmed using palatal and post-palatal measruements (Kearney and Seamark, 2005: 85).

Cooper-Bohannon *et al.* (2016: Table S2) mention its habitat preferences as Savanna (83 %) and Afromontane (16 %).

HABITS:
Becomes torpid during day at ambient temperatures 21 - 24 °C. Predicted mean maximum urine concentration is medium (3745 mOsmol/kg); captive bats drank regularly every night (Kearney, 2013c: 582).
Forages by slow hawking. A light-tagged individual, released in an area with marshland, a large dam, some woodland and farmland, observed for 53 min, foraged mainly between 1 - 3 m over the marsh, making straight level traverses to and fro with some jerky zig-zagging and some wide circling, but no diving or swooping upwards or any other acrobatic manoeuvres; also foraged over tall grass in spaces between trees, and flew over a banana plantation; did not fly above other trees and did not forage over the open water (M. Happold *pers. comm.* in Kearney (2013c: 582)).
Of 20 individuals sampled in Malawi, one post-lactating ♀ and one sub adult ♂ were mist netted together; one reproductively inactive ♀, one lactating ♀ and one ♂ with abdominal testes were caught in one mist-net at intervals of 15 mm and 5 mm respectively; and all others were caught singly on different dates and at different localities (M. Happold *pers. comm.* in Kearney (2013c: 582). All of four individuals mist-netted by Herholdt (1989) in the Waterberg area in the Limpopo Province of South Africa were caught singly.

ROOST:
A pair was found roosting under the bark of a broken limb of a tree (HZM specimen label written by W F. H. Ansell); no other roosts known (Kearney, 2013c: 582).

DIET:
In Zimbabwe, *Laephotis botswanae* has been recorded feeding on Coleoptera, Lepidoptera and Trichoptera (Fenton *et al.*, 1977a, Fenton and Thomas, 1980). Fenton (1985) reported Coleoptera, Lepidoptera and Trichoptera in cool season diet of *Laephotis* in Zimbabwe, and Lepidoptera only in wet season; however, he was not sure if the bats represented *L. botswanae* or *L. angolensis* and this is still unresolved.

POPULATION:
Structure and Density - The abundance of this species is not well known. It seems to be rarely

collected, and may be naturally rare (Schlitter, 2008e; IUCN, 2009). Rare in some parts of their distribution, although Herholdt (1989) and Happold and Happold (1997b) have suggested it is not uncommon, but seldom caught at other localities (Kearney, 2013c: 582). There was a marked change in numbers recorded in Malawi between a survey in 1984 - 85 with three specimens (Happold *et al.*, 1988), and 1993 - 94 with 17 specimens (Happold and Happold, 1997b). Herholdt (1989) suggested that their being caught singly might indicate they are not easily captured in mist-nets. Numbers in museum collections are growing (Kearney, 2013c:582).
Trend - 2008 - Unknown (Schlitter, 2008e; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Litter-size not known (Kearney, 2013c: 582).
Reproductive chronology not known (data inconclusive) (Monadjem *et al.*, 2010d: 435, Kearney, 2013c: 582). At 15° 31' 5 (near Namadzi, Malawi), 2 of 3 adult ♀♀ were lactating and one was reproductively inactive in Dec; 2 of 2 were reproductively inactive in Jan; 2 of 2 were post-lactating in Feb; no data for other months (M. Happold *pers. comm.* in Kearney (2013c: 582)). Two subadults were captured in Jan and Feb. These data suggest that ♀♀ might not reach sexual maturity until second year.

PARASITES:
HEMIPTERA

A bed bug *Cocodmus viliosus* (Hemiptera: Cimieidae) has been recorded on *L. botswanae* from Huila, Angola, and found on *Laephotis* from S DR Congo, of which most of the host series have been identified as *L. botswanae*, although two specimens are considered to represent *L.* cf. *angolensis* (Stanley and Kock, 2004).

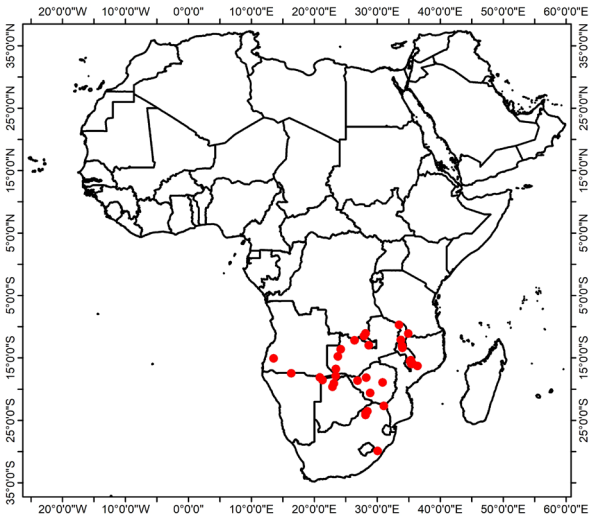


Figure 306. Distribution of *Laephotis botswanae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Botswana, Congo (Democratic Republic of the), Malawi, Mozambique, Namibia, South Africa, Tanzania, Zambia, Zimbabwe.

Laephotis namibensis Setzer, 1971

*1971. *Laephotis namibensis* Setzer, Proc. Biol. Soc. Wash., 84 (32): 259, fig. 1a, 1c. Publication date: 4 November 1971. Type locality: Namibia: Namib Desert, Kuiseb River: Gobabeb (Namib Desert Research Station) [23 30 S 15 03 E, 407 m] [Goto Description]. Holotype: USNM 342152: ad ♀, skin and skull. Collected by: Ronald E. Cole; collection date: 22 November 1963; original number: 270. Paratype: USNM 342153: ♀. See Setzer (1971: 259). - Etymology: Referring to the country where the type specimen was collected. (Current Combination)

? *Laephotis cf. wintoni:*

TAXONOMY:
In a morphometric analysis with specimens of the other *Laephotis* taxa, specimens of *L. wintoni* and *L. namibensis* were not clearly separated (Kearney and Seamark, 2005: 85). Additional characters, or other systematic techiques will be required to clarify the species distinction. Unfortunately, specimens from the Western Cape province in South Africa have been identified as both *L. wintoni* (Rautenbach and Nel, 1978b) and *L. namibensis* (Skinner and Smithers, 1990). Hence, see also the account for *L. wintoni* for the results of a study based in the Western Cape province of South Africa that identified the specimens as *L. wintoni* (Jacobs *et al.*, 2005).
Laephotis namibensis and *L. wintoni* may be conspecific, which would make the former a paler, western race of *L. wintoni* (Kearney and Seamark, 2005).
Bacular studies have also failed to show differences between selected species of *Laephotis* (Kearney *et al.*, 2002). Kearney and Seamark (2005) could not find a clear distinction between *L. namibensis* and *L. wintoni* and echoed the suggestion that they might be geographic races of the same species (Peterson, 1973). These results endorse the use of molecular studies to clarify the

current confusion over species limits within this genus (Monadjem *et al.*, 2010d).

No subspecies are currently recognized.

COMMON NAMES:
Afrikaans: Namib-langoorvlermuis. Czech: netopýr namibský. English: Namibian Long-eared Bat, Namib Long-eared Bat. French: Oreillard de Namibie, Oreillard du Namib, Chauve-souris à longues oreilles de Namibie, Noctophile du Namib. German: Namibia-Langohrfledermaus.

SIMILAR SPECIES:
Not easily distinguished from other *Laephotis*:
Laephotis angolensis - FA shorter (34.3 (32 - 36) mm). Ears shorter, 15 -18 mm and narrower. Skull smaller, GLS: 13.7 - 13.8 mm; GWS: 6.7 - 8.1 mm; C-M^3: 4.3 mm.
L. botswanae - Skull shorter, GLS: 14.1 - 15.5 mm.
L. wintoni - Skull usually shorter, GLS: 15.6 - 16.3 mm. Dorsal pelage and wings apparently never creamy-brown (as far as is known).

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a relatively large area, it is listed as Least Concern (LC ver 3.1 (2001)), as most of the range is within well protected areas, wherer there are no significant threats, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Schlitter, 2008f; IUCN, 2009). Type locality (Gobabeb) is close to Namib Naukluft Park, which includes some of the Naukluftberge where this species probably roosts (Kearney, 2013d: 583).

Assessment History -
2008 - LC ver 3.1 (2001) (Schlitter, 2008f; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Schlitter, 2004b; IUCN, 2004). 1996 - EN (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - VU D2 ver 3.1 (2001) (Jacobs *et al.*, 2016a). 2004 - considered a vagrant not assessed, not recorded in SA, Cederberg specimens considered to be *L. wintoni* (Friedmann and Daly, 2004). 1986 - Indeterminate, assessed as *L. wintoni* (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Schlitter, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008f) [in IUCN (2009)] reports that much of the range of this species is protected within the Namib-Naukluft National Park, Namibia. Further studies are needed into the distribution and general natural history of this species.

GENERAL DISTRIBUTION:
Laephotis namibensis has been recorded from a few localities in Namibia (Kuiseb River, Gobabeb, Zwartmodder, Klein Aus and Helmeringshausen), and a single area in South Africa (Algeria in the Cedarberg Mountains of the Western Cape) (Skinner and Chimimba, 2005).

Found in the South West Arid BZ (Namib Desert) and in the South West Cape BZ. Recorded from Namibia (Gobabeb, Zwartmodder, Klein Aus, Helmeringshausen) and South Africa (Algeria Forest) (Setzer, 1971, Kearney, 2013d: 583).

Although, specimens from South Africa have also been identified as *L. wintoni*, see the discussion in the generic account.

Native: Namibia (Setzer, 1971; Kearney and Seamark, 2005: 87; Simmons, 2005; Monadjem *et al.*, 2010d: 564); South Africa (Kearney and Seamark, 2005: 87; Simmons, 2005; Monadjem *et al.*, 2010d: 564).

GEOGRAPHIC VARIATION:
Specimens from Namibia have much paler pelage and flight-membranes than those from South Africa (Kearney, 2013d: 583).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Laephotis namibensis is a small bat with a mass of around 10 g, without noseleaf and with tail more or less fully enclosed in interfemoral membrane; ears separated, of medium length for a vespertilionid (22 - 25 mm) and of medium relative length (54 - 65 % of FA, n= 11).
Pelage soft, slightly shaggy on rump; mid-dorsal hairs ca. 7 mm. Dorsal pelage creamy-brown or yellowish-brown, varies geographically: the upper parts are pale brown in the Namib, but buffy-brown in the Western Cape; hairs distinctly bicoloured, basal 4 mm dark brown, terminal 3 mm creamy-brown or yellowish-brown. Ventral pelage (except in pelvic region) pale cream to whitish; hairs with basal 4 mm blackish-brown, terminal 3 mm pale cream or white (Kearney, 2013d: 583). Hairs in pelvic region pure white. The naked skin on muzzle and around eyes is pale brown. Ears pale to medium-brown, roughly triangular but elongated; tip rounded; inner margins almost meeting on forehead but not joined. Ears may be held erect above the head or (when resting) held horizontally at right-angles to head. Tragus shape much like that of *L. botswanae* except that in *L. namibensis* the bulge above the basal, posterior notch extends further out, making the tragus much wider at that point (Kearney, 2013d: 583). Wings

pale creamy-brown (when dorsal pelage is pale) or dark brown (when dorsal pelage is yellowish-brown); arm-wing usually with whitish hind-border. Interfemoral membrane paler and more translucent (Kearney, 2013d: 583).

DENTAL FORMULA:
$^{2113}/_{3123}$ = 32.
Four upper and five lower cheekteeth and two upper incisors on each side. The upper premolar is sharply pointed and rises above the molars.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
As in all *Laephotis* spp. with braincase slightly flattened (rises slightly above the rostrum); rostrum rather narrow; zygomatic arches slender; no sagittal crest; lambdoid crest weakly developed. Skull on average long and wide for the genus (GLS: 16.1 - 17.0 mm; GWS: 8.4 - 9.2 mm). Palatal length: 8.0 (7.6 - 8.7) mm, n = 10 (Kearney and Seamark, 2005).

DETAILED MORPHOLOGY:
Baculum - See Kearney *et al.* (2002), which showed no difference to *L. botswanae*.

FUNCTIONAL MORPHOLOGY:
Laephotis namibensis has relatively broad wings with intermediate wing loading (7.0 N/m^2) and low aspect ratio (5.7) (Jacobs *et al.*, 2005; also see Schoeman and Jacobs (2008). It is a clutter-edge forager.

SEXUAL DIMORPHISM:
Sexes similar (Monadjem *et al.*, 2010d, Kearney, 2013d: 583).

ECHOLOCATION:
Laephotis namibensis produces low- intensity LD-FM echolocation calls with a low peak frequency (22 ± 0.6 kHz, n = 5), narrow bandwidth (13.5 ± 2.9 kHz, n = 5), and short duration (2.6 ± 0.8 ma, n = 5) (Jacobs *et al.*, 2005; also see Schoeman and Jacobs (2008). Besides the fundamental, the second harmonic is often present on the spectrogram (Monadjem *et al.*, 2010d).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2001) for the results of a specimen from Namibia. See Stadelmann *et al.* (2004b) for the results of a specimen from the Western Cape in South Africa identified as *L. wintoni*, but from a locality where the species identification has also been assigned to *L. namibensis* (Skinner and Smithers, 1990).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 34, FN = 50, BA = 18, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from Namibia. Rautenbach *et al.* (1993) also obtained the same results for specimens from the Western Cape, which were identified as *L. wintoni*, but reassigned to *L. namibensis* (Skinner and Smithers, 1990).
Protein / allozyme - Unknown.

HABITAT:
Found in desert (60 % of specimen records), fynbos (20 % of specimen records), and savanna (20 % of specimen records) biomes (Kearney and Seamark, 2005: 85). Arid, mountainous habitat, in close proximity to open water (Kearney, 2013d: 583). Sirami *et al.* (2013: 35) recorded in the Western Cape Province, South Africa that *L. namibensis* activity was not significantly, nor positively influenced by size of wetland or habitats located 100 m from surrounding these wetlands. *L. namibensis* preferentially near trees, orchards surrounding wetlands and over these wetlands (Sirami *et al.*, 2013: 35).

HABITS:
The holotype and paratype were mist-netted over a waterhole in the bed of the Kuiseb R. near Namib Desert Research Station (Setzer, 1971). Individuals from Algeria Forest were mist netted as they flew along a water course, close to the water surface, between 20:30 and 21 :00h.

ROOST:
Roosts not known, but the association of this bat with cliffs (in South Africa) indicates that it might roost in cracks and crevices of cliff faces (Jacobs *et al.*, 2005, Kearney, 2013e: 585). Specimens have been caught while foraging for insects from early to mid-evening (18h30 - 21h40).

Three radio tagged females in the Western Cape province of South Africa roosted in different crevices or narrow fissures in a cliff face above the valley where they foraged (Jacobs *et al.*, 2005). They also moved roost from one day to the next (Jacobs *et al.*, 2005).

DIET:
In the Cedarberg, Western Cape, its diet comprised mainly Lepidoptera and Coleoptera (Jacobs *et al.*, 2005, Schoeman 2006).

POPULATION:
Structure and Density - Although the species appears to be naturally rare in the Namib desert, it is rather commonly captured in mist-nets set around water tanks outside of the Namib (Schlitter, 2008f; IUCN, 2009). Rare (Kearney, 2013d: 583).
Trend - 2008 - Stable (Schlitter, 2008f; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
In the Cedarberg, Western Cape, a pregnant ♀ was caught in November (Jacobs *et al.*, 2005) and a post-lactating ♀ was collected in late January (Seamark and Brand, 2005).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Namibia, South Africa.

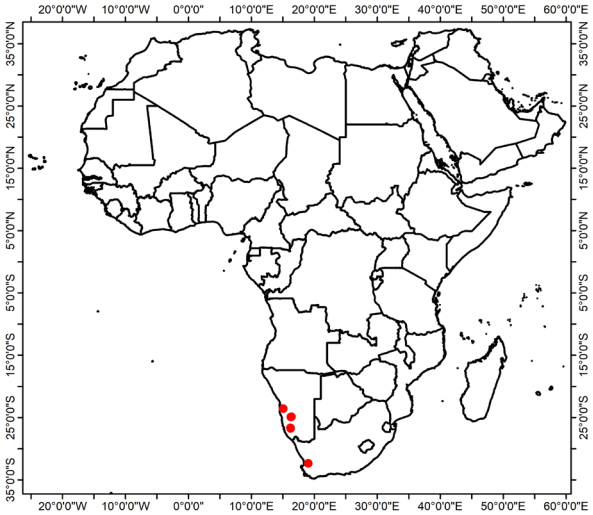


Figure 307. Distribution of *Laephotis namibensis*

Laephotis wintoni Thomas, 1901

*1901. *Læphotis Wintoni* Thomas, Ann. Mag. nat. Hist., ser. 7, 7 (41): 460. Publication date: 1 May 1901. Type locality: Kenya: Kitui [01 22 S 38 01 E, 3 500 ft] [Goto Description]. Holotype: BMNH 1901.5.6.5: ♂, skin and skull. Collected by: Dr. Sidney Langford Hinde; collection date: 7 January 1901; original number: S.L.H.64. - Etymology: In honour of Mr W.E. de Winton, "whose labours on the small mammals of Africa all naturalists...have been so constantly indebted for assistance" (Thomas, 1901d: 462). (Current Combination)
? *Laephotis cf. wintoni:*
? *Laephotis wintoni:* (Current Spelling)

TAXONOMY:
In a morphometric analysis with specimens of the other *Laephotis* taxa, specimens of *L. wintoni* and *L. namibensis* were not clearly separated (Kearney and Seamark (2005: 85). Unfortunately, specimens from the Western Cape province in South Africa have been identified as both *L. wintoni* (Rautenbach and Nel, 1978b) and *L. namibensis* (Skinner and Smithers, 1990). Specimens from Lesotho and the Free State province in South Africa were assigned to cf. *wintoni* pending clarification of the species distinctions (Kearney and Taylor, 1997). Additional characters, or other systematic techiques will be required to clarify the species distinction. Specimens from KwaZulu-Natal Province in South Africa previously identified as cf. *wintoni* (Kearney and Taylor, 1997) were reassigned to *L. botswanae* (Kearney and Seamark, 2005: 85).

South African specimens were assigned to *L. wintoni* based on multivariate analysis of external and cranial measurements (Rautenbach and Nel, 1978b, Watson, 1990a, Kearney and Taylor, 1997). However, on the basis of post-palatal measurements and morphometric analyses of cranial characters including palatal measurements by Hill (1974a), the specimens assigned to *L. wintoni* by Kearney and Taylor (1997) have now been re-identified as *L. botswanae* (Kearney and Seamark, 2005). Specimens from Algeria Forest in the Western Cape (South Africa) originally described by Rautenbach and Nel (1978b) as *L. wintoni* were subsequently re-identified as *L. namibensis* in Skinner and Smithers (1990). However, new specimens from Algeria have been referred to as *L. wintoni* (based on Rautenbach and Nel, 1978b) by Jacobs *et al.* (2005). On the basis of morphometric analyses of cranial characters, including palatal measurements, the distinction between *L. wintoni* and *L. namibensis* could not be confirmed by Kearney and Seamark (2005); therefore, pending clarification of the status of *namibensis*, information from Jacobs *et al.* (2005) is mentioned in the profile for *L. namibensis*.

Laephotis namibensis and *L. wintoni* may be conspecific, which would make the former a paler, western race of the latter (Kearney and Seamark, 2005).

No subspecies are currently recognized.

COMMON NAMES:
Afrikaans: Winton se langoorvlermuis, Winton-langoorvlermuis. Chinese: 温氏长耳蝠. Czech:

netopýr Wintonův. English: De Winton's Long-eared Bat, Winton's Long-eared Bat. French: Oreillard de De Winton, Chauve-souris à longues oreilles de De Winton, Noctophile de De Winton. German: De Wintons Langohrfledermaus. Italian: Lefòte di Wìnton.

SIMILAR SPECIES:
Not easily distinguished from other *Laephotis*:
Laephotis angolensis - FA shorter (32 - 36 mm). Ears shorter (15 - 18 mm) and narrower. Skull shorter and broader (GLS: 13.7 - 13.8 mm; GWS: 6.7 - 8.1 mm; C-M^3: 4.3 mm).
L. botswanae - FA on average shorter, 36.3 (30 - 39) mm. Skull usually smaller, GLS: 14.6 (14.1 - 15.5) mm; C-M^3: 4.7 (4.5 - 4.9) mm.
L. namibensis - Skull usually longer, GLS: 16.1 - 17.0 mm. Dorsal pelage and wings sometimes creamy-brown (see Geographic Variation).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) because, although it is seldom recorded, it has a relatively wide distribution, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Schlitter, 2008g; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Schlitter, 2008g; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Schlitter, 2004a; Jacobsen *et al.*, 1986). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - VU D2 ver 3.1 (2001) (Avenant *et al.*, 2016a). 2004 - VU D2 ver 3.1 (2001), included *L. botswanae* from Hella-Hella and *L. namibensis* from Cederberg (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species (Schlitter, 2008g; IUCN, 2009).

CONSERVATION ACTIONS:
Schlitter (2008g) [in IUCN (2009)] reports that it has been recorded from the Sehlabathebe National Park in Lesotho, and may be present in additional protected areas. Additional studies into the population abundance and distribution are needed.

GENERAL DISTRIBUTION:
Recorded from Ethiopia in the north of its range, south through parts of Kenya (including Nyeri, Mount Kenya) and Tanzania (Mazumbai Forest Reserve, West Usambara Mountains (Kock and Howell, 1988); Kebebe Farms, Iringa district (Stanley and Kock, 2004), southern Zambia, Lesotho (including Sehlabathebe National Park), and South Africa (the Clarens district in the eastern Free State).

Laephotis wintoni occurs at high altitude (> 1,500 m above sea level) in Lesotho and the Free State (Kearney and Seamark, 2005), where it has been collected from montane grasslands. In Lesotho, it was netted over water (Lynch, 1994).

Specimens recorded from the Western Cape Province in South Africa have also been identified as *L. namibensis*, see the discussion in the generic account. The specimens from Game Valley Estates (Hella Hella) near Richmond, KwaZulu Natal, South Africa (Kearney and Taylor, 1997; Skinner and Chimimba, 2005: 317) are infact *L. botswanae* (Kearney and Seamark, 2005).

Native: Ethiopia (Kearney and Seamark, 2005: 87; Simmons, 2005: 492; Skinner and Chimimba, 2005: 317); Kenya (Kearney and Seamark, 2005: 87; Simmons, 2005: 492; Skinner and Chimimba, 2005: 317); Lesotho (Lynch and Watson, 1990; Lynch, 1994: 194; Kearney and Seamark, 2005: 87 as *L.* cf. *wintoni*; Skinner and Chimimba, 2005: 317; Monadjem *et al.*, 2010d: 564 as *L* cf. *wintoni*); South Africa (Lynch, 1994; Kearney and Taylor, 1997; Kearney and Seamark, 2005: 87 as *L.* cf. *wintoni*; Simmons, 2005: 492; Skinner and Chimimba, 2005: 317; Monadjem *et al.*, 2010d: 564 as *L.* cf. *wintoni*); Tanzania (Kock and Howell, 1988; Stanley and Kock, 2004: 174; Simmons, 2005: 492).

BIOGEOGRAPHY:
There are scattered records in the Afromontane Afroalpine and Somalia Masai BZs of Ethiopia and East Africa, and records much further south in the Afromontane Afroalpine and Highveld BZs of South Africa.

GEOGRAPHIC VARIATION:
None recorded (Kearney, 2013e: 584).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Laephotis wintoni is a small bat with a mass of around 10 g, without noseleaf and with tail more or less fully enclosed in interfemoral membrane; ears separated, of medium length for a vespertilionid (21 - 21 mm) and of medium relative length (53 - 60% of FA, n= 12). Mid-dorsal hairs ca. 8 mm. Dorsal pelage yellowish-brown to reddish-brown; hairs distinctly bicoloured, basal 6 mm dark brown, terminal 2 mm yellowish-brown or reddish-brown. Ventral pelage with chin yellowish-orange, reddish-brown or pale brown, throat paler, pelvic region cream or white. Hairs (except in pelvic region) blackish- brown with yellowish-orange, reddish-brown, cream or white tips. Hairs in pelvic

region pure white. Head fairly flat; naked skin on muzzle and around eyes is dark brown. Buccal pads observed in one ♂. Ears dark brown, roughly triangular but very elongated; tip rounded; inner margins almost meeting on forehead hut not joined. Ears may be held erect above the head or (when resting) held horizontally at right-angles to head. Wings dark brown or blackish-brown; presence or absence of hind-border is not known. Interfemoral membrane paler and more translucent.

DENTAL FORMULA:
$^{2113}/_{3123}$ = 32.
Four upper and five lower cheekteeth and two upper incisors on each side. The upper premolar is sharply pointed and rises above the molars.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:



Figure 308. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1901.5.6.5, holotype of *Laephotis Wintoni* Thomas, 1901.

As in all *Laephotis* spp. with braincase slightly flattened (rises slightly above the rostrum); rostrum rather narrow; zygomatic arches slender; no sagittal crest; lambdoid crest weakly developed. Skull on average medium-long and wide for the genus (GLS: 15.6 -16.3 mm; GWS: 8.8 - 9.5 mm). Palatal length: 8.1 (7.9 - 8.5) mm, n= 15.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002) as *L.* cf. *wintoni*.

SEXUAL DIMORPHISM:
Sexes similar (Monadjem *et al.*, 2010d, Kearney, 2013e: 584).

ECHOLOCATION:
The echolocation call of this species has not been recorded (Monadjem *et al.*, 2010d). However, Thiagavel *et al.* (2017: Suppl.) mention a peak frequency of 23.08 kHz.

MOLECULAR BIOLOGY:
DNA - See Stadelmann *et al.* (2004b) for the results of a specimen from the Western Cape in South Africa, for a locality that has had the taxa reassigned to *L. namibensis* (Skinner and Smithers, 1990).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 34, FN = 50, BA = 18, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from the Western Cape Province in South Africa, which were identified as *L. wintoni*, but reassigned to *L. namibensis* (Skinner and Smithers, 1990). Rautenbach *et al.* (1993) also obtained the same results for specimens from Namibia identified as *L. namibensis*.
Protein / allozyme - Unknown.

HABITAT:
Excluding records from the Western Cape province locality in South Africa that have also been assigned to *L. namibensis* (Skinner and Smithers, 1990), it is a montane species found at high altitudes above 1000 m (Kock and Howell, 1988; Stanley and Kock, 2004: 176; Kearney and Seamark, 2005). *L. wintoni* has been found in East Africa in both forest (62.5 % of specimen records) and savanna (37.5 % of specimen records) biomes (Kock and Howell, 1988; Kearney and Seamark, 2005: 85). Specimens assigned to *L.* cf. *wintoni* from the Free State Province of South Africa and Lesotho are from the grassland biome (Kearney and Seamark, 2005: 85).

HABITS:
In Ethiopia, found at 1700 m, near a large Rift Valley reservoir on the Awash R. surrounded by Acacia woodland that has been extensively degraded to provide open farmland (Largen *et al.*, 1974). In East Africa, recorded from highland and mountainous areas with mosaics of evergreen bushland, secondary Acacia wooded grasslands and farmlands, and forests on the mountains: caught in forests, near forests and in woodlands. In the Free State Province of South Africa, recorded amongst large exotic trees in a drainage line flanked by sandstone cliffs (Watson, 1990a). In Lesotho, recorded from the vicinity of a dam surrounded by a vlei overgrown with medium-height (600 mm) vegetation in Sehlabathebe N. P. (Lynch and Watson, 1990). In Sehlabathebe N. P.,

there is no significant cover of tall grass, forbs or woody vegetation; the climate is harsh; the topographical relief is fairly uniform, and the altitude is 2,300 - 2,650 m (Kearney, 2013e 584). See Jacobs *et al.*, 2005).

ROOST:
One individual was found under exfoliating rock (TM) (Kearney, 2013d: 583).

DIET:
A study in the Western Cape province of South Africa found the diet was dominated by tympanate moths in three of four individuals studied, the fourth individual's diet was dominated by beetles (Jacobs *et al.*, 2005). Hemiptera and Tricoptera were also eaten but in much smaller proportions (Jacobs *et al.*, 2005).

POPULATION:
Structure and Density - This seems to be an uncommon species, possibly having large population fluctuations. Multiple individuals have been caught in Lesotho and South Africa, however, in East Africa it is known from many localities, but as one or two animals only (Schlitter *pers. comm.* [in Schlitter (2008g) in IUCN (2009)]). Rare, but numbers in museum collections are increasing (Kearney, 2013e: 584).
Trend - 2008 - Unknown (Schlitter, 2008g; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
In Lesotho, a pregnant ♀ was collected in November (Lynch, 1994).

VIRUSES:
Bunyaviridae
Phlebovirus
Rift Valley Fever Virus (RVFV) - Oelofsen and Van der Ryst (1999) tested two and four individuals from Clarens, South Africa and Lesotho respectively for RVFV antigen using an enzyme linked immunosorbet assay (ELISA), none tested positive.

Coronaviridae - Coronaviruses
SARS-CoV - Müller *et al.* (2007b) tested between 1986 and 1999, for antibodies to SARS-CoV in serum of one individual from Limpopo Province, South Africa, and found none (0/1).

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested two and four individuals from Clarens, South Africa and Lesotho respectively using "Trousse Platelia Rage" ELISA kit (Diagnostic Pasteur), none tested positive for antibodies to rabies virus glycoprotein G. Oelofsen and Smith (1993) also tested two and four individuals from Clarens, South Africa and Lesotho respectively by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

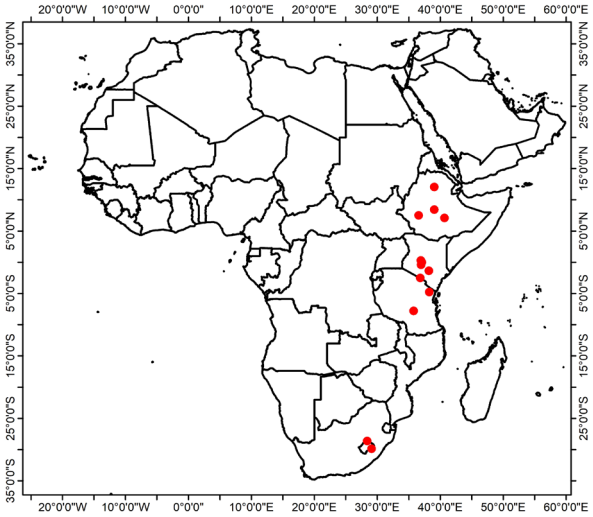


Figure 309. Distribution of *Laephotis wintoni*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Ethiopia, Kenya, Lesotho, South Africa, Tanzania.

Genus ***Mimetillus*** Thomas, 1904

*1904. *Mimetillus* Thomas, Abstr. Proc. Zool. Soc. Lond., 10: 12. Publication date: 22 November 1904. - Comments: Type species: *Vesperugo (Vesperus) moloneyi* Thomas, 1891. - Etymology: Lanza *et al.* (2015: 361 - 362) indicate that it possibly is derived from the masculine scientific Latin adjective *mimèticus*, meaning "mimetic" and the end of the masculine scientific Latin substantive *(Pipistre)llus*, meaning "bat", which combines to a "bat miming a member of the genus *Pipistrellus* (= *Vesperugo*)". (Current Combination)

? *Mimetillus sp.:*

TAXONOMY:
Pending revision, considered here to be a monotypic genus endemic to tropical Africa including Bioko Island (Happold, 2013da: 585). See Simmons (2005), Cotterill (2001 d) and Monadjem *et al.* (2010d).
Placed in tribe Vespertilionini (Simmons, 2005).

Known species of the genus *Mimetillus*: ***moloneyi*** (Thomas, 1891); ***thomasi*** Hinton, 1920.

COMMON NAMES:
Czech: Moloneyovi netopýři. English: Flat-headed Vesper Bats, Mimic Bats, Narrow-winged Bats, Flat-headed Bats. French: Mimétille, Chauve-souris à tête plate. German: Schmalflügel-Fledermäuse. Italian: Mimetìlli.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Diagnostic combination of characters: four upper and five lower cheekteeth and two upper incisors on each side; head conspicuously flattened; ears relatively short and not joined at base; outer margin of ear not reaching mouth; phalanges of third, fourth and fifth fingers very short (third finger shorter than HB); no body pattern; wings not reticulated (Happold, 2013da: 585).

DENTAL FORMULA:
$^{2113}/_{3123}$ = 32.

Mimetillus moloneyi (Thomas, 1891)

*1891. *Vesperugo (Vesperus) Moloneyi* Thomas, Ann. Mag. nat. Hist., ser. 6, 7 (42): 528, text-fig. Publication date: 1 June 1891. Type locality: Nigeria: Western region: Lagos [06 27 N 03 23 E] [Goto Description]. Holotype: BMNH 1891.5.5.2: ad ♂, alcoholic (skull not removed). Collected by: Sir Alfred Moloney. Presented/Donated by: Sir Alfred Moloney. See Thomas (1891a: 529). - Etymology: In honour of Sir Cornelius Alfred Moloney (1848 - 1913), a British civil cervant, collector of the type specimen (see Lanza *et al.*, 2015: 363).
? *Mimetillus moloneyi moloneyi:* (Name Combination)
? *Mimetillus moloneyi:* (Name Combination, Current Combination)

TAXONOMY:
Koopman (1993a: 207) included *thomasi* and *berneri*; but see Cotterill (2001c) and Simmons (2005).

COMMON NAMES:
Chinese: 非洲扁颅蝠. Czech: netopýr Moloneyův. English: Moloney's Flat-headed Vesper Bat, Moloney's Mimic Bat, Moloney's Flat-headed Bat. French: Mimétille de Moloney, Chauve-souris à tête plate de Moloney. German: Moloneys Schmalflügel-Fledermaus, Moloneys Flachkopf-Fledermaus. Italian: Mimetìllo di Moloney. Spanish (Castillian): Murciélago de cabeza Plana.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008ai; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008ai; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004ah; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Jacobs *et al.*, 2008ai; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008ai) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Additional research into the taxonomy of this species is needed.

GENERAL DISTRIBUTION:
Widespread over much of sub-Saharan Africa. It ranges from Sierra Leone in the west, through West Africa and Central Africa (although seemingly absent from much of the Congo basin), to southern Sudan and western Ethiopia in the east, from here it ranges southwards through East Africa to Zambia and Angola, with the southernmost record from south-central Mozambique. It is found at elevations of up to 2,300 m asl.

Native: Angola; Cameroon; Central African Republic (Lunde *et al.*, 2001: 537); Congo (Bates *et al.*, 2013: 325 - 1st authenticated record); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 564); Côte d'Ivoire; Equatorial Guinea; Ethiopia; Gabon; Ghana; Guinea (Fahr *et al.*, 2006a; Decher *et al.*, 2016: 266); Kenya (Start, 1969: 223); Liberia (Fahr, 2007a: 104); Mozambique; Nigeria; Sierra Leone; Sudan; Tanzania; Togo; Uganda; Zambia.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

HABITAT:
Monadjem *et al.* (2016y: 369) recorded this species from forested and disturbed habitats between 400 and 520 m at the Mount Nimba area.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - Although the species is difficult to catch, it is not considered to be especially rare (Jacobs *et al.*, 2008ai; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008ai; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Krutzsch (2000: 124) indicates that males have enlarged testes in January and June and that females parturate in February/March and in August.

PARASITES:
ACARI:
Fain (1963: 256) reported the presence of a *Notoedres (Notoedres) mimetilli* Fain, 1959 on a *M. moloneyi* from Bio [=Bo?], Sierra-Leone.

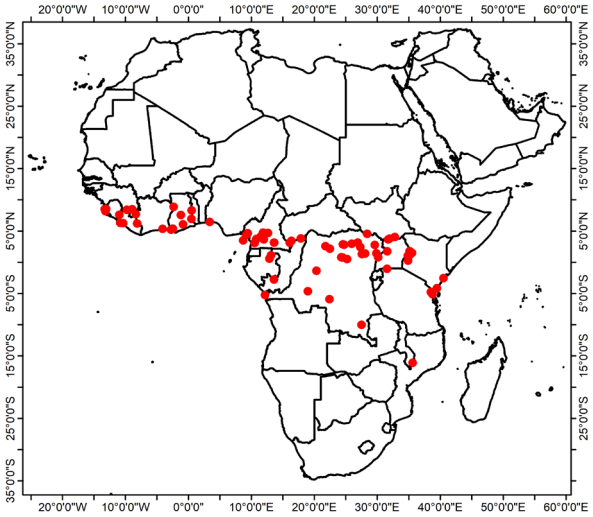


Figure 310. Distribution of *Mimetillus moloneyi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Guinea, Kenya, Liberia, Malawi, Nigeria, Sierra Leone, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe.

Mimetillus thomasi Hinton, 1920

*1920. *Mimetillus thomasi* Hinton, Ann. Mag. nat. Hist., ser. 9, 6 (32): 240. Publication date: 1 August 1920. Type locality: Zambia: Ndola [12 58 S 28 38 E, 1 400 m] [Goto Description]. Holotype: BMNH 1920.11.3.28: ad ♀. Collected by: Captain Guy Chester Shortridge; collection date: 4 October 1919; original number: 481. - Etymology: In honour of Oldfield Thomas. (Current Combination)
1933. *Mimetillus berneri* Monard, Bull. Soc. Neuchât. Sci. nat., 57: 49 (for 1932?). Type locality: Angola: South-Central Angola: Vila da Ponte [14 25 S 16 15 E]. - Comments: Allen (1939a:89) mentions 1932 as year of publication.
? *Mimetillus moloneyi berneri:*
? *Mimetillus moloneyi thomasi:*

TAXONOMY:
Koopman (1993a: 207) included *thomasi* and *berneri* in *moloneyi*; but see Cotterill (2001c), Monadjem *et al.* (2010d: 444; 2010c: 390) who consider *thomasi* to be a separate species.

COMMON NAMES:
English: Thomas's Flat-headed Bat. French: Mimétille de Thomas. German: Thomas' Schmalflügel-Fledermaus.

CONSERVATION STATUS:
Global - Not assessed (IUCN, 2004).

GENERAL DISTRIBUTION:
Mimetillus thomasi is found from Bioko, Zambia and southern Congo south to Tanzania, Angola and Mozambique.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 564; Taylor *et al.* (2018b: 60); Congo (Democratic Republic of) (Schouteden, 1944; Monadjem *et al.*, 2010d: 564); Mozambique (Monadjem *et al.*, 2010d: 564); Zambia (Monadjem *et al.*, 2010d: 564).

PARASITES:
Acari:

Fain (1959d: 155) described *Notoedres (Notoedres) mimetilli* (Sarcoptidae) from *Mimetillus thomasi* from Katanga, DRC.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Congo (Democratic Republic of the), Mozambique, Tanzania, Zambia.

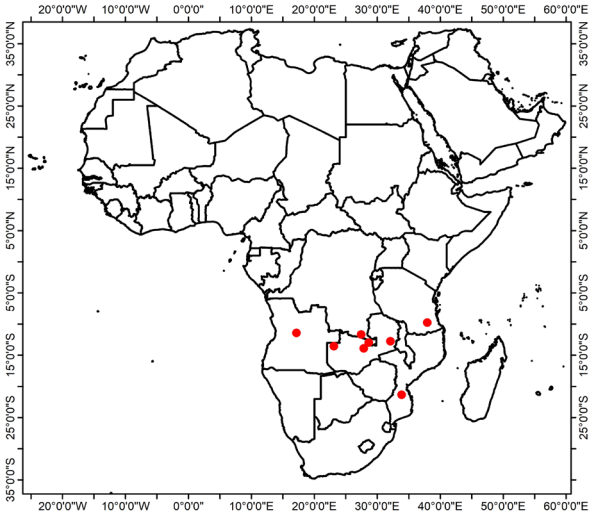


Figure 311. Distribution of *Mimetillus thomasi*

Genus ***Neoromicia*** Roberts, 1926

1908. *Scabrifer* G.M. Allen, Bull. Mus. comp. Zool., 52 (3): 46. Publication date: July 1908. - Comments: Type species: *Scabrifer notius* G.M. Allen, 1908. Originally described as substitute for *Rhinopterus* Miller, preoccupied by *Rhinoptera* Kuhl, 1841 (see Allen, 1908: 46; 1939a: 97).

*1926. *Neoromicia* Roberts, Ann. Transv. Mus., 11: 245. Publication date: 14 September 1926 [Goto Description]. - Comments: Type species: *Eptesicus zuluensis* Roberts, 1924. - Etymology: From the Greek prefix "*νεο*" (nèo), meaning "new" and the feminine scientific Latin substantive *Romìcia*, which in turn is a feminine scientific Latin substantive almost surely deriving from the Greek substantive "*ῥόμιξα*" (rhómiksa), corresponding to the masculine Latin substantive *rùmex* (genitive *rùmicis*), meaning "dock", a plant with spear-shaped leaves. *Neoromicia calcarata,* the type species of the genus, is really provided of a well developed calcar, i.e. of a well developed uropatagial spur (see Lanza *et al.*, 2015: 380). - ZooBank: 7173CFF6-F27B-44D7-948E-23FC40080224. (Current Combination)

1956. *Ephesicus:* Theodor, Parasitology, 46: 391. - Comments: used in combination with the species *tenuipinnis*, and therefore synonym of *Neoromicia*, not of *Eptesicus*. (Lapsus)

1987. *Nycterikaupius* Menu, Palaeovert., 17 (3): 108, pl. 4, fig. 1. Publication date: 15 November 1987 [Goto Description]. - Comments: In part.

1995. *Scabifer:* Peterson, Eger and Mitchell, Faune de Madagascar, Chiroptères, 84: 95. (Lapsus)

2000. *Pipestrellus:* Nwoha, Caxton-Martins and Baxter-Grillo, Folia Morphol., 59 (3): 154. Publication date: 6 July 2000. (Lapsus)

2003. *Neuromicia:* Avery, Avery and Colahan, Navors. nas. Mus., 19 (1): 8. Publication date: April 2003. (Lapsus)

2013. *Epseticus:* Bitty, Kadjo, Gonéndélé, Okon and Kouassi, Int. J. Biol. Chem. Sci., 7 (4): 1684. Publication date: August 2013. (Lapsus)

2013. *Necroromicia:* Fenton, Koedoe, 55 (1): 1140 (p.3). Publication date: 19 March 2013. (Lapsus)

2015. *Neoromycia:* Thies and Lewis, Occ. Pap. Mus. Texas Tech Univ., 330: 7. Publication date: 10 February 2015. (Lapsus)

? *Neoromicia sp.:*

TAXONOMY:
Considered a subgenus of *Eptesicus* by Koopman (1993a: 201); considered a subgenus of *Pipistrellus* by Grubb *et al.* (1998: 85) and Hill and Harrison (1987: 248), but considered a valid genus by Volleth *et al.* (2001: 25), Simmons (2005). See also Riccucci and Lanza (2008) for a discussion on the gender of this genus name.

Helbig *et al.* (2010: 168) suggest that *Neoromicia* is actually a para- or polyphyletic group.

Without any further explication, Taylor and Tuttle (2019: 282, 283) placed all *Neoromicia* species in the genus *Laephotis*.

Known species of the genus *Neoromicia*: ***brunneus*** (Thomas, 1880); ***capensis*** (A. Smith, 1829); ***guineensis*** (Bocage, 1889); ***helios*** (Heller, 1912); sp. aff. ***melckorum*** (Roberts, 1919); ***nana*** (Peters, 1852); ***rendalli*** (Thomas, 1889); ***somalicus*** (Thomas, 1901); ***tenuipinnis*** (Peters, 1872); ***zuluensis*** (Roberts, 1924).

COMMON NAMES:
Czech: banánoví netopýři. English: Neoromicia Pipistrelle Bats. Italian: Neoromìcie.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Avery (2007: 619) reported on the presence of *Neoromicia* sp. in Pleistocene deposits at Wonderwerk Cave, South Africa.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) present a line drawing of the tragi of specimen DNSM 13225 (identified as *N.* sp. 1) from Mount Nimba, Liberia.

DETAILED MORPHOLOGY:
Baculum: The shaft tip of the baculum was bulbous and lobed in all the *Neoromicia* species from Liberia examined (Monadjem *et al.*, 2013c: 197).

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls potentially from *N. melckorum* and *N. matroka*, which had steep FM followed by a shallow QFM pulse at a low duty cycle.

PREDATORS:
Goodman *et al.* (2015c: 78) found the remains of five *Pipistrellus/Neoromicia* sp. individuals in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

VIRUSES:
Coronaviridae
None of the 34 Kenyan *Neoromicia* sp. tested by Tao *et al.* (2017: Suppl.) was positive for CoV.

Geldenhuys *et al.* (2018: 5) investigated fecal, rectal and intestinal swaps of 58 *Neoromicia* (*N. capensis, N. zuluensis, N. nana* and *N.* cf. *helios*) specimens collected over an eight-year period (2007 - 2015) in northeastern RSA. In these, they found the following virus families: ssRNA viruses: *Orthomyxoviridae* (30.49 %), *Picornaviridae* (22.56 %), *Bunyaviridae* (10.98 %), *Coronaviridae* (9.15 %), *Virgaviridae* (2.44 %), *Caliciviridae* (2.44 %), *Tymoviridae* (2.44 %), *Flaviviridae* (1.83 %), *Rhabdoviridae* (1.22 %) *Sobemoviridae* (0.61 %), and unclassified (15.9 %); ssDNA viruses: *Microviridae* (86 %), *Circoviridae* (8 %), *Parvoviridae* (6 %), *Inoviridae* (0.9 %), and *Anelloviridae* (0.05 %); dsDNA viruses: *Herpesviridae*(48 %), *Caudoviridae* (26.7 %), *Adenoviridae* (17 %), *Papillomaviridae* (2.7 %), *Ampullavirida* (1.8 %), *Iridoviridae* (0.9 %), *Phycodnaviridae* (0.9 %), *Baculoviridae* (0.6 %), *Polydnaviridae* (0.6 %), *Nimaviridae* (0.3 %), and unclassified (0.3 %). One of the *Ciroviridae* (genus *Cyclovirus*) was found to be a new species: *Neoromicia*-associated cyclovirus 1 strain 19681/RSA (or NeoCycloV-1), for which the closest relative was retrieved from human stool (Geldenhuys *et al.*, 2018: 10). Furthermore, they (p. 13) reported the a novel *Neoromicia* picornavirus sequence (BatPicV/NeoC21877/RSA), which should be the first bat picornavirus from an insectivorous bat genus in Africa.

ZOOBANK:
7173CFF6-F27B-44D7-948E-23FC40080224

Neoromicia aff. guineensis Bocage, 1889

2016. *Neoromicia sp. (aff. guineensis):* Kruskop, Benda, Vasenkov and Lavrenchenko, Lynx, 47: 62. (Name Combination)

TAXONOMY:
Although very similar to *N. guineensis* morphologically, preliminary molecular genetic analyses by Kruskop *et al.* (2016: 62) indicated that a number of animals differed from other Ethiopian specimens belonging to *N. guineensis, N.* cf. *zuluensis* and *N. somalica*. Further comparisons with specimens from other areas from Africa will be required to assess the taxonomic status of these specimens.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia.

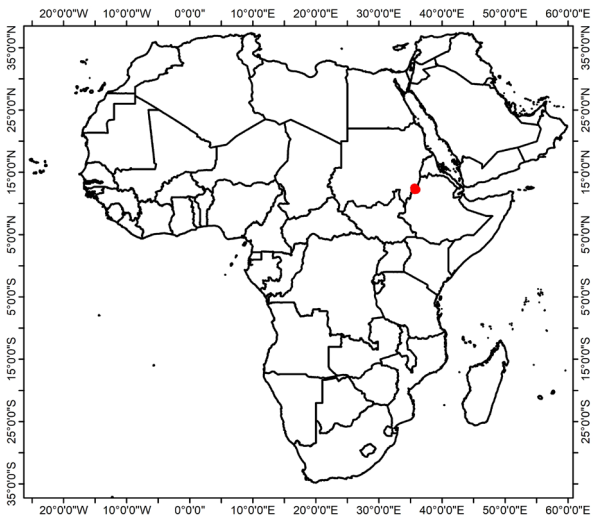


Figure 312. Distribution of *Neoromicia* aff. *guineensis*

Neoromicia brunnea (Thomas, 1880)

*1880. *Vesperugo (Vesperus) brunneus* Thomas, Ann. Mag. nat. Hist., ser. 5, 6 (32): 165, 1 text-fig. Publication date: 1 August 1880. Type locality: Nigeria: Eastern region: Calabar [04 56 N 08 22 E]. Holotype: BMNH 1880.7.21.7: ad ♀, skull and alcoholic. Collected by: Dr. A. Robb. Presented/Donated by: Dr. J.A. Smith. - Comments: Allen (1939a: 84), Grubb *et al.* (1998: 86) mentioned "Old Calabar, West Africa" as type locality.

1880. *Vesperugo brunneus:* Dobson, Report 50th Meeting British Association Advancement Science, 1880: 185. - Comments: (redescription of type). (Name Combination)

1939. *Eptesicus brunneus:* G.M. Allen, Bull. Mus. comp. Zool., 83: 84. (Name Combination)

1971. *Eptesicus [(Eptesicus)] brunneus:* Hayman and Hill, Mammals of Africa: Chiroptera, 44. (Name Combination)

1987. *Nycterikaupius brunneus:* Menu, Palaeovert., 17 (3): 109. Publication date: 15 November 1987. (Name Combination)

1987. *Pipistrellus (Neoromicia) brunneus:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)

1989. *P[ipistrellus] brunneus:* Koopman, Am. Mus. Novit., 2946: 10. - Comments: (This might be a lapsus, since Koopman used *Eptesicus brunneus* on page 7). (Name Combination, Lapsus)

1993. *Eptesicus (Neoromicia) brunneus:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 201. (Name Combination)

1995. *Pipistrellus brunneus:* Koopman, Kofron and Chapman, Am. Mus. Novit., 3148: 11. (Name Combination)

2003. *? (Hypsugo) brunneus:* Hoofer and Van Den Bussche, Acta Chiropt., 5 (Suppl.): 38. (Name Combination)

2008. *N[eoromicia] brunnea:* Riccucci and Lanza, Hystrix, It. J. Mamm., (n.s.) 19 (2): 176. - Comments: Riccucci and Lanza (2008: 176) indicate that the genus *Neoromicia* is feminine, therefore the spelling of the species ending must also be feminine according to Art. 31.2 of the ICZN (1999). (Current Combination, Current Spelling)

2019. *L[aephotis] brunnea:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

? *Neoromicia brunnea:*

? *Neoromicia brunneus:* (Name Combination)

TAXONOMY:
Mentioned in the genus *Pipistrellus* by Koopman (1994: 117). Included (as "*(Hypsugo) brunneus*") in a separate, unnamed genus by Hoofer and Van Den Bussche (2003: 38).

Helbig *et al.* (2010: 168) suggest that *brunnea* needs to be transferred to a genus that needs to be newly created or resurrected from the current synonymy.

Riccucci and Lanza (2008) indicate that the genus *Neoromicia* is feminine, therefore the species name *brunneus* must be corrected into *brunnea*.

COMMON NAMES:
Czech: netopýr kalabarský. English: Brown Pipistrelle Bat, Dark-brown Pipistrelle Bat, Dark-brown Serotine. French: Sérotine brune d'Afrique, Sérotine brun-noire. German: Dunkelbraune Zwergfledermaus, Dunkelbraune Pipistrelle.

CONSERVATION STATUS:
Global - Listed as Near Threatened (NT ver 3.1 (2001)) because this species is probably in significant decline (but at a rate of less than, but close, to 30 % over a ten year period) because of widespread habitat loss through much of its range, thus making the species close to qualifying for Vulnerable A4c (Fahr, 2008f; IUCN, 2009).

Assessment Histroy -
2008 - NT ver 3.1 (2001) [assessed as *Pipistrellus brunneus*] (Fahr, 2008f; IUCN, 2009). 2004 - NT ver 3.1 (2001) [assessed as *Neoromicia brunneus*] (Fahr, 2004k; IUCN, 2004). 1996 - LR/nt [assessed as *Eptesicus brunneus*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
This species is threatened by deforestation resulting from logging operations, and the conversion of its habitat to agricultural use (Fahr, 2008f; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008f) [in IUCN (2009)] reports that there appear to be no conservation measures in place for this species. There is a need to establish and manage suitable protected areas for this species.

GENERAL DISTRIBUTION:
Neoromicia brunnea is known from a few widespread localities in West and Central Africa. It ranges from Sierra Leone in the west, to Congo in the east. The distribution is believed to be patchy, as surveys have generally been unable to locate this species outside of its known range.

Native: Cameroon; Congo (Bates *et al.*, 2013: 325 - 1st authenticated record); Côte d'Ivoire; Equatorial Guinea (Bioko); Gabon; Ghana; Liberia; Nigeria; Sierra Leone.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) present a line drawing of the tragi of specimen DNSM 13229 from Mount Nimba, Liberia.

DETAILED MORPHOLOGY:
Baculum: The basal lobes in the lateral view were broadest near the shaft base, tapering to a rounded end and were flattened at the bottom, giving them a 'shoe-like' appearance (Monadjem *et al.*, 2013c: 197). Line drawing of dorsal and ventral bacula of specimen DNSM 13229 from Mount Nimba, Liberia are shown in Monadjem *et al.* (2013c: 204).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).
Karyotype - McBee *et al.* (1987) reported 2*n* = 36, FN = 50, BA = 16, a submetacentric X chromosome and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

HABITAT:
Monadjem *et al.* (2016y: 369) recorded this species from forested habitats between 400 and 520 m altitude in the Mount Nimba area.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:



Figure 313. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1880.7.21.7, holotype of *Vesperugo* (*Vesperus*) *brunneus* Thomas, 1880.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Fahr, 2008f; IUCN, 2009).
Trend - 2008 - Decreasing (Fahr, 2008f; IUCN, 2009).

PARASITES:
Nycteribiidae: *Tripselia echinata* Theodor 1957 from Old Calabar, Nigeria (Haeselbarth *et al.*, 1966: 113).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Gabon, Ghana, Liberia, Nigeria, Sierra Leone.

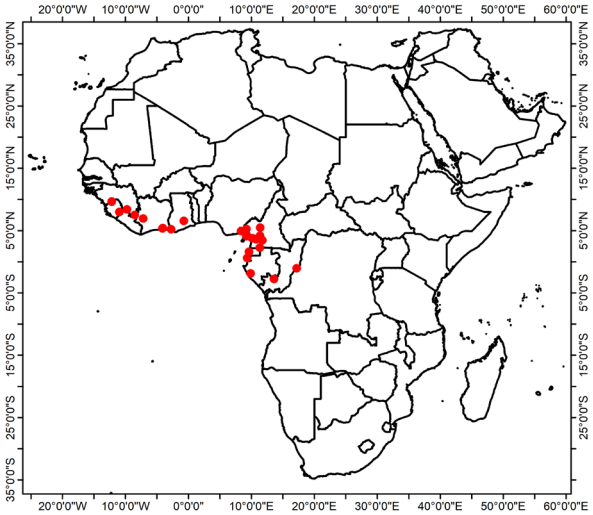


Figure 314. Distribution of *Neoromicia brunnea*

Neoromicia capensis (A. Smith, 1829)

*1829. *Vespertilio Capensis* A. Smith, Zool. Journ., 4 (16): 435. Publication date: May 1829. Type locality: South Africa: Cape province: Grahamstown [33 18 S 26 32 E] [Goto Description]. Lectotype: BMNH 1848.6.12.18: ad, skin only. Collected by: Dr. J.A. Smith. This skin should match skull BMNH 1848.6.12.21. Lectotype: BMNH 1849.8.16.21: ad, skull only. Collected by: Dr. J.A. Smith. Presented/Donated by: ?: Collector Unknown. This skull should match skin BMNH 1849.8.16.18. - Comments: Thorn *et al.* (2009: 56) mention that the "Lectotype (Thomas 1926) probably does not match the Grahamstown type-locality selected by Roberts (1951), see Thorn (1988a).". - Etymology: The name *capensis* refers to the Cape, where the type specimen was collected.

1840. *Vespertilio minuta* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe. Tome Seconde, 2: 209. Type locality: South Africa: Cape of Good Hope [ca. 33 56 S 18 28 E] [Goto Description]. - Comments: Preoccupied by *Vespertilio minutus* Montagu, 1808.

1855. *Vespertilio (Vesperus) minutus:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 747.

1860. *Hypsugo minutus:* Kolenati, Monographie der Europäischen Chiroptern, 20.

1861. *Scotophilus capensis:* Tomes, Proc. zool. Soc. Lond., 1861, I: 36. (Name Combination)

1861. *Scotophilus minutus:* Tomes, Proc. zool. Soc. Lond., 1861, I: 32.

1878. *Vesperugo (Vesperus) capensis:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 198. (Name Combination)

1878. *Vesperugo (Vesperus) minutus:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 197.

1886. *Vesperugo capensis?:* Nehring, Katalog der Säugethiere, 5. (Name Combination)

1887. *Vesperus minutus:* Jentink, Mus. Hist. nat. Pays-Bas, Leyden, 275.

1889. *Vesperus damarensis* Noack, Zool. Jb. Syst., 4: 213, pl. 5, fig. 59. Publication date: 28 February 1889. Type locality: Namibia: Damaraland: Omburu and Golabie [Goto Description]. Syntype: ZMB 86231: ad ♀, skin and skull. Collected by: Heinrich Rudolph Schinz; collection date: August 1886. Formerly A4902; see Turni and Kock (2008: 65). Syntype: ZMB A.4903: ad ♀, alcoholic (skull missing). Collected by: Heinrich Rudolph Schinz; collection date: August 1886. From Omburo; see Turni and Kock (2008: 65) [missing]. Syntype: ZMZ ad ♀, skin and skull. Collected by: Heinrich Rudolph Schinz. Locality Golabie, see Turni and Kock (2008: 65).

1897. *Eptesicus minutus:* Matschie, Arch. Naturgesch. Berlin, 63 (1): 84.

1897. *Vesperugo (Vesperus) damarensis:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, fasc. I: 110.

1901. *Vespertilio (Eptesicus) capensis:* Sclater, Mammals of South Africa, 123, 125. (Name Combination)

1901. *Vespertilio (Eptesicus) damarensis:* Sclater, Mammals of South Africa, 123, 128.

1901. *Vespertilio (Eptesicus) minutus:* Sclater, Mammals of South Africa, 123, 124.
1905. *Vespertilio capensis gracilior* Thomas and Schwann, Proc. zool. Soc. Lond., 1905, I, II: 257. Publication date: 10 August 1905. Type locality: South Africa: KwaZulu-Natal: Eshowe [28 54 S 31 28 E]. Holotype: BMNH 1904.8.31.3: ad? ♂, skin and skull. Collected by: Captain Claude Henry Baxter Grant and C.D. Rudd; collection date: 15 February 1904; original number: 678. (Name Combination)
1907. *Vespertilio (Vespertilio) minutus:* Elliot, Field Columbian Mus., Zool. Ser., 115 (8): 512.
1908. *Scabrifer notius* G.M. Allen, Bull. Mus. comp. Zool., 52 (3): 46. Publication date: July 1908. Type locality: South Africa: SW Cape province: [=Western Cape]: Cape Town [33 56 S 18 28 E] [Goto Description]. Holotype: MCZ 4555: ad ♂, skull and alcoholic. Collected by: Edgar Leopold Layard; collection date: August 1864. Presented/Donated by: Edgar Leopold Layard. See Allen (1908: 46); Helgen and McFadden (2001: 147).
1917. *Eptesicus garambæ* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 445. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Garamba [04 11 N 30 00 E] [Goto Description]. Holotype: AMNH 49340: ad ♂, skull and alcoholic. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 14 March 1912; original number: 1888.
1917. *Eptesicus minutus minutus:* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 410, 445.
1919. *Eptesicus melckorum* Roberts, Ann. Transv. Mus., 6(3): 113. Type locality: South Africa: SW Cape province: Berg River: Kersfontein [32 51 S 18 42 E] [Goto Description]. Holotype: TM 2283: ad ♀, skin and skull. Collected by: Austin Roberts and Adendorff; collection date: 21 November 1917; original number: 533. Note: In loft, under eaves of house. - Etymology: In honour of R. Melck of Kersfontein, Berg River, Cape Province, on whose property the original specimen was taken (Smithers, 1983: 102).
1923. *Eptesicus capensis:* Kershaw, Rev. Zool. afr., 11 (4): 358. (Name Combination)
1924. *Eptesicus capensis gracilior:* Roberts, Ann. Transv. Mus., 10: 60. (Name Combination)
1926. *Eptesicus damarensis:* Thomas, Proc. zool. Soc. Lond., 1926, I: 286.
1932. *Eptesicus capensis nkatiensis* Roberts, Ann. Transv. Mus., 15 (1): 16. Publication date: 1 October 1932. Type locality: Botswana: N Bechuanaland: Nkate [20 00 S 26 10 E] [Goto Description]. Holotype: TM 6549: ad ♀, skin and skull. Collected by: The Vernay-Lang Kalahari Expedition 1930; collection date: 18 August 1930; original number: 999. (Name Combination)
1934. *Eptesicus capensis capensis:* Shortridge, Mammals of South West Africa, 61. (Name Combination)
1939. *Rhinopterus notius:* G.M. Allen, Bull. Mus. comp. Zool., 83: 97.
1953. *Eptesicus (Eptesicus) capensis capensis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 75. (Name Combination)
1953. *Eptesicus (Eptesicus) capensis damarensis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 75. (Name Combination)
1953. *Eptesicus (Eptesicus) capensis gracilior:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 75. (Name Combination)
1953. *Eptesicus (Eptesicus) capensis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 75. (Name Combination)
1953. *Eptesicus (Rhinopterus) notius:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78.
1961. *Eptesicus notius:* Bateman, Koedoe, 4: 82.
1965. *Eptesicus capensis garambae:* Koopman, Am. Mus. Novit., 2219: 15. (Name Combination)
1975. *Eptiscus capensis:* Dean, Zool. Afr., 10: 218. (Lapsus)
1984. *[Pipistrellus] capensis:* Heller and Volleth, Z. zool. Syst. Evolut.-forsch., 22: 72. (Name Combination)
1984. *Eptesicus (Eptesicus) capensis garambae:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch.. (Name Combination)
1984. *Eptesicus (Eptesicus) capensis grandidieri:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch.. (Name Combination)
1987. *Nycterikaupius capensis:* Menu, Palaeovert., 17 (3): 109. Publication date: 15 November 1987. (Name Combination)
1987. *Pipistrellus (Neoromicia) capensis:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)
1988. *P[ipistrellu]s c[apensis] notius:* Thorn, Mammalia, 52 (2): 202. (Name Combination)

1988. *Pipistrellus (Neoromicia) capensis capensis:* Ansell and Dowsett, Mammals of Malawi, 41. (Name Combination)
1988. *Pipistrellus (Neoromicia) capensis gracilior:* Ansell and Dowsett, Mammals of Malawi, 41. (Name Combination)
1988. *Pipistrellus capensis capensis:* Thorn, Mammalia, 52 (2): 199. (Name Combination)
1988. *Pipistrellus capensis gracilior:* Thorn, Mammalia, 52 (2): 204. (Name Combination)
1988. *Pipistrellus capensis:* Thorn, Mammalia, 52 (2): 199. (Name Combination)
1993. *Eptesicus (Neoromicia) capensis:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 201. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] c[apensis] damarensis:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 55. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] c[apensis] garambae:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 55. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] c[apensis] grandidieri:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 55. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] c[apensis] matroka:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 55. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] c[apensis] notius:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 55. (Name Combination)
2001. *Hypsugo capensis:* Volleth, Bronner, Göpfert, Heller, von Helversen and Yong, Chromosome Res., 9 (1): 25. - Comments: Possibly a lapsus since this combination is only mentioned once in the abstract, as is *Pipistrellus (Neoromicia) capensis*. All other references to this taxon refer to it as *Neoromicia capensis*. (Name Combination, Lapsus)
2001. *Neoromicia capensis:* Volleth, Bronner, Göpfert, Heller, von Helversen and Yong, Chromosome Res., 9 (1): 26. (Name Combination, Current Combination)
2019. *L[aephotis] capensis:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)
? *Eptesicus capensis damarensis:* (Name Combination)
? *Eptesicus capensis notius:* (Name Combination)
? *Eptesicus capensis subsp.:*
? *Neoromicia capensis A2:*
? *Neoromicia capensis capensis:* (Name Combination)
? *Neoromicia capensis damarensis:* (Name Combination)
? *Neoromicia capensis garambae:* (Name Combination)
? *Neoromicia capensis gracilior:* (Name Combination)
? *Neoromicia capensis nkatiensis:* (Name Combination)
? *Neoromicia cf. capensis*

TAXONOMY:



Figure 315. *Neoromicia capensis* (SMG-15768) caught at Marloth Park, Mpumalanga, South Africa.

Includes *notius*; see Koopman (1975: 405). Mentioned in the genus *Pipistrellus* by Koopman (1994: 117). Most of the West African populations have not been allocated to subspecies. Volleth *et al.* (2001: 27) assigned this species to the genus *Neoromicia*. Koopman (1993a: 201) included *matroka*, but see Peterson *et al.* (1995: 104). Thorn *et al.* (2007: 70) removed *grandidieri* Dobson, 1876.

Helbig *et al.* (2010: 168) suggest transferring *capensis* to the genus *Laephotis*.

COMMON NAMES:

Afrikaans: Kaapse dakvlermuis. Chinese: 南非伏翼. Czech: netopýr kapský, netopýr hnědý, netopýr damarský. English: Cape bat, Cape Serotine, Cape Pipistrelle Bat, Cape Serotine Bat,

Cape House Bat. French: Sérotine du Cap. German: Kap-Zwergfledermaus, Kap-Pipistrelle, Capische Abendfledermaus. Italian: Pipistrèllo capènse. Kiluba (DRC): Kasusu. Portuguese: Morcego caseiro do cabo.

ETYMOLOGY OF COMMON NAME:
The colloquial name serotine is derived from the Latin *serotinus*, late in the evening (*serus*) (Taylor, 2005). The name serotine is referring to *Eptesicus serotinus* and was in general use when the current species was still considered to belong to that genus.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
This species has been recovered from the upper Pleistocene at Border Cave (Avery, 1991: 6) and Wonderwerk (Avery and Avery, 2011: 19), South Africa, as well as from Holocene deposits at Blinkklipkop, Limerock, Wonderwerk (Avery and Avery, 2011: 19).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008r; IUCN, IUCN, 2009).

Assessment Histroy -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus capensis*] (Jacobs *et al.*, 2008r; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004t; IUCN, 2004). 1996 - LR/lc [assessed as *Eptesicus capensis*] (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016w). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Jacobs *et al.*, 2008r; IUCN, 2009), although Doty and Martin (2012: 75) report on fatalities due to wind turbines in the Eastern Cape, South Africa.

CONSERVATION ACTIONS:
Jacobs *et al.* (2008r) [in IUCN (2009)] report that in view of the species wide range and adaptability it is expected to occur in many protected areas (such as the Udzungwa Mountains National Park (Stanley *et al.*, 2005b)). There are no direct conservation measures currently needed for this species as a whole.

GENERAL DISTRIBUTION:
Neoromicia capensis is widespread over much of sub-Saharan Africa. It has been recorded from Guinea Bissau in the west, to Somalia, southern Sudan and Eritrea in the east, ranging south to most of South Africa. In the RSA, the species' distribution is linked with land use/land cover (Babiker Salata, 2012: 50).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,719,255 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 565; Taylor *et al.*, 2018b: 60); Benin (Capo-Chichi *et al.*, 2004: 163); Botswana (Archer, 1975; Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 565); Burkina Faso (Kangoyé *et al.*, 2012: 6026; 2015a: 619); Burundi; Cameroon; Central African Republic; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 565); Côte d'Ivoire; Equatorial Guinea; Eritrea; Ethiopia (Largen *et al.*, 1974; Yalden *et al.*, 1996; Lavrenchenko *et al.*, 2004b: 142); Gabon; Ghana (Decher and Fahr, 2007: 16 as *N.* cf. *capensis*); Guinea; Guinea-Bissau (Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001: 63); Kenya; Lesotho (Lynch, 1994: 195; Monadjem *et al.*, 2010d: 565); Liberia (Fahr, 2007a: 104); Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 565); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 565; Monadjem *et al.*, 2010c: 384); Namibia (Monadjem *et al.*, 2010d: 565); Nigeria; Sierra Leone; Somalia; South Africa (Seamark and Kearney, 2007; Monadjem *et al.*, 2010d: 566); Sudan; Swaziland (Monadjem *et al.*, 2010d: 567); Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 62); Zambia (Ansell, 1967; Ansell, 1969; Ansell, 1973; Monadjem *et al.*, 2010d: 567); Zimbabwe (Monadjem *et al.*, 2010d: 567).
Presence uncertain: Djibouti.

Bates *et al.* (2013: 339) reject the presence of *N. capensis* in the Republic of Congo as the data presented by Lavrenchenko *et al.* (2004b: 142) are actually from the DRC.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Fisk (1890: 97) reported on an albino specimen shot at Broadlands farm (Somerset West, South Africa), see also Allen (1939b) and Lucati and López-Baucells (2016: Suppl.).

Schoeman and Jacobs (2002: 157) mention the following parameters for 10 specimens from the Algeria Forestry Station (RSA): Fa: 35.9 ± 1.2 mm, Wing area: 87.6 ± 7.4 cm^2, Wing span: 24.0 ± 0.8

cm, Wing loading: 7.3 ± 1.0 N/m^2, and aspect ratio: 6.6 ± 0.4.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

ECHOLOCATION:
See Jacobs (1996), Taylor (1999b) and Taylor *et al.* (2005).

For the Algeria Forest Station (RSA), Schoeman and Jacobs (2002: 157) reported the call type to be a low duty echolocation dominated by frequency modulated calls, with a F_{peak}: 41.9 ± 1.4 kHz.

Schoeman and Waddington (2011: 291) mention a peak frequency of 39.4 ± 1.1 kHz and duration of 5.1 ± 1.2 msec for specimens from Durban, South Africa.

Taylor *et al.* (2013b: 17) recorded the following parameters for 7 calls from Soutpansberg, South Africa: F_{max}: 48.9 ± 6.15 (41.4 - 61.4) kHz, F_{min}: 37.6 ± 1.86 (34.7 - 40.9) kHz, F_{knee}: 40.0 ± 1.92 (37.0 - 42.4) kHz, F_{char}: 38.2 ± 1.68 (35.8 - 41.2) kHz, duration: 3.6 ± 1.05 (2.1 - 5.0) msec.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg (RSA): F_{min}: 34 - 39 kHz, F_{char}: 36 - 41 kHz, F_{knee}: 37 - 42 kHz, Slope: 254 - 509 OPS, duration: 2 - 5 msec.
At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 40 (37 - 42) kHz. 10 calls from the Kalahari Desert, recorded by Adams and Kwiecinski (2018: 4), had the following values: F_{char}: 36.9 ± 0.6 kHz, F_{max}: 39.6 ± 4.3 kHz, F_{min}: 36.7 ± 0.6 kHz, duration: 3.5 ± 0.5 msec. 20 calls from the Mapungubwe National Park (RSA) recorded by Parker and Bernard (2018: 57) had the following features: F_{char}: 39.54 ± 1.17 kHz, F_{max}: 63.06 ± 5.75, F_{min}: 38.59 ± 1.21 kHz, F_{knee}: 46.16 ± 3.94 kHz, duration: 5.18 ± 1.45 msec and 7.36 ± 2.31 calls/sec.

In the Telperion Nature Reserve (RSA), Kearney *et al.* (2019: 37) recorded the release calls of 37 bats (559 pulses) with the following characteristics: F_{char}: 37.10 ± 1.42 (32.65 - 42.11) kHz, slope at start of call: 53.67 ± 42.21 (-42.66 - 261.53), time from start of call to F_{char}: 4.25 ± 1.14 (1.66–7.64) msec and duration: 4.61 ± 1.12 (3.01 - 8.19). Subdivided according to sexe, these data were respectively: ♂♂:37.26 ± 1.46 (32.65 - 42.11) kHz, 58.29 ± 46.30 (-18.07 - 261.53), 4.24 ± 1.09 (1.66–6.99) msec, 4.63 ± 1.07 (3.01 - 7.74) msec;♀♀: 36.93 ± 1.36 (33.20 - 40.20) kHz, 48.68 ± 36.75 (-42.66 - 205.01), 4.26 ± 1.19 (1.76–7.64) msec, 4.59 ± 1.18 (3.02 -8.19) msec. As February is probably in the mating season of *N. capensis*, this dimorphism in calls might be playing a social role within the reproductive context (Kearney *et al.* (2019: 41).

MOLECULAR BIOLOGY:
DNA -
Karyotype - Peterson and Nagorsen (1975), Rautenbach *et al.* (1993), Volleth *et al.* (2001), and Kearney *et al.* (2002) all reported 2*n* = 32, FN = 50, BA = 20. While Rautenbach *et al.*, 1993) and Kearney *et al.* (2002) reported a metacentric X chromosome, Peterson and Nagorsen (1975) reported a submetacentric X chromosome. Peterson and Nagorsen (1975) and Rautenbach *et al.* (1993) both reported an acrocentric Y chromosome. GTG-bands identified three Robertsonian fusion chromosomes (7/11, 8/9, 10,12), considered as distinguishing characters for the genus *Neoromicia* Kearney *et al.* (2002).
Protein / allozyme - See Morales *et al.* (1991) for results from seven specimens from South Africa.

HABITAT:
Sirami *et al.* (2013: 34) recorded in the Western Cape Province, South Africa that *N. capensis* activity was significantly and positively influenced by size of wetland, while habitats 100 m surrounding wetlands were also significantly and positively influenced by the water body. *N. capensis* favoured open habitats surrounding wetlands (Sirami *et al.*, 2013: 35).

Minnaar *et al.* (2014a: 522) found that moth consumption by *N. capensis* was low under unlit conditions (mean percentage volume ± SD: 5.91 ± 6.25 %), while moth consumption increased sixfold (35.42 ± 17.90 %) under artificially lit conditions despite a decrease in relative moth abundance. They conclude (p. 529) that the "introduction of artificial lights into previously unlit environments may allow syntonic bats [such as *N. capensis*, which are audible to eared moths] access to an historically unavailable resource in eared moths".

ROOST:
Taylor *et al.* (1999: 69) reported on a single roost found in the Durban area, which was located in the roof and spaces between wooden shutters and the outer wall of a school building in the Kloof suburb.

Kearney *et al.* (2019: 30) indicate that there seems to be a shift in roosting sites from natural crevice and vegetation types to to man-made structures, which seems to be accompanied by a change in roosting group size. Vegetation roosts were usually inhabited by two or three individuals, whereas buildings can house groups of over 50 animals.

DIET:
From the Algeria Forestry Station (RSA), Schoeman and Jacobs (2002: 157) reported the following prey groups based on 89 faecal pellets from 10 bats (in volume percent): Hemiptera (46.6 ± 33.7), Diptera (37.6 ± 28.4), Coleoptera (12.5 ± 21.5), Ephemeroptera (2.3 ± 5.5), and unknown (1 ± 3.2).

PREDATORS:
Thomas and Jacobs (2013: 127) [referring to Avery *et al.* (2005)] indicate that *N. capensis* is more often taken by owls due to its clutter-edge foraging style, which combines slow flight with foraging at the edge of the vegetation.

Dean (1975: 218) reports on one specimen being found in a barn owl (*Tyto alba* pellet in South Africa (see also Avery *et al.*, 2005: 1054). Avery *et al.* (2003: 7) found *N. capensis* to be the best represented prey in barn owl pellets collected in the Free State during the summer.

Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850), the Pied crow (*Corvus albus* Statius Muller, 1776) and the Southern fiscal (*Lanius collaris* Linnaeus, 1766) as diurnal avian predators of "*Eptesicus capensis*".

POPULATION:
Structure and Density - In general, this is a locally common species (Jacobs *et al.*, 2008r; IUCN, 2009).
Trend - 2008 - Stable (Jacobs *et al.*, 2008r; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
van der Merwe and Rautenbach (1990: 540) reported that "*Eptesicus capensis*" commonly gives birth to twins and occasionally even triplets. van der Merwe (1990: 202) examined five pregnant females and found three of them having two foetuses (one in each uterine horn), one had three foetuses (two in the right and one in the left uterine horn) and one even four foetuses.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births from late October to November.

PARASITES:
Genov *et al.* (1992) reported the Nematode *Molinostrongylus omatus* (Mönnig, 1927) from an "*Eptesicus capensis*" specimen from South Africa.

Schaer *et al.* (2013a: 17416) report the presence of hemosporidian parasites of the genus *Polychromophilus* in one out of three investigated bats.

BACTERIA:
Dietrich *et al.* (2016a: 4) found *Rickettsia* in the faeces of bats from South Africa.

HEMIPTERA
Cimicidae: *Cacodmus villosus* (Stål, 1855) in the Transvaal, South Africa (Haeselbarth *et al.*, 1966: 11). Haeselbarth *et al.* (1966: 11) suggests that Bedford (1932)'s record of *Cimex pipistrelli* Jenyns from Cape Town most probably refers to *Cacodmus villosus* (Stål, 1855) (see also Reinhardt and Jacobs, 2006).

DIPTERA
Nycteribiidae: *Nycteribia schmidlii* Schiner, 1853 (Haeselbarth *et al.*, 1966: 108).

SIPHONAPTERA
Ischnopsyllidae: *Ischopsyllus emminus* Jordan and Rothschild, 1921 only known from the type series collected at Greenwood Park, Natal, South Africa (Haeselbarth *et al.*, 1966: 187). *Dampfia grahami* (Waterston, 1915) from Malawi (Beaucournu and Kock, 1996); *Araeopsylla scitula* (Rothschild, 1909) a single record from Kanye, Botswana (Haeselbarth *et al.*, 1966: 189).

Brennan *et al.* (2015: 145) found no antibodies against *Pseudogymnoascus destructans* (White-nose syndrome) in blood samples from bats from Botswana.

VIRUSES:
Bunyaviridae
Hantavirus
Tešíková *et al.* (2017: 279) found Hantavirus RNA in dried blood samples of *N. capensis* from the Dhati Walel National Park in Ethiopia.

Coronaviridae - Coronaviruses
Geldenhuys *et al.* (2013: 516) found one *N. capensis* specimen (out of 10) testing positive for CoV RNA in Taung, RSA. Ithete *et al.* (2013: 1697) reported on a new virus from a *N.* cf. *capensis* (incorrectly identified as *N.* cf. *zuluensis*) from South Africa, which is related to Middle East respiratory syndrome (MERS)-CoV. Corman *et al.* (2014) determined the full genome sequence of the MERS-related CoV identified in Ithete *et al.* (2013: 1697) and found that 85 % of its genome was identical to Middle East respiratory syndrome (MERS)-CoV.
In South Africa, Cronjé *et al.* (2019: 2) found that female *N. capensis* [and bats trapped at low altitude sites with low body condition scores] were most likely to be infected with coronaviruses.

Phenuiviridae
Phlebovirus

Rift Valley Fever Virus (RVFV) - Oelofsen and Van der Ryst (1999) tested 28 individuals from four localities in the Free State Province, South Africa for RVFV antigen using an enzyme linked immunosorbet assay (ELISA), none tested positive.

Rhabdoviridae
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested 101 individuals from 5 localities using "Trousse Platelia Rage" ELISA kit (Diagnostic Pasteur), none tested positive for antibodies to rabies virus glycoprotein G. Oelofsen and Smith (1993) tested 145 individual brains, from 12 localities by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), none were tested positive.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Botswana, Burundi, Cameroon, Congo (Democratic Republic of the), Eritrea, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mozambique, Namibia, Nigeria, Senegal, Sierra Leone, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

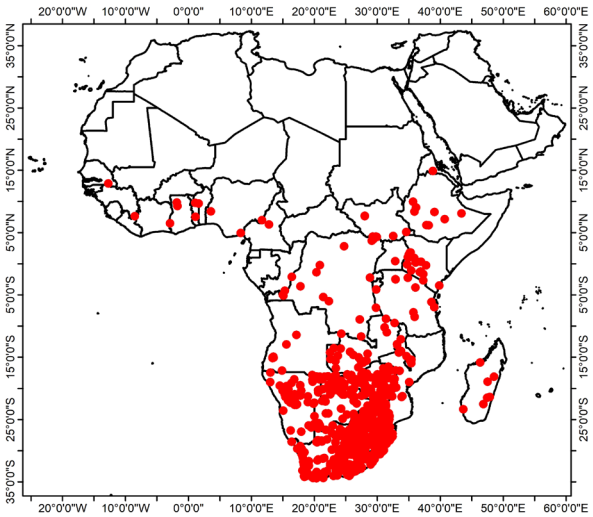


Figure 316. Distribution of *Neoromicia capensis*

Neoromicia guineensis (Bocage, 1889)

*1889. *Vesperus guineensis* Bocage, J. Sci. mat. phys. nat., ser. 2, 1 (1): 6. Publication date: March 1889. Type locality: Guinea-Bissau: Bissau (island) [11 52 N 15 39 W] [Goto Description]. - Comments: Bocage (1889a: 7) mentions 2 ♀♀; sent from Bissau in 1879 by Mr. Rodrigo da Costa. - Etymology: From the feminine scientific Latin *guineènsis*, meaning "inhabitnig Guinea", referring to the provenance of the type specimen (Guinea-Bissau) (see Lanza *et al.*, 2015: 403).

1897. *Vesperugo (Vesperus) guineensis:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, fasc. I: 110. (Name Combination)

1916. *Eptesicus rectitragus* Wettstein, Anz. kais. Akad. Wiss., Wien, 53: 191. Publication date: 1916. Type locality: Sudan: S Kordofan, N edge of Nuba Mountains: Dilling [12 02 N 29 39 E, 660 m] [Goto Description]. Holotype: NMW 8411: juv ♂. Collected by: Otto Ritter von Westersheim Wettstein; collection date: 20 March 1914; original number: AM 96/2. - Comments: Wettstein (1916: 189) mentions Prof. Dr. Franz Werner as collector.

1923. *Eptesicus guineensis:* de Beaux, Atti Soc. ital. Sci. nat., 62: 98. (Name Combination)

1975. *Eptesicus (Eptesicus) guineensis:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 406. (Name Combination)

1987. *Pipistrellus (Neoromicia) guineensis:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)

1993. *Eptesicus (Neoromicia) guineensis:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 202. (Name Combination)

1994. *P[ipistrellus (Neoromicia)] g[uineensis] guineensis:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)

1994. *P[ipistrellus (Neoromicia)] g[uineensis] rectitragus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)

1995. *Pipistrellus guineensis:* Koopman, Kofron and Chapman, Am. Mus. Novit., 3148: 11. (Name Combination)

2006. *Neoromicia guineensis:* Van Cakenberghe, Kearney and Seamark, African Chiroptera Project, Pretoria, 133 - 134. (Name Combination, Current Combination)

2007. *Eptesicus quineensis:* Lameed, Biodiversity, 8 (4): 8. (Lapsus)

2011. *N[eoromicia] guineenesis:* Benda, Al-Jumaily, Reiter and Nasher, Hystrix, It. J. Mamm., (n.s.) 22 (1): 41. Publication date: July 2011. (Lapsus)

2019. *L[aephotis] guineensis:* Taylor and Tuttle, Bats: An illustrated guide to all species, 284. Publication date: 11 April 2019. (Name Combination)
? *Eptesicus guineensis rectitragus:* (Name Combination)
? *Neoromicia guineensis guineensis:* (Name Combination)
? *Neoromicia guineensis rectitragus:* (Name Combination)

TAXONOMY:
This species is called *pusillus* by Hayman and Hill (1971); but see Koopman (1975: 406, 407). Mentioned in the genus *Pipistrellus* by Koopman (1994: 117).

COMMON NAMES:
Czech: netopýr savanový. English: Guinean Pipistrelle Bat, Tiny Serotine, Guinea Serotine. French: Sérotine de Guinée, Sérotine minuscule, Pipistrelle de Guinée. German: Guinea-Zwergfledermaus, Guinea-Pipistrelle. Italian: Pipistrèllo guineàno.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr, 2008l; IUCN, 2009).

Assessment Histroy -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus guineensis*] (Fahr, 2008l; Bocage, 1889c). 2004 - LC ver 3.1 (2001) (Fahr, 2004g; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Fahr, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008l) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas.

GENERAL DISTRIBUTION:
Neoromicia guineensis is widely distributed in West and Central Africa, ranging into East Africa. Western distribution ranges from Senegal and Gambia to Ghana, Burkina Faso, and Benin. Recorded as far east as the border between Ethiopia and Somalia, and in Yemen. The southernmost records are from Congo and the DRC (close to the border areas with Angola).

Specimens reported from Tanzania might pertain to *N. somalica*, see Koopman (1994: 117)).

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Burkina Faso (Kock *et al.*, 2002: 89; Kangoyé *et al.*, 2015a: 620); Cameroon; Central African Republic; Chad (Kock *et al.*, 2002: 89); Congo (The Democratic Republic of the); Côte d'Ivoire; Ethiopia; Gambia (Kock *et al.*, 2002: 89); Ghana; Guinea; Guinea-Bissau (Bocage, 1889a; Seabra, 1900a; Monard, 1939; Veiga-Ferreira, 1949;; Rainho and Ranco, 2001; Kock *et al.*, 2002: 89); Liberia (Monadjem and Fahr, 2007: 47); Nigeria; Senegal; Sudan; Togo; Uganda; Yemen (Entwistle and Corp, 1997a: 40).

Bates *et al.* (2013: 339) rejected the presence of *N. guineensis* in the Republic of Congo as Van Cakenberghe and Happold (2013k: 625) only mark a locality on the map without providing further data.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Benda *et al.* (2011b: 41).
Brain - Amrein *et al.* (2007) from specimens collected from Bénin reported that proliferating cells, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus was found to be absent. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream.

SEXUAL DIMORPHISM:
In Burkina Faso, Kangoyé *et al.* (2015a: 620) found that females have higher average values than males for both body (except Ear and 3ph2) and cranial measurements.

POPULATION:
Structure and Density - This species is relatively common (Fahr, 2008l; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008l; IUCN, 2009).

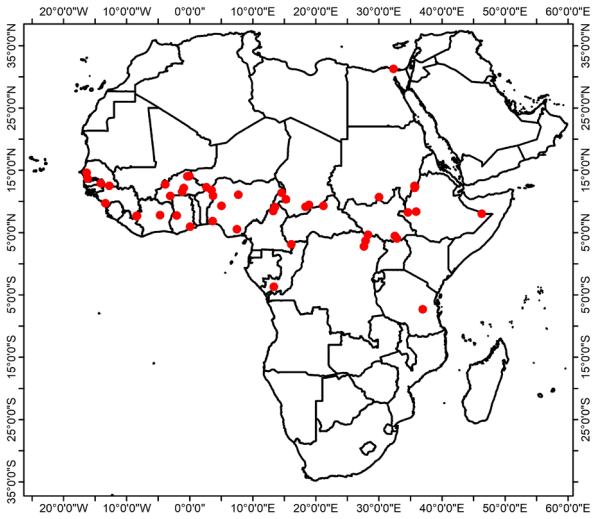


Figure 317. Distribution of *Neoromicia guineensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Egypt, Ethiopia, Ghana, Guinea, Kenya, Nigeria, Senegal, South Sudan, Sudan, Tanzania, The Gambia.

Neoromicia helios (Heller, 1912)

*1912. *Pipistrellus helios* Heller, Smiths. Misc. Coll., 60 (12): 3. Publication date: 4 November 1912. Type locality: Kenya: 30 mi (48 km) S Mount Marsabit: Merelle Water [01 23 S 37 44 E] [Goto Description]. Holotype: USNM 181813: ad ♂, skin and skull. Collected by: Edmund Heller; collection date: 22 July 1911; original number: 3065. - Etymology: From the masculine Greek substantive "*ἥλιος*" (hèlios), meaning "sun", referring to the ochraceous-buff colour of the dorsal fur (see Lanza *et al.*, 2015: 407).

1951. *Pipiestrellus helios:* Watson, Uganda J., 15 (1): xx. - Comments: Lapsus. (Lapsus)

1968. *Pipistrellus nanus helios:* Funaioli and Lanza, Mon. Zool. ital., (N.S.) 2 (Suppl.): 199. (Name Combination)

1987. *Pipistrellus (Hypsugo) helios:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 281. (Name Combination)

1994. *P[ipistrellus (Pipistrellus)] a[fricanus] helios:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 113. (Name Combination)

2002. *Hypsugo helios:* Kruskop, Plecotus et al., pars spec.: 21. (Name Combination)

2006. *Neoromicia helios:* Van Cakenberghe, Kearney and Seamark, African Chiroptera Project, Pretoria, 134. (Name Combination, Current Combination)

2019. *L[aephotis] helios:* Taylor and tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

TAXONOMY:
Hayman and Hill (1971) indicated that the shape of the baculum supports the separation of *helios* from *Pipistrellus nanus*, which is confirmed by Kock (pers. Comm.). See discussion in Simmons (2005).

COMMON NAMES:
Chinese: 桑布魯伏. Czech: netopýr slunečný. English: Samburu Pipistrelle Bat, Helios Pipistrelle Bat, Heller's Pipistrelle Bat, Heller's Pipistrelle. French: Pipistrelle soleil. German: Samburu-Zwergfledermaus, Samburu-Pipistrelle. Italian: Pipistrèllo di Hèller.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Jacobs *et al.*, 2008t; IUCN, 2009).

Assessment Histroy -
2008 - DD ver 3.1 (2001) [assessed as *Pipistrellus helios*] (Jacobs *et al.*, 2008t; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004z; IUCN, 2004).

MAJOR THREATS:
The threats to this species are not known (Jacobs *et al.*, 2008t; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008t) [in IUCN (2009)] report that it is not known if the species is present in any protected area. There is a need for studies into the distribution, abundance, natural history and possible threats to this species.

GENERAL DISTRIBUTION:
Neoromicia helios is an East African species, which has been recorded from Djibouti, southern Somalia, southern Sudan, northeastern Uganda, Kenya and northern Tanzania. It may be more widely distributed (Peterson, 1987; Simmons, 2005).

Native: Djibouti; Kenya; Somalia; Sudan; Tanzania; Uganda.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

HABITS:
Keeley and Keeley (2004: 116) [referring to O'Shea (1980) and Happold and Happold (1996)] mention that male "*Pipistrellus nanus*" roosting in palm-thatched roofs show territoriality and aggressive competition for spacious roosts, whereas males in populations roosting in banana leaves appear not to defend territories aggressively, and indicate that this difference might be based on the availability of preferred roosts. However, the more likely explanation being that these differences are due to these two groups belonging to different species, as the thatched roof inhabiting form is most likely *N. helios*.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Jacobs *et al.*, 2008t; IUCN, 2009).

Trend - 2008 - Unknown (Jacobs *et al.*, 2008t; IUCN, 2009).

PARASITES:
Nycteribiidae: *Basilia ansifera* Theodor, 1956 - mainly a West African species reaching Lake Victoria in the east and Lake Nyasa in the south - nearly all localities lie between 15° latitude north and south (Haeselbarth *et al.*, 1966: 110).

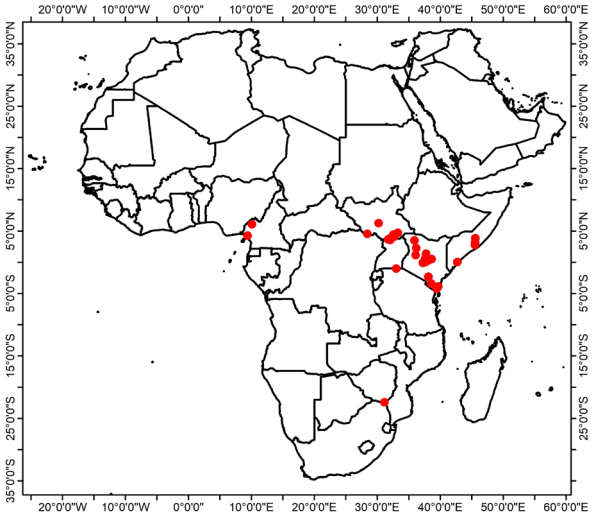


Figure 318. Distribution of *Neoromicia helios*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Ghana, Kenya, Somalia, South Africa, South Sudan, Tanzania, Uganda.

Neoromicia humbloti (A. Milne-Edwards, 1881)

*1881. *Vesperus Humbloti* A. Milne-Edwards, C. R. séances Acad. Sci., Paris, 91: 1035. Publication date: 1881. Type locality: Madagascar: "Madagascar" [Goto Description]. Syntype: MNHN ZM-MO-1986-1074: juv, alcoholic (skull not removed). 1 ad ♀, 2 ad ♂♂, 1 ad? ♂, 2 imm ♀♀, 3 imm ♂♂. Syntype: MNHN ZM-MO-1986-1075: juv, alcoholic (skull not removed). Syntype: MNHN ZM-MO-1986-1076: juv, alcoholic (skull not removed). Syntype: MNHN ZM-MO-1986-1077:. Syntype: MNHN ZM-MO-1986-1078:. Syntype: MNHN ZM-MO-1986-1079:. Syntype: MNHN ZM-MO-1986-1080:. Syntype: MNHN ZM-MO-1986-1081:. Syntype: MNHN ZM-MO-1986-1082:. - Comments: The label on the type specimen mentions: "between Foulepoint and Lake Alaoutr".
1897. *Vesperugo (Vesperus) humbloti:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, fasc. I: 110. (Name Combination)
1939. *Eptesicus humbloti:* G.M. Allen, Bull. Mus. comp. Zool., 83: 85. (Name Combination)
1994. *P[ipistrellus (Neoromicia] s[omalicus] humbloti:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)
2006. *E[ptesicus] humblotii:* Hoofer, Van den Bussche and Horácek, J. Mamm., 87 (5): 991. Publication date: October 2006. (Lapsus)
2006. *Neoromicia humbloti:* Van Cakenberghe, Kearney and Seamark, African Chiroptera Project, Pretoria, 135. (Name Combination, Current Combination)
2012. *Vespertilio humbloti:* Goodman, Taylor, Ratrimomanarivo and Hoofer, Zootaxa, 25: 25. (Name Combination)

TAXONOMY:
The status of *humbloti* can not be validated (see Peterson *et al.*, 1995: 104). It is sometimes mentioned as synonym of *somalicus* Thomas, 1901. However, if this is correctly assigned to that form, then *humbloti* A. Milne-Edwards, 1881 should be the valid name for what is now known as *Neoromicia somalica*.
We consider *humbloti* to be an island species, allied to *N. somalica* Thomas, 1901, but differing from it on specific level. The relation with *N. malagasyensis* Peterson, Eger and Mitchell, 1975 still needs to be evaluated.

CONSERVATION STATUS:
Global - Not assessed (IUCN, 2004).

GENERAL DISTRIBUTION:
Madagascar.

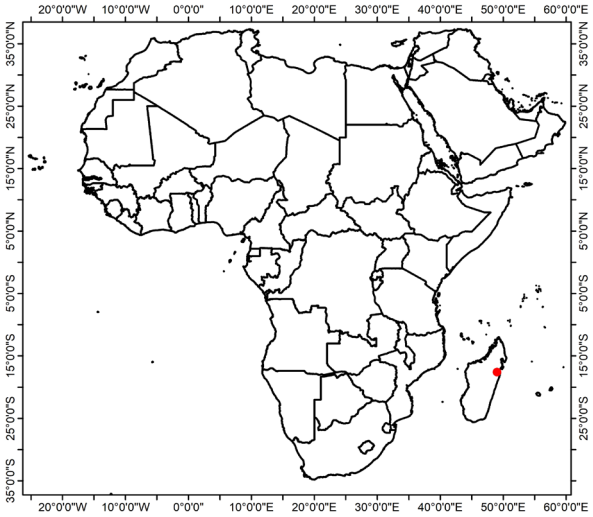


Figure 319. Distribution of *Neoromicia humbloti*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Neoromicia isabella Decher, Hutterer and Monadjem, 2016

2013. *Neoromicia cf. rendalli:* Monadjem, Richards, Taylor and Stoffberg, Zool. J. Linn. Soc., 167 (1): 194. Publication date: 18 January 2013. (Name Combination)

*2016. *Neoromicia isabella* Decher, Hutterer and Monadjem, in: Decher et al., Acta Chiropt., 17 (2): 260, 74867, figs 4,6,7B-C, 8 (for 2015). Publication date: 27 January 2016. Type locality: Guinea: Macenta Province: Simandou Range: Foko Confluence [08 29 48.62 N 08 54 48.22 W, 765 m] [Goto Description]. Holotype: ZFMK 2008.0292: ad ♂, skull and alcoholic. Collected by: Jan Decher; collection date: 7 March 2008; original number: JD 650. Presented/Donated by: ?: Collector Unknown. COI sequence GenBank nr. KT598187 (see Decher *et al.*, 2016: 267). Paratype: ZFMK 2008.0291: ad ♀, alcoholic (skull not removed). Collected by: Jan Decher; collection date: 7 March 2008; original number: JD 647. Presented/Donated by: ?: Collector Unknown. - Etymology: "The species epithet refers (as a noun in apposition) to the 'Isabella' colouration (sensu Ridgeway, 1912) of the dorsal fur of this bat, and also recalls the name of Jan Decher's daughter Isabelle." (see Decher *et al.*, 2016: 267). - ZooBank: 5F782E04-64B5-40EA-8315-92A56DAE3EA8.

2019. *L[aephotis] isabella:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

COMMON NAMES:
English: Isabelline White-winged Serotine.
German: Isabell-Weissflügel Serotine.

ZOOBANK:
5F782E04-64B5-40EA-8315-92A56DAE3EA8

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Guinea, Liberia.

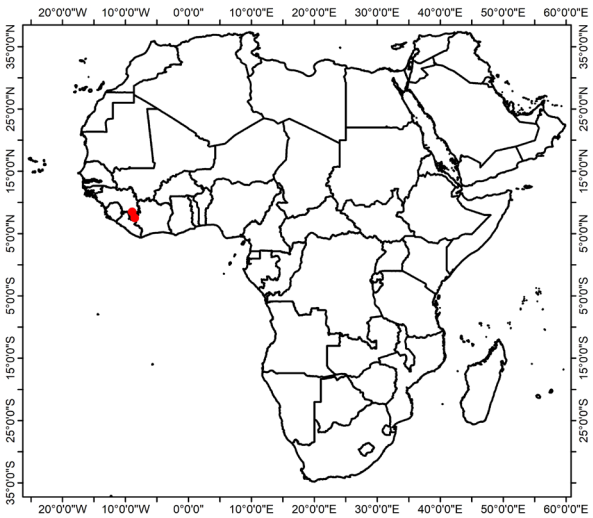


Figure 320. Distribution of *Neoromicia isabella*

Neoromicia malagasyensis (Peterson, Eger and Mitchell, 1995)

*1995. *Eptesicus somalicus malagasyensis* Peterson, Eger and Mitchell, Faune de Madagascar, Chiroptères, 84: 100, fig. 49. Type locality: Madagascar: Sakaraha sous-prefecture: 220 km NE Tuléar [=Toleara]: Ilakaka, East of [22 41 S 45 13 E] [Goto Description]. Holotype: ROM 42713: ad ♀, skin and skull. Collected by: Randolph L. Peterson, John George Williams and Robert M. Glen; collection date: 13 May 1967. See Peterson *et al.* (1995: 100), Goodman and Ranivo (2004: 434). - Comments: Bates *et al.* (2006: 313) situated the type locality at Maninday [22 47 S 44 48 E].
2004. *N[eoromicia] malagasyensis:* Goodman and Ranivo, Mamm. biol., 69 (6): 436. (Name Combination)
2004. *Neoromicia somalicus malagasyensis:* Goodman and Ranivo, Mamm. biol., 69 (6): 434. (Name Combination)
2012. *Neoromicia cf. malagasyensis:* Goodman, Taylor, Ratrimomanarivo and Hoofer, Zootaxa, 25: 25. (Name Combination)
2019. *L[aephotis] malagasyensis:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)
? *Eptesicus malagasyensis:* (Name Combination)
? *Neoromicia malagasyensis:* (Name Combination, Current Combination)

TAXONOMY:
Only known from a very limited number of specimens. Originally considered a subspecies of *somalicus* Thomas, 1901 by Peterson *et al.* (1995), but see Goodman and Ranivo (2004: 438), who elevate it to species rank, which is supported by Bates *et al.* (2006). However, they did not discuss the relation of this form with *humbloti* A. Milne-Edwards, 1881.

COMMON NAMES:
English: Isalo Serotine. French: Sérotine de Sakahara. German: Madagaskar-Zwergfledermaus, Madagaskar Pipistrelle.

CONSERVATION STATUS:
Global - This species is listed as Endangered (EN B1ab(iii) ver 3.1 (2001)) because it has a range of only 2,000 km^2, and is currently known only from the area around the Isalo Massif where it is presumably at risk of habitat loss (Andriafidison *et al.*, 2008c; IUCN, 2009).

Assessment History -
2008 - EN B1ab(iii) ver 3.1 (2001) [as *Eptesicus malagasyensis*] (Andriafidison *et al.*, 2008c; IUCN, 2009).

MAJOR THREATS:
The threats to this species are not known, but its habitat is presumably undergoing some decline. It has yet to be recorded from synanthropic settings and probably relies on natural roost sites in trees and other vegetation (Andriafidison *et al.*, 2008c; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008c) [in IUCN (2009)] report that this species is present in Parc National d'Isalo. Future conservation measures should focus on roosting sites, but further research is needed to investigate the roosting and foraging habitats of this species.

GENERAL DISTRIBUTION:
Neoromicia malagasyensis is endemic to Madagascar, where it is restricted to an area of 1,905 km^2 around the Isalo Massif (Bates *et al.*, 2006). It has been recorded between 450 and 700 m above sea level (Goodman and Ranivo, 2004) and is currently known from four localities (Bates *et al.*, 2006).

Native: Madagascar (Peterson *et al.*, 1995; Goodman and Ranivo, 2004: 438; Bates *et al.*, 2006).

ECHOLOCATION:
Kofoky *et al.* (2009: 382) reported the calls of six individuals which consisted of FM/QCF components produced at low duty cycle, with maximum energy in the fundamenetal at about 45.8 kHz.

PARASITES:
Ramasindrazana *et al.* (2016: 7) report the presence of an unnamed filarial Nematode.

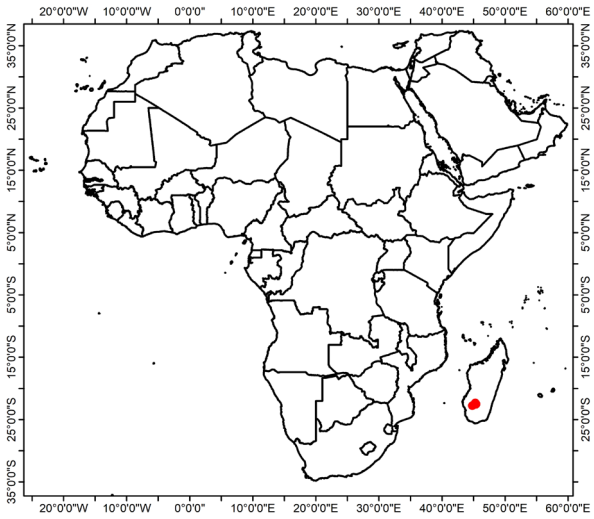


Figure 321. Distribution of *Neoromicia malagasyensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Neoromicia matroka (Thomas and Schwann, 1905)

*1905. *Vespertilio matroka* Thomas and Schwann, Proc. zool. Soc. Lond., 1905, I, II: 258. Publication date: 10 August 1905. Type locality: Madagascar: Betsileo: Ambositra [20 31 S 47 15 E, 1 100 m]. Holotype: BMNH 1897.9.1.32: ad ♂, skull and alcoholic. Collected by: Dr. Charles Immanuel Forsyth Major; collection date: 2 February 1875; original number: 177. See Peterson *et al.* (1995: 104).
1939. *Eptesicus matroka:* G.M. Allen, Bull. Mus. comp. Zool., 83: 86. (Name Combination)
1987. *Nycterikaupius matroka:* Menu, Palaeovert., 17 (3): 109. Publication date: 15 November 1987. (Name Combination, Lapsus)
2006. *Neoromicia matroka:* Van Cakenberghe, Kearney and Seamark, African Chiroptera Project, Pretoria, 136. (Name Combination, Current Combination)
2019. *L[aephotis] matroka:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

TAXONOMY:
Considered a synonym of *capensis* by Hayman and Hill (1971) and Koopman (1993a: 201), but see Peterson *et al.* (1995: 104), Russ *et al.* (2001), Simmons (2005: 456) who consider it a valid species.
Simmons (2005: 456) placed *matroka* within the genus and subgenus *Eptesicus*.

COMMON NAMES:
Czech: netopýr malgašský. English: Madagascar serotine, Matroka Bat, Malagasy Serotine. French: Sérotine de Madagascar. German: Matroka-Zwergfledermaus, Matroka-Pipistrelle.

CONSERVATION STATUS:
Global - This species is listed as Least Concern (LC ver 3.1 (2001)) because there is no evidence of a severe decline in habitat or population size and it occurs across a wide range of habitats which includes built-up areas (Andriafidison *et al.*, 2008r; IUCN, 2009).

Assessment History - 2008 - LC ver 3.1 (2001) [as *Eptesicus matroka*] (Andriafidison *et al.*, 2008r; IUCN, 2009). 2000 - Data Deficient.

MAJOR THREATS:
There are no known major threats to this species (Andriafidison *et al.*, 2008r; IUCN, 2009).

CONSERVATION ACTIONS:
Andriafidison *et al.* (2008r) [in IUCN (2009)] report that this species has yet to be recorded from inside protected areas, but is known to use agricultural land adjacent to Parc National de Mantadia (Randrianandriananina *et al.*, 2006).

GENERAL DISTRIBUTION:
Neoromicia matroka is endemic to Madagascar and appears to be largely restricted to an area in the eastern highlands between 970 and 1,300 m above sea level (Bates *et al.*, 2006).

Native: Madagascar (Peterson *et al.*, 1995: 105; Bates *et al.*, 2006; Randrianandriananina *et al.*, 2006).

GEOGRAPHIC VARIATION:
Goodman *et al.* (2012b: 3) found geographical variation in the cranio-dental measurements, which lead them to divide this species into geographical units or Operational Taxonomic Units (OTUs): OTU 1 - the Central Highlands above 1,000 m, which includes the type locality near Ambositra (Thomas and Schwann, 1905b: 258); OTU 2 - areas in central western Madagascar less than 900 m; OTU 3 - eastern lowlands from sea-level to 200 m; and OTU 4 - eastern lowlands from 201 - 900 m.

DETAILED MORPHOLOGY:
Baculum - See Bates *et al.* (2006).

HABITAT:
It is found alongside humid forests and has also been recorded from open anthropogenic agricultural and grassland areas (Bates *et al.*, 2006; Randrianandriananina *et al.*, 2006).

ROOST:
It has been netted emerging from buildings (Bates *et al.*, 2006).

DIET:
On Madagascar, Rakotondramanana *et al.* (2015: 74) report the following volume percentages for: Coleoptera: 49.7 ± 22.44; Hymenoptera: 18.7 ± 17.57; Lepidoptera: 16.3 ± 16.34; Trichoptera: 9.2 ± 8.74; Homoptera: 5.5 ± 6.93; Arachnida: 0,2 ± 0,80. The frequencies for these groups were: Coleoptera: 97.6 ± 6.63; Hymenoptera: 64.0 ± 37.86; Lepidoptera: 55.2 ± 42.54, Trichoptera: 48.0 ± 40.82; Homoptera: 25.6 ± 28.0, and Arachnida: 0.8 ± 4.00. Rasoanoro *et al.* (2015: 64) mention the following volume percentages: Coleoptera: 53.4, Diptera: 11.0, Hemiptera: 17.6, and Hymenoptera: 18.0.

POPULATION:
Structure and Density - The population and local abundance of this species are not known, but it is thought to be locally common (Bates *et al.*, 2006). Trend - 2008 - Unknown (Andriafidison *et al.*, 2008r; IUCN, 2009).

PARASITES:
Zhu *et al.* (2014: 2160) report the presence of the flea *Dampfia grahami grahami* (Waterston, 1915) (Ischnopsyllidae), which is a carrier of *Bartonella* bacteria. This flea was also reported by Hastriter (2016: 16).

Ramasindrazana *et al.* (2016: 6) report the presence of an unnamed filariod in this bat species.

Richard (1966: 413) reported the Trematode *Plagiorchis (Plagiochis) vespertilionis* (Müller, 1784) Braun, 1900.

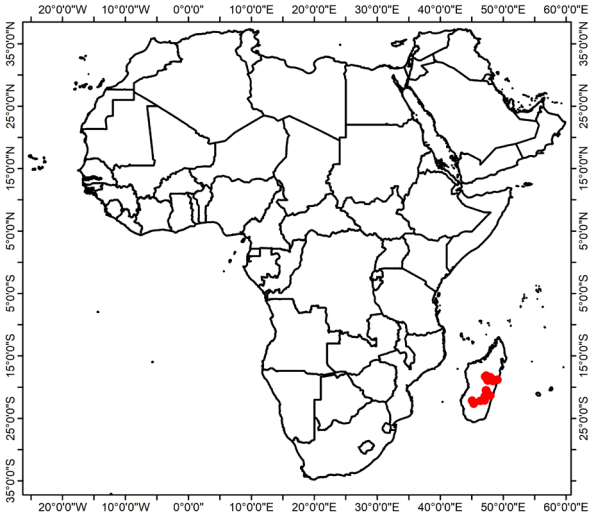


Figure 322. Distribution of *Neoromicia matroka*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Neoromicia nana (Peters, 1852)

1842. *Vespertilio Pipistrellus varietas africana* Rüppell, Mus. Senckenberg., 3 (2): 156. Type locality: Ethiopia: Shoa province: Shoa province [ca. 09 00 N 39 00 E] [Goto Description]. Lectotype: SMF 4306: ad ♀, skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1842. Old number II.N.9*.a.

*1852. *Vespertilio nanus* Peters, Naturwissenschaftliche Reise nach Mossambique, Zoologie, Säugethiere, 63, pl. 16, fig. 2. Publication date: 1852. Type locality: Mozambique: Inhambane [24 00 S 35 28 E] [Goto Description]. Syntype: BMNH 1907.1.1.421: ad, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters. See Turni and Kock (2008). Syntype: BMNH 1907.1.1.422: ad ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters. Syntype: BMNH 1907.1.4.421: ad, skin and skull. Collected by: Prof. Wilhelm Carl Hartwig Peters. Presented/Donated by: ?: Collector Unknown. Syntype: BMNH 1907.1.4.422: ad ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters. Presented/Donated by: ?: Collector Unknown. Syntype: NMW 19644: ad ♂, alcoholic (skull not removed). Collected by: Prof. Wilhelm Carl Hartwig Peters. See Turni

and Kock (2008). Syntype: ZMB 588a: ad ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). Syntype: ZMB 588b: ad ♀, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). Syntype: ZMB 588c: ad ♂, skull and alcoholic. Collected by: Prof. Wilhelm Carl Hartwig Peters; collection date: between 1843 and 1847. See Turni and Kock (2008). - Etymology: From the Latin "*nanus*" meaning dwarf (see Lausen and Barclay, 2005: 5).

1855. *Vespertilio (Vesperugo) nanus:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 746. (Name Combination)
1860. *Hypsugo nanus:* Kolenati, Monographie der Europäischen Chiroptern, 18. (Name Combination)
1870. *Vesperugo pusillulus* Peters, J. Sci. mat. phys. nat., ser. 1, 3 (10): 124. Publication date: December 1870. Type locality: Angola: Cabinda: Loango [ca. 04 52 S 12 52 E] [Goto Description]. Syntype: ZMB 3975: ♂, alcoholic (skull missing). Collected by: José Vicente Barboza du Bocage. See Turni and Kock (2008). - Comments: The type locality (Loango) was originally located in Angola, but see Kock et al. (in prep).
1875. *Vesperugo nanus:* Dobson, Proc. zool. Soc. Lond., 1875, III: 472. (Name Combination)
1878. *Vesperugo (Vesperugo) nanus:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 237. (Name Combination)
1888. *Vesperugo stampflii* Jentink, Notes Leyden Mus., 10: 54 (for 1887). Publication date: April 1888. Type locality: Liberia: Farmington River [06 08 N 10 22 W] [Goto Description]. Holotype: RMNH MAM.17836: ad ♂, skull only. Collected by: F.X. Stampfli; collection date: 1 July 1887.
1889. *Vesperugo pagenstecheri* Noack, Zool. Jb. Syst., 4: 220, pl. 2, fig. 3, pl. 5, fig. 64 - 65. Publication date: 28 February 1889. Type locality: Congo (Democratic Republic of the): Bas Congo province: near mouth of Congo river, Banana Creek: Netonna [05 58 S 12 27 E] [Goto Description]. Lectotype: SMF 2524: ad ♀, skull only. Collected by: P. Hesse; collection date: 1887. See Mertens (1925: 22). Paralectotype: SMF 2525: ad ♀, skull only. Collected by: P. Hesse. See Mertens (1925: 22). Noack (1889: 220) refers to two female specimens, both in alcohol and collected by P. Hesse.
1889. *Vesperus pusillus* Noack, Zool. Jb. Syst., 4: 216, pl. 2, fig. 3, pl. 5, fig. 60, 61. Publication date: 28 February 1889. Type locality: Congo (Democratic Republic of the): Congo River: Boma [05 50 S 13 03 E, 30 m] [Goto Description]. Holotype: SMF 2523: juv ♂, skull only. Collected by: P. Hesse; collection date: 1887.
1897. *Vesperugo (Vesperugo) Pagenstecheri:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, fasc. I: 112.
1900. *Pipistrellus minusculus* Miller, Proc. Wash. Acad. Sci., 2: 647, fig. 43. Publication date: 28 December 1900. Type locality: Liberia: Mount Coffee [06 34 N 10 33 W] [Goto Description]. Holotype: USNM 84500: ad ♀, skull and alcoholic. Collected by: Orator Fuller Cook Jr. Collection date: May 1894. Catalogued: 11 April 1898.
1900. *Pipistrellus stampflii:* Miller, Proc. Wash. Acad. Sci., 2: 647. Publication date: 28 December 1900.
1901. *Vespertilio (Pipistrellus) nanus:* Sclater, Mammals of South Africa, 123, 126. (Name Combination)
1903. *Pipistrellus nanus:* Cabrera, Mem. Soc. espan. Hist. nat., 1: 22. (Name Combination)
1906. *Vespertilio (Vesperugo) stampflii:* Johnston, Liberia, Volume II: 692. (Name Combination)
1907. *Myotis nanus:* Matschie, Liste der von Herrn V.B. Schillings gesammelten Säugetier-Arten, 534. (Name Combination)
1908. *Vespertilio (Glischropus) nanus:* Lönnberg, Sjöstedts Kilimanjaro-Meru Expedition, 2: 11. (Name Combination)
1911. *Pipistrellus culex* Thomas, Ann. Mag. nat. Hist., ser. 8, 7 (41): 458. Publication date: 29 April 1911. Type locality: Nigeria: Northern Nigeria, Bauchi plateau: Kabwir [09 24 N 09 34 E, 2 700 ft] [Goto Description]. Holotype: BMNH 1911.3.24.4: ad ♀, skin and skull. Collected by: Rév. G.J. Fox; collection date: 15 May 1910; original number: 100.
1913. *Pipistrellus nanus australis* Roberts, Ann. Transv. Mus., 4: 67. Publication date: 20 October 1913. Type locality: South Africa: Transkei, Western Pondoland: Port St. Johns district: "Port St. Johns district" [ca. 31 27 S 29 33 E, 200 ft]. Holotype: TM 1076: ad ♀, skin and skull. Collected by: H.H. Swinny; collection date: 20 April 1908. - Comments: Replaced by *P. africanus meesteri* by Kock (2001a: 129).

1917. *Pipistrellus abaensis* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 442. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Aba [03 53 N 30 17 E] [Goto Description]. Holotype: AMNH 48979: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 18 December 1910; original number: 1825. Topotype: AMNH 48980: ♀, skin only. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 48981: ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown.
1925. *Pipistrellus pagenstecheri:* Mertens, Senckenb. biol., 7 (1/2): 22.
1926. *Pipistrellus fouriei* Thomas, Proc. zool. Soc. Lond., 1926, I: 288. Publication date: 29 April 1926. Type locality: Namibia: NW Ovamboland: 32 mi NW of Rehoboth Mission Station: Ukualukasi [17 32 S 14 37 E, 3 400 ft] [Goto Description]. Holotype: BMNH 1925.12.4.20: ad ♀, skin and skull. Collected by: Captain Guy Chester Shortridge; collection date: 7 October 1924; original number: 1390.
1934. *Neoromicia pusilla pusilla:* Shortridge, Mammals of South West Africa, 59.
1939. *Pipistrellus nanus nanus:* G.M. Allen, Bull. Mus. comp. Zool., 83: 95. (Name Combination)
1951. *Eptesicops fouriei:* Roberts, Mammals of South Africa, 84.
1951. *Pipistrellus (Pipistrellus) nanus nanus:* Swynnerton and Hayman, J. East Afr. Nat. Hist. Soc., 20 (6-7) (90): 293 (for 1950). (Name Combination)
1953. *Pipistrellus (Pipistrellus) culex culex:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78.
1953. *Pipistrellus (Pipistrellus) culex fouriei:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78.
1953. *Pipistrellus (Pipistrellus) culex:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78.
1953. *Pipistrellus (Pipistrellus) nanus:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination)
1956. *Pipistrellus culex culex:* Eisentraut, Zool. Jb. Syst., 84 (3): 530.
1957. *[Pipistrellus] stampfli:* Aellen, Rev. suisse Zool., 64 (6): 202.
1959. *Pipistrellus nanus stampflii:* Booth, J. West Afr. Sci. Ass., 5 (1): 29. (Name Combination)
1968. *Pipistrellus (Pipistrellus) nanus fouriei:* Smithers, A check list and atlas of the mammals of Botswana (Africa), ???. (Name Combination)
1978. *Pipistrellus nanus fouriei:* Ansell, Mammals of Zambia, 24. (Name Combination)
1987. *Pipistrellus (Hypsugo) nanus:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 281. (Name Combination)
1988. *Pipistrellus (Hypsugo) africanus africanus:* Ansell and Dowsett, Mammals of Malawi, 41.
1988. *Pipistrellus (Hypsugo) africanus nanus:* Ansell and Dowsett, Mammals of Malawi, 41. (Name Combination)
1989. *Pipistrellus africanus:* Koopman, Am. Mus. Novit., 2946: 7.
1994. *P[ipistrellus (Pipistrellus)] a[fricanus] africanus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 113. (Name Combination)
1994. *P[ipistrellus (Pipistrellus)] a[fricanus] culex:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 113.
1994. *P[ipistrellus (Pipistrellus)] a[fricanus] fouriei:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 113.
1994. *P[ipistrellus (Pipistrellus)] a[fricanus] nanus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 113. (Name Combination)
1994. *P[ipistrellus (Pipistrellus)] a[fricanus] stampflii:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 113.
1994. *P[ipistrellus (Pipistrellus)] africanus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 112. (Name Combination)
1998. *Pipistrellus (Hypsugo) nanus nanus:* Grubb, Jones, Davies, Edberg, Starin and Hill, Mammals of Ghana, Sierra Leone and The Gambia, 85. (Name Combination)
1998. *Pipistrellus (Hypsugo) nanus stampflii:* Grubb, Jones, Davies, Edberg, Starin and Hill, Mammals of Ghana, Sierra Leone and The Gambia, 85. (Name Combination)

2000. *Pipestrellus manus:* Nwoha, Xaxton-Martins and Baxter-Grillo, Folia Morphol., 59 (3): 154. Publication date: 6 July 2000. (Lapsus)
2001. *Pipistrellus africanus meesteri* Kock, Acta Chiropt., 3 (1): 129. Type locality: South Africa: Transkei [Goto Description]. Holotype: TM 1076: ad ♀, skin and skull. Collected by: H.H. Swinny; collection date: 20 April 1908. - Comments: Replacement name for *P. nanus australis* Roberts, 1913 (preoccupied by *P. hesperus australis* Miller, 1897). The type specimen is the one used by Roberts (1913).
2002. *Neoromicia nanus:* Kearney, Volleth, Contrafatto and Taylor, Acta Chiropt., 4 (1): 58, 60. (Name Combination)
2002. *Pipistrellus (Hypsugo) africanus stampflii:* Kock, Barnett, Fahr and Emms, Acta Chiropt., 4 (1): 58.
2007. *Neoromicia manus:* Decher and Fahr, Myotis, 43: 11. Publication date: August 2007. (Lapsus)
2019. *L[aephotis] nana:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)
? *Neoromicia nana:* (Name Combination, Current Combination)
? *Neoromicia nanus africanus:* (Name Combination, Alternate Spelling)
? *Neoromicia nanus culex:* (Name Combination, Alternate Spelling)
? *Neoromicia nanus fouriei:* (Name Combination, Alternate Spelling)
? *Neoromicia nanus helios:* (Name Combination, Alternate Spelling)
? *Neoromicia nanus minusculus:* (Name Combination, Alternate Spelling)
? *Neoromicia nanus nanus:* (Name Combination, Alternate Spelling)
? *Neoromicia nanus stampflii:* (Name Combination, Alternate Spelling)
? *Pipistrellus africanus nanus:* (Name Combination)

TAXONOMY:

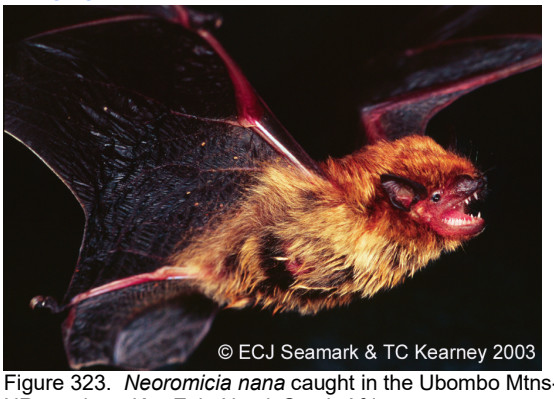


Figure 323. *Neoromicia nana* caught in the Ubombo Mtns-NR, northern KwaZulu Natal, South Africa.

The oldest name for this species is (possibly) *africana*; see Koopman (1975: 400), but most authors still remained using the name *nana*, until Koopman (1994: 112) and Simmons (2005), who mention this species under the name *Pipistrellus africanus*. In Opinion 2120 (Anonymus, 2005), however, the ICZN ruled that the name *Pipistrellus nanus* (currently *Neoromicia nana*) should be given precedence over *africana*, whenever the two are considered to be synonyms.

Bronner *et al.* (2003) state that Volleth *et al.* (2001) and Kearney *et al.* (2002) provided karyotypic evidence for the inclusion of the banana bat (*"Pipistrellus" nanus*) in *Neoromicia*. Ansell and Dowsett (1988) and Koopman (1966) point out that *africanus* Ruppell, 1842 antedates *nanus* (Peters, 1852) as the valid name for this species. However, they continue to use the better-known name *nanus*, as topotypical *africanus* is restricted to Ethiopia (and is thus unlikely to be conspecific with *nanus*) and Happold (2003) has applied to the International Commission on Zoological Nomenclature for conservation of this specific epithet on the grounds of nomenclatural stability.

Grubb *et al.* (1998: 85) include it - as *nanus* - in the subgenus *Hypsugo*. Kearney *et al.* (2002: 68) states that *nana* belongs to the genus *Neoromicia*.

Hoofer and Van Den Bussche (2003: 38) include this taxon as "*(Hypsugo) nanus*" in a separate, unnamed genus.

The generic allience of *nana* is certainly not clear at this stage. Most authors mention this species in the genus *Pipistrellus*, but as pointed out in the previous paragraphs, present taxonomical investigations seem to indicate that it should be included in *Neoromicia*. However, the assignement to *Hypsugo* or even a new genus is not yet excluded. Further research is needed to fix its generic assignment.

Helbig *et al.* (2010: 168) suggest that *nana* needs to be transferred to a genus that needs to be newly created or resurrected from the current synonymy.

Recently, Meri Happold (pers. Comm.) reported that unlike all other pipistrelles placed in *Neoromicia* by Simmons (2005) and also unlike all African species placed in *Hypsugo* (ibid.), "*P. nanus*" has nyctalodont lower molars (as have all

African species in *Pipistrellus*). The taxonomic implications need further investigation.

Happold (ibid) also reported that the following subspecies of *P. nanus* (as *P. africanus*) were recognized by Koopman (1994) and/or Kock (2001a), but their status and geographic ranges are uncertain:
P. n. stampflii. Sierra Leone to Côte d'Ivoire.
P. n. culex. Nigeria, Ghana.
P. n. africanus. Zaire to Ethiopia, mostly in highlands.
P. n. nanus. Zaire, Kenya and Tanzania to South Africa, also Cameroon (Rosevear 1965).
P. n. fouriei. S Angola, W Zambia, N Namibia.
P. n. meesteri. Transkei, South Africa.
P. n. minusculus. Liberia.

COMMON NAMES:
Afrikaans: Piesangvlermuis. Arabian: Khouchaf al matoussat. Azande (DRC): Fulo. Chewa: Ndemia. Chinese: 香蕉伏翼. Czech: netopýr banánový, netopýr šplhavý. English: Banana Pipistrelle Bat, Banana Bat, Banana Pipistrelle. French: Pipistrelle naine, Pipistrelle naine aux ailes brunes. German: Bananen Zwergfledermaus, Bananen-Fledermaus, Bananen-Pipistrelle, Mozambique Dämmerungsfledermaus, Zwerg-Hausfledermaus. Italian: Pipistrèllo di Pèters, Pipistrèllo nàno déi banàni. Kiluba (DRC): Kasusu. Manganja (Malawi): Chuchu. Misuku (Malawi): Kashusha. Portuguese: Morcego das bananeiras, Morcego-das-bananas. Spanish (Castillian): Pipistrelo Enano; Yao: Liputiputi (Malawi; applied to all small bats).

ETYMOLOGY OF COMMON NAME:
Characteristically this species roosts during the day in the rolled-up, sprouting terminal leaves of banana plants and has become associated with them in particular (Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Hutson *et al.*, 2008g; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Hutson *et al.*, 2008g; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessed as *Neoromicia nanus*] (Jacobs, 2004d; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016m). 2004 - LC ver 3.1 (2001) [assessed as *Neoromicia nanus*] (Friedmann and Daly, 2004).

MAJOR THREATS:
There appear to be no major threats to this widespread and seemingly adaptable species (Hutson *et al.*, 2008g; IUCN, 2009), although Aronson *et al.* (2013: 9) report a fatality due to wind turbines in South Africa.

CONSERVATION ACTIONS:
Hutson *et al.* (2008g) [in IUCN (2009)] report that in view of the species wide range it is likely that it is present in many protected areas. Further research is needed into the taxonomy of this species.

GENERAL DISTRIBUTION:
Neoromicia nana is widely distributed throughout most of sub-Saharan Africa. It ranges from Senegal in the west, through West and Central Africa, to Eritrea, Ethiopia and Somalia in the east; from here it is found southwards to southeastern South Africa. The species has been recorded from Madagascar, where it has only been reported from the Kirindy CFPF forest in western Madagascar, and from Zombitse (Rasolozaka, 1994). It has also been recorded from the Tanzanian islands of Pemba, Unguja [= Zanzibar], and Mafia (O'Brien, 2011: 290).

It appears to be absent, or largely absent, from northern Kenya, Namibia, southern Botswana, western Zimbabwe, northern Mozambique, Lesotho and much of South Africa. It is possible that the species ranges more widely in these areas than is currently known, and further field studies are needed to investigate the distribution of the species.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,165,508 km^2. In South Africa, its distribution is mainly affected by the mimimum temperature of the coldest month (Babiker Salata, 2012: 49).

Besides *Neoromicia nana*, Taylor *et al.* (2018b: 63) also mentioned *Neoromicia* cf. *nana*, whose echolocation calls do not match any known species.

Bates *et al.* (2006) recommend that the identity of the specimens from Madagascar need to be reviewed.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 568; Taylor *et al.*, 2018b:

63); Benin (Capo-Chichi *et al.*, 2004: 163); Botswana (Archer, 1975; Monadjem *et al.*, 2010d: 568); Burkina Faso (Kangoyé *et al.*, 2015a: 620); Burundi; Cameroon; Central African Republic; Chad; Congo (Bates *et al.*, 2013: 337); Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Van Cakenberghe *et al.*, 1999; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 568); Côte d'Ivoire; Djibouti (Pearch *et al.*, 2001: 388); Equatorial Guinea; Eritrea; Ethiopia; Gabon; Gambia (Emms and Barnett, 2005: 50); Ghana (Decher and Fahr, 2007: 18); Guinea (Fahr *et al.*, 2006a: 73); Guinea-Bissau (Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Rainho and Ranco, 2001:60); Kenya; Liberia (Monadjem and Fahr, 2007: 50 [as *Neoromicia nanus*]); Madagascar; Malawi (Happold *et al.*, 1988; Ansell and Dowsett, 1988: 41; Monadjem *et al.*, 2010d: 568); Mali; Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 568; Monadjem *et al.*, 2010c: 384); Namibia (Monadjem *et al.*, 2010d: 569); Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa (De Graaf, 1960; Monadjem *et al.*, 2010d: 569); Sudan; Swaziland (Monadjem *et al.*, 2010d: 569); Tanzania (Stanley and Goodman, 2011: 47); Togo; Uganda (Kityo and Kerbis, 1996: 61); Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 569); Zimbabwe (Monadjem *et al.*, 2010d: 569).
Presence uncertain: Lesotho.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) contains a line drawing of the tragus of specimen DNSM 12594 from Mount Nimba, Liberia.

From western Uganda, Monadjem *et al.* (2011: 30) reported the following data for 5 specimens: Fa: 31.60 ± 0.758 mm, mass: 3.6 ± 0.89 g, wing loading: 4.2 ± 0.59 N/m^2, aspect ratio: 6.2 ± 0.14.

DENTAL FORMULA:
Dorst (1949: 47) indicates that the milk dentition of "*P. nanus*" is very similar to that of *P. kuhlii*. He also indicated that the milk teeth form a clearly separated arcade outside the pernanent tooth series.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

Skull - Using CT-microscans, Curtis and Simmons (2018: 1390) investigated the presence of mineralized elements in the rostra of bats, and found these to be present in *N. nana*. However, the shape and size of these was different in the two specimens they examined. As both specimens were males, the differences are not sex-based.

ECHOLOCATION:
See Jacobs (1996), Taylor (1999b) and Taylor *et al.* (2005).

Schoeman and Waddington (2011: 291) mention a peak frequency of 67.1 ± 1.9 kHz and duration of 4.0 ± 0.9 msec for specimens from Durban, South Africa. Naidoo *et al.* (2011: 23) report a peak frequency of 68.1 ± 1.0 kHz and a duration of 3.1 ± 0.8 msec from the same area.

At Uzungwa Scarp Forest Reserve, Tanzania, Trentin and Rovero (2011: 57) indicate that the starting frequency is very variable (mean 86.9 kHz). In about 2 msecs the call decreases from its maximum to its minimum at 60.7 kHz, after which it increases slightly to 64.5 kHz. The maximum intensity occurs at 66 kHz.

Taylor *et al.* (2013b: 17) recorded the following parameters for 4 calls from Swaziland: F_{max}: 77.2 ± 3.34 (74.4 - 80.9) kHz, F_{min}: 66.2 ± 0.92 (64.9 - 67.0) kHz, F_{knee}: 68.2 ± 1.60 (66.1 - 69.9) kHz, F_{char}: 66.9 ± 0.96 (65.4 - 67.4) kHz, duration: 3.2 ± 0.59 (2.4 - 3.6) msec. Also from Swaziland, Monadjem *et al.* (2017c: 179) reported: F_{min}: 69.7 ± 2.29 (66.8 - 71.8) kHz, F_{knee}: 72.3 ± 2.08 (70.6 - 75.1) kHz, F_c: 70.2 ± 2.25 (67.5 - 72.2) kHz and duration: 2.8 ± 0.32 (2.6 - 3.2) msec. The maximum distance over which they were able to dectect the calls was 10 m (mean: 5.8 ± 1.07 m).

At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 68 (66 - 70) kHz. In the Mapungubwe National Park, Parker and Bernard (2018: 57) recorded 20 calls with F_{char}: 68.53 ± 2.10, F_{max}: 85.09 ± 10.70 kHz, F_{min}: 67.61 ± 2.57 kHz, F_{knee}: 72.45 ± 3.38 kHz, duration: 4.24 ± 0.83 msec and 8.15 ± 3.64 calls/sec.

From western Uganda, Monadjem *et al.* (2011: 32) reported the following parameters for 5 calls: F_{min}: 71.06 ± 6.019 kHz, F_{max}: 98.94 ± 4.751 kHz, F_{char}: 79.76 ± 8.196 kHz, F_{knee}: 84.89 ± 7.145 kHz, duration: 1.1 ± 0.089 msec.

Eisenring *et al.* (2016: SI 2) reported PF: 66.8 ± 2.0 (63.0 - 69.9), HF: 94.7 ± 17.5 (69.6 - 117.9), LF: 63.7 ± 2.1 (59.8 - 66.9), DT: 0.0 ± 0.0 (0.0 - 0.1), DF: 31.0 ± 16.9 (4.9 - 55.8), IPI: 0.7 ± 0.3 (0.3 - 1.5) for 27 calls from the Aberdares Range in Kenya.

For 1 FM/QCF type call from Maroua, Cameroon, Manga Mongombe (2012: 79) reported: F_{max}: 106.4 kHz, F_{min}: 96.6 kHz, F_{mean}: 101.7 kHz, F_{knee}: 106.4 kHZ, F_{char}: 96.9 kHz, and duration: 0.42 msec.

Two calls recorded by Adams and Kwiecinski (2018: 4) in the Kalahari Desert had the following characteristics: F_{char}: 61.5 ± 8.9 kHz, F_{max}: 74.3 ± 6.2 kHz, F_{min}: 61.1 ± 3.5 kHz, duration: 3.7 ± 0.3 msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) for the results of a specimen from Kenya.

Karyotype - Both Peterson and Nagorsen (1975) and Rautenbach *et al.* (1993) reported 2*n* = 36, FN = 50, BA = 16, a metacentric X chromosome, and an acrocentric Y chromosome. GTG-bands identified three Robertsonian fusion chromosomes (7/11, 8/9, 10,12), considered as distinguishing characters for the genus *Neoromicia* Kearney *et al.* (2002).

From Senegal, Koubínová *et al.* (2013: 3) report the following karyotype for 9 ♂♂ and 7 ♀♀: 2*n* = 34, FNa = 50, FN = 54, X = Subtelocentric and Y = dot-like (probably acrocentric). They also found (p. 7) that two pairs of acrocentric autosomes were missing compared to previous findings, but contained an additional metacentric pair, which could be the result of a Robersonian fusion. Due to these differences, they assigned their specimens to *N.* cf. *nana*.

Protein / allozyme - See Morales *et al.* (1991) for results from two specimens from South Africa.

HABITAT:
Monadjem *et al.* (2010a) found that there was no difference in use by *N. nana* between logged and undisturbed forested areas; however, the species exhibited higher levels of activity along the wide tracks running through the two forests than either 30 m off these tracks or along the narrow forest trails. Naidoo *et al.* (2009: 30) showed that the abundance and feeding activity of *N. nana* at sludge tank sites and at sites downstream of wastewater treatment works (WWTWs) was significantly higher than at sites upstream of these, probably due to insect abundance, specifically pollution tolerant chironomid midges. Naidoo *et al.* (2013b: 108) found that haematocrits were significantly higher in *N. nana* foraging at WWTWs indicating that *N. nana* may be compensating for a chronically low oxygen circulation within the body or kidney damage. They also report that hepatosomatic and renalsomatic indices were significantly higher suggesting hypertrophy of the detoxification organs. Additionally, the gonadosomatic index of the testes were also significantly larger at WWTWs, suggesting that reproductive potential of males may be compromised.

Naidoo *et al.* (2013a: 51) found that essential metals (Cu, Zn and Fe) were detected in all tissue samples from *N. nana* foraging at upstream and wastewater-polluted sites. Non-essential metals (Cd, Ni and Cr) were detected only in *N. nana* foraging at wastewater-polluted sites (except one upstream occurrence of Cd). The first set of metals is essential for normal cellular processes and bodily function, the latter are considered harmful to organisms.
Significant differences for essential metals and mineral nutrients (Fe and Zn in liver; Cu and K in kidneys) were also reported by Naidoo *et al.* (2015a: 830).
The effects of WWTWs on energy stores and leptin levels was examined by Mehl *et al.* (2016), whereas Hill *et al.* (2018: 232) investigated the arsenic concentrations and acetylcholinesterase activity.

Naidoo *et al.* (2014) reported that *N. nana* specimens captured at WWTWs also had higher DNA damage, lower antioxidant capacity, and higher haematocrits than bats from non-polluted sites.

In another study at WWTWs, Hill *et al.* (2016: 92) found that bats rely on iBrAT (interscapular brown adipose tissue) as an energy source, and that opportunistic foraging on abundant, pollutant-tolerant prey may change fatty acid profiles in their tissue, with possible effects on mitochondrial functioning, torpor and energy usage.

LaVal and LaVal (1977) [in Naidoo *et al.* (2014)] indicate that *N. nana* has a relatively small home range of about 300 m around its roost.

In the Mount Nimba area, Monadjem *et al.* (2016y: 370) recorded this species from forested and forest edge habitats ranging from 450 to 530 m.

HABITS:
Monadjem *et al.* (2010a) found that *N. nana* was most active in the first 5 hrs after sunset with activity declining rapidly after midnight.

Keeley and Keeley (2004: 116) [referring to O'Shea (1980) and Happold and Happold (1996)] mention that male "*Pipistrellus nanus*" roosting in palm-thatched roofs show territoriality and aggressive competition for spacious roosts, whereas males in populations roosting in banana leaves appear not to defend territories aggressively, and indicate that this difference might be based on the availability of preferred roosts. However, the more likely explanation being that these differences are due to these two groups belonging to different species, as the

thatched roof inhabiting form is most likely *N. helios*.

DIET:
From the Umbilo River (KwaZulu Natal, RSA), Naidoo *et al.* (2011: 26) reported the following prey volume percentages: during summer: Lepidoptera (2.3 ± 1.4), Hemiptera (34.6 ± 14.1), Diptera (43.6 ± 17.4), and Trichoptera (19.6 ± 6.8); during winter: Coleoptera (36.4 ± 2.5), Coleoptera (3.2 ± 0.9), Hemiptera (19.1 ± 7.5), Diptera (29.5 ± 3.7), and Trichoptera (12 ± 7.2).

Weier *et al.* (2019b: 6) examined droppings from this species in the Levubu region (Limpopo, RSA) and found DNA sequences of: Lepidoptera: *Cryptophlebia peltastica* (Meyrick, 1921) and *Thaumatotibia batrachopa* (Meyrick, 1908); Hemiptera: *Bathycoelia distincta* Distant, 1878 and *Nezara viridula* (Linnaeus, 1758).

PREDATORS:
Broadley (1982) [in Schätti (1984: 338)] reported the killing of a "*Pipistrellus nanus*" specimen by an opisthoglyphe treesnake (*Thelotornis capensis* A. Smith, 1849).

Nyffeler and Knörnschild (2013: 5) refer to Rosevear (1953: 267) for a dead bat being recovered by T.S. Jones from a spider's web near Kerema, Sierra Leone.

Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - Probably not uncommon in suitable habitats (Happold, 1987).
Trend - 2008 - Unknown (Hutson *et al.*, 2008g; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
N. nana uses territorial calls (possibly with a courtship function) consising of a simple syllable type in series (O'Shea, 1980 in Smotherman *et al.*, 2016: 537).

REPRODUCTION AND ONTOGENY:
van der Merwe and Stirnemann (2007: 53) report that *N. nana* is a seasonal monoestrous breeder. In Mpumalanga Province (South Africa), they found that spermatogensis began in late September and spermatozoa were present in the caudae epididymides from late April throughout August. Mating started in May and ovulation and fertilization occurred from the beginning of August, when the first implantations also occurred. Parturition took place between late October and the end of November. Lactating females were found until mid January. They also indicate that reproduction timing was about one month earlier than in Malawi, where Happold and Happold (1998a: 67) found pregnant females from late August to mid-November, and births and lactating females were observed from mid-November to the end of April.

Trentin and Rovero (2011: 51) report five lactating females, captured at the end of November 2005 at Uzungwa Scarp Forest Reserve, Tanzania.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births taking place between November and early December.

Happold (2001: 397) - referring to Bernard *et al.* (1997) - indicates that sperm storage and delayed fertilisation is used to alter the interval between copulation and parturition, and as such their chronology of reproduction.

MATING:
McCracken and Wilkinson (2000: 329) indicate that *N. nana* mating groups consist of a single male and multiple females, but can not be considered as harems. Males are often visited simultaneously by several females, and some males are visited more frequently by more females than others (see also Happold and Happold, 1996).

PARASITES:
ACARI
Sarcoptidae: Fain (1959d: 157) described *Notoedres (Metanotoedres) miniopteri* from a "*Pipistrellus nanus*" from Bukavu, DRC.

DIPTERA
Nycteribiidae: *Nycteribia schmidlii* Schiner, 1853 (Haeselbarth *et al.*, 1966: 108, host referred to both *N. nana* and *P. culex*). *Basilia ansifera* Theodor, 1956 mainly a West African species, reaches Lake Victoria in the east and Lake Nyasa in the south, nearly all localities lie between 15° latitude north and south (Haeselbarth *et al.*, 1966: 110, host referred to *N. nana*, *P. culex* and *P. stampflii*). *Basilia robusta* Theodor, 1956 (Haeselbarth *et al.*, 1966: 111).

ACARINA
Dermanyssidae: Zumpt and Till (1954: 49) described *Steatonyssus eos* from "*Pïpistrellus nanus*" specimens from Kenya.

NEMATODA
Durette-Desset and Chabaud (1975: 323) described *Allintoschius dunni* from a *Myotis mystacinus* specimen from Malaysia, but also indicated that this Nematode was also found in five

"*Pipistrellus nanus*" specimens from Maboké (CAR).

VIRUSES:

Astroviridae

Neither of the two Mozambican bats tested by Hoarau *et al.* (2018: 2) was positive for this group of viruses.

Coronaviridae - Coronaviruses

SARS-CoV - During Febuary 2008 in Ghana, Pfefferle *et al.* (2009) tested negative five fecal samples for coronavirus (CoV) RNA.

Hantaviridae (formerly included in Bunyaviridae)

Mouyassué virus - MOYV (or MOUV)

Sumibcay *et al.* (2012: 2) reported hantavirus RNA from 2 out ot 12 banana pipistrelles captured near Mouyassué village, in Côte d'Ivoire. However, Gu *et al.* (2014) were unable to find any additional bats infected with this virus. Arai *et al.* (2019: 2) tentatively assigned this virus to the genus *Loanvirus*).

Paramyxoviridae

Mortlock *et al.* (2015: 1841) reported that two out of seven examined South African specimens tested positive for *Paramyxovirus* sequences.

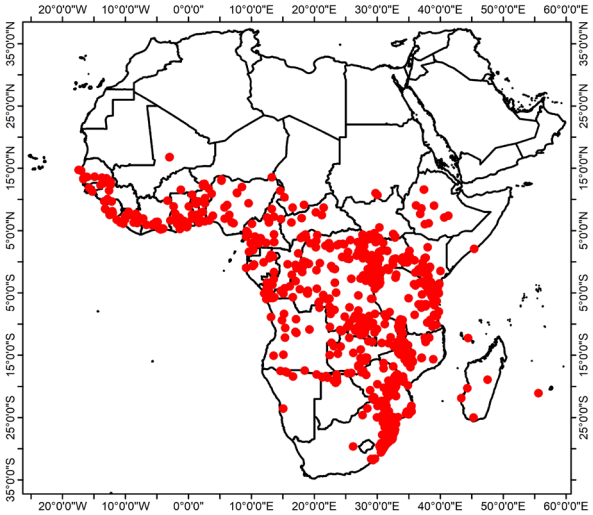


Figure 324. Distribution of *Neoromicia nana*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:

"Africa", Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Djibouti, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Neoromicia rendalli (Thomas, 1889)

*1889. *Vesperugo (Vesperus) Rendalli* Thomas, Ann. Mag. nat. Hist., ser. 6, 3 (16): 362, fig. 1. Publication date: 1 April 1889. Type locality: The Gambia: Bathurst [=Banjul] [13 28 N 16 39 W] [Goto Description]. Holotype: BMNH 1889.3.2.3: ad ♂, skull and alcoholic. Collected by: Dr. Percy Rendall. See Thomas (1889: 26-7). - Etymology: In honour of Dr. Percy Rendall (1861 - 1948), an English zoologist and the collector of the type specimen (see Thomas, 1889: 364; Smithers, 1983: 102; Taylor, 2005; Lanza *et al.*, 2015: 428).

1897. *Vesperugo (Eptesicus) rendalli:* Thomas, Proc. zool. Soc. Lond., 1896, IV: 791. Publication date: April 1897. (Name Combination)

1899. *Vesperugo Rendalli:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, fasc VI: 1280. (Name Combination)

1911. *Eptesicus phasma* G.M. Allen, Bull. Mus. comp. Zool., 54 (6): 327. Publication date: December 1911. Type locality: Kenya: Northern Guaso Nyiro: Meru River: effluent of northern Guaso Nyiro [=Ewaso Ngiro] [00 03 N 37 39 E] [Goto Description]. Holotype: MCZ 8279: ad ♂, skin and skull. Collected by: Glover Morrill Allen; collection date: 6 August 1909; original number: 94. See Allen (1911: 327). - Comments: Coordinates of the type locality mentioned as 00 31 N 37 40 E by Thorn *et al.* (2009: 56). The MCZ also has a small series of paratypes (see Helgen and McFadden, 2001: 14).

1917. *Eptesicus faradjius* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 444. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Faradje [03 44 N 29 43 E] [Goto Description]. Holotype: AMNH 49045: ad ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 21 February 1911; original number: 1914. Topotype: AMNH 49044: ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 49048: ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 49049: ♀, skin only.

Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 49051: ♂, skin only. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 49052: ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 49053: ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 49054: ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. Topotype: AMNH 49055: ♀, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown. - Comments: The museum label mentions 1414 as original number.

1926. *Eptesicus rendalli:* Cabrera and Ruxton, Ann. Mag. nat. Hist., ser. 9, 17 (103): ???. Publication date: 1 May 1926. (Name Combination)
1953. *Eptesicus (Eptesicus) rendalli:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77. (Name Combination)
1965. *E[ptesicus rendalli] phasma:* Koopman, Am. Mus. Novit., 2219: 14. (Name Combination)
1965. *Eptesicus rendalli faradjius:* Koopman, Am. Mus. Novit., 2219: 14. (Name Combination)
1968. *Eptesicus rendalli phasma:* Funaioli and Lanza, Mon. Zool. ital., (N.S.) 2 (Suppl.): 200. (Name Combination)
1975. *E[ptesicus (Eptesicus)] r[endalli] phasma:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 409. (Name Combination)
1984. *Eptesicus (Eptesicus) rendalli phasma:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch.. (Name Combination)
1984. *Eptesicus (Eptesicus) rendalli rendalli:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch.. (Name Combination)
1987. *Nycterikaupius rendalli:* Menu, Palaeovert., 17 (3): 109. Publication date: 15 November 1987. (Name Combination)
1987. *Pipistrellus (Neoromicia) rendalli:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)
1992. *Eptesicus rendallii:* Rautenbach and Fenton, Z. Säugetierk., 57: 113. (Lapsus)
1993. *Eptesicus (Neoromicia) rendalli:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 203. (Name Combination)
1994. *E[ptesicus (Neoromicia)] r[endalli] phasma:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)
1994. *E[ptesicus (Neoromicia)] r[endalli] rendalli:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)
1995. *Pipistrellus rendalli:* Koopman, Kofron and Chapman, Am. Mus. Novit., 3148: 11. (Name Combination)
2002. *Neoromicia rendalli:* Kearney, Volleth, Contrafatto and Taylor, Acta Chiropt., 4 (1): 58. (Name Combination, Current Combination)
2002. *Pipistrellus r[endalli] phasma:* Kock, Barnett, Fahr and Emms, Acta Chiropt., 4 (1): ???. (Name Combination)
2003. *? (Hypsugo) rendalli:* Hoofer and Van Den Bussche, Acta Chiropt., 5 (Suppl.): 38. (Name Combination)
2019. *L[aephotis] rendalli:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)
? *Neoromicia rendalli faradjius:* (Name Combination)
? *Neoromicia rendalli phasma:* (Name Combination)
? *Neoromicia rendalli rendalli:* (Name Combination)
? *Neoromicia rueppellii:* (Alternate Spelling)
? *Pipistrellus (Neoromicia) rendalli rendalli:* (Name Combination)

TAXONOMY:
Mentioned in the genus *Pipistrellus* by Koopman (1994: 117). Volleth *et al.* (2001: 44) assigned this species to the genus *Neoromicia*. Reviewed by Kock *et al.* (2002: 89). Included (as (*Hypsugo*) *rendalli*) in a separate, unnamed genus by Hoofer and Van Den Bussche (2003: 38).

Helbig *et al.* (2010: 168) suggest that *rendalli* needs to be transferred to a genus that needs to be newly created or resurrected from the current synonymy.

COMMON NAMES:
Afrikaans: Rendall se dakvlermuis, Rendal-dakvlermuis. Chinese: 任氏伏翼. Czech: netopýr Rendallův. English: Rendall's Serotine, Rendall's Serotine Bat, Rendall's Pipistrelle Bat, Rendall's Pipistrelle. French: Serotine de Rendall, Pipistrelle de Rendall. German: Rendalls Zwergfledermaus, Rendalls Pipistrelle. Italian: Pipistrèllo di Rèndall. Portuguese: Morcego caseiro de Rendall.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008w; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus rendalli*] (Jacobs *et al.*, 2008w; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004ad; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016ab). 2004 - CR B2ab(iii) ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
In general, there appear to be no major threats to this species. In some parts of its range, this species is threatened by the conversion of its habitat to agricultural use (Jacobs *et al.*, 2008w; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008w) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas. Further research is needed into the distribution of this patchily recorded species.

GENERAL DISTRIBUTION:
Neoromicia rendalli has been widely, but patchily, recorded over much of sub-Saharan Africa. It ranges from Senegal in the west, through West and Central Africa to Somalia in the east, and as far south as eastern South Africa.

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Botswana (Archer, 1975; Monadjem *et al.*, 2010d: 569); Burkina Faso (Kangoyé *et al.*, 2012: 6026; 2015a: 621); Cameroon; Central African Republic; Chad; Congo; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Gallagher and Harrison, 1977; Monadjem *et al.*, 2010d: 569); Gambia; Ghana; Kenya; Liberia (Fahr, 2007a: 104); Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 569); Mali (Meinig, 2000: 105); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 569; Monadjem *et al.*, 2010c: 384); Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa [KwaZulu Natal] (Kearney and Taylor, 1997: 54; Monadjem *et al.*, 2010d: 569); Sudan; Tanzania; Togo; Uganda; Zambia (Ansell, 1969; Ansell, 1974; Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 569); Zimbabwe (Monadjem *et al.*, 2010d: 569).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) line drawing of tragi of specimen DNSM 12619 referred to as *N. cf. rendalli* from Mount Nimba, Liberia.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:

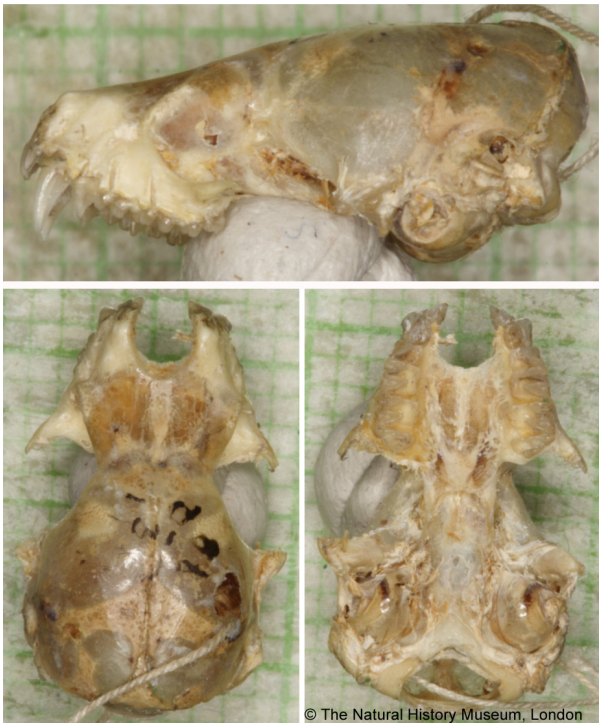


Figure 325. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1889.3.2.3, holotype of *Vesperugo* (*Vesperus*) *rendalli* Thomas, 1889.

In their study on the reversibility of the mandibular symphyseal fusion, Scott *et al.* (2012: 2943) report that this symphyse is unfused, with smooth surfaces.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002). The baculum of *N.* cf. *rendalli* was longer in total length (2.97 mm). The angle of shaft curvature, measured from mid-shaft to the shaft base, was more acute in *N. tenuipinnis* (43°) than in *N.* cf. *rendalli* (58°) (Monadjem *et al.*, 2013c: 197). Line drawing of the dorsal and ventral view of the baculum of specimen DNSM 12619 from Mount Nimba, Liberia referred to as *N.* cf. *rendalli* are shown in Monadjem *et al.* (2013c: 204).
Brain - Amrein *et al.* (2007), from specimens collected from Benin, reported that proliferating cells, detected with Ki-67 and MCM2, in the subgranular layer of the dentate gyrus was found to be absent. Amrein *et al.* (2007) also reported moderate to ample proliferating cells (Ki-67 positive cells) and migrating young neurons (DCX positive cells) in the rostral migratory stream. Amrein *et al.* (2007) furthermore detected few DCX positive cells in the rostral migratory stream and the olfactory bulb.

ECHOLOCATION:
Musila *et al.* (2018c: 43) [referring to Van Cakenberghe and Happold (2013p: 646)] mention a starting frequency of up to 76 kHz and an ending frequency of 42 - 44 kHz.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).

Karyotype - McBee *et al.* (1987), Rautenbach and Fenton (1992) and Kearney *et al.* (2002) all recorded 2*n* = 38, FN = 50, BA = 14, and a submetacentic X chromosome. Rautenbach and Fenton (1992) and Kearney *et al.* (2002) also recorded an acrocentric Y chromosome. GTG-bands identified three Robertsonian fusion chromosomes (7/11, 8/9, 10,12), considered as distinguishing characters for the genus *Neoromicia* Kearney *et al.* (2002).
In Senegal, Koubínová *et al.* (2013: 3) found a very similar karyotype, although they mention the Y chromosome as dot-like and presumably acrocentric.

Protein / allozyme - Unknown.

POPULATION:
Structure and Density - This appears to be a locally rare species, usually occurring as moderately small colonies of several individuals up to a few dozen animals (Jacobs *et al.*, 2008w; IUCN, 2009). Trend - 2008 - Unknown (Jacobs *et al.*, 2008w; IUCN, 2009).

PARASITES:
DIPTERA
Nycteribiidae: *Basilia ansifera* Theodor, 1956 mainly a West African species, reaching Lake Victoria in the east and Lake Nyasa in the south, nearly all localities lie between 15° latitude north and south (Haeselbarth *et al.*, 1966: 110). *Basilia bouvieri* (Falcoz, 1924) from Tanzania, Sudan, Senegal and Sierra Leone (Haeselbarth *et al.*, 1966: 111, host referred to as *E. phasma*).

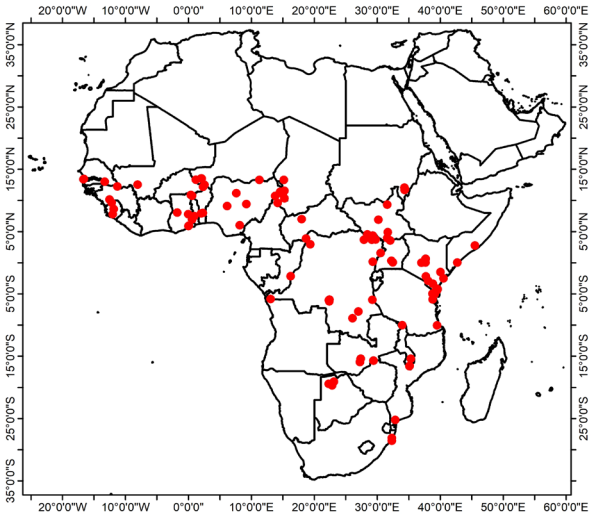


Figure 326. Distribution of *Neoromicia rendalli*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Botswana, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Ghana, Guinea, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, The Gambia, Togo, Uganda, Zambia, Zimbabwe.

Neoromicia robertsi Goodman, Taylor, Ratrimomanarivo and Hoofer, 2012

*2012. *Neoromicia robertsi* Goodman, Taylor, Ratrimomanarivo and Hoofer, Zootaxa, 3250: 1, 11, figs 3A, 4, 5A, 6A. Publication date: 29 March 2012. Type locality: Madagascar: Province d'Antananarivo, Anjozorobe, Amboasary [18 24.295 S 47 56.699 E] [Goto Description]. Holotype: UADBA 43677: ad ♂, skull and alcoholic. Collected by: Richard K.B. Jenkins; collection date: 25 September 2002; original number: RBJ 105. Presented/Donated by: ?: Collector Unknown. Paratype: FMNH 213931: ad ♂, skull and

alcoholic. Collected by: Richard K.B. Jenkins; original number: RBJ 119. Presented/Donated by: ?: Collector Unknown. Formerly UADBA 43679. Madagascar: Province de Toamasina, Parc National de Mantadia, between PK 9 and PK 10, 18 48.941 S, 48 25.633 E (see Goodman *et al.*, 2012b: 11). Paratype: UADBA 43678: ad ♀, skull and alcoholic. Collected by: Richard K.B. Jenkins; original number: RBJ 118. Presented/Donated by: ?: Collector Unknown. Madagascar: Province de Toamasina, Parc National de Mantadia, between PK 9 and PK 10, 18 48.941 S, 48 25.633 E (see Goodman *et al.*, 2012b: 11). - Etymology: In honour of Austin Roberts, who conducted systematic research on African mammals at the Transvaal Museum in Pretoria, and studied southern Africa bats, including small vespertilionids, during which he provided important insights into sorting out their generic affiliations (see Goodman *et al.*, 2012b: 11). (Current Combination)

2017. *N[eoromicia] roberti:* Goodman, Kearney, Ratsimbazafy and Hassanin, Zootaxa, 4236 (2): 358. Publication date: 23 February 2017. (Lapsus)

2019. *L[aephotis] robertsi:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

TAXONOMY:
Bates *et al.* (2006: 303) previously assigned these Madagascan specimens to *Neoromicia melckorum*, but see Goodman *et al.* (2012b: 2).

Goodman *et al.* (2012b: 7) indicate that *N. robertsi* forms a sister-species pair with *N. malagasyensis*.

COMMON NAMES:
German: Roberts Zwergfledermaus.

GENERAL DISTRIBUTION:
Eastern Madagascar.

BIOGEOGRAPHY:
Only known from two localities in eastern Madagascar, at altitudes between 900 and 1,300 m (see Goodman *et al.*, 2012b: 20).

MOLECULAR BIOLOGY:
N. robertsi is separated from its sister-species (*N. malagasyensis*) by a 1.8 % (12S rRNA) and 2.3 % (16S rRNA) sequence divergence. It is separated by a 3.3 % (12S rRNA) and 5.1 % (16S rRNA) sequence divergence from the other sister-species pair: *N. matroka* and *N. capensis*. The divergence between *N. robertsi* and other related taxa is greater than 6.0 % (12S rRNA) and 8.0 % (16S rRNA) (see Goodman *et al.* (2012b: 7).

DIET:
Rakotondramanana *et al.* (2015: 74) report the following prey volume percentages: Coleoptera: 55.0 ± 9.01; Hymenoptera: 25.3 ± 15.73; Lepidoptera: 7.5 ± 7.87; Trichoptera: 2.5 ± 2.95, and Homoptera: 9.7 ± 14.00. The frequency by which these occur are: Coleoptera: 96.7 ± 8.16; Hymenoptera: 80.0 ± 25.30; Lepidoptera: 50.0 ± 45.16; Trichoptera: 26.7 ± 30.11, and Homoptera: 40.0 ± 33.47.

PARASITES:
BACTERIA
Gomard *et al.* (2016: 5) found the single specimen they tested to be posifive for *Leptospira*.

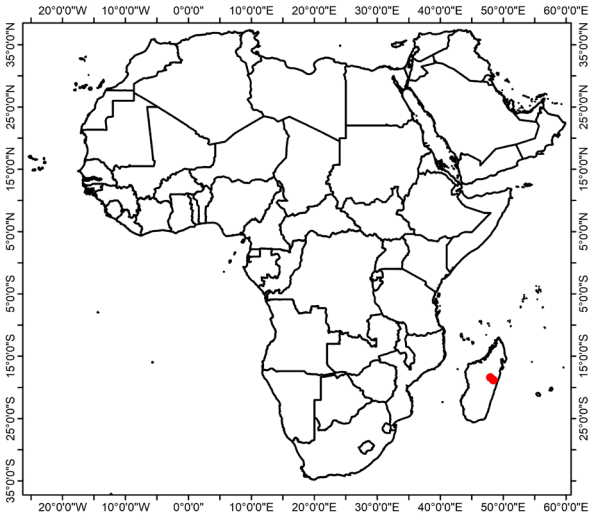


Figure 327. Distribution of *Neoromicia robertsi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

Neoromicia roseveari Monadjem, Richards, Taylor and Stoffberg, 2013

*2013. *Neoromicia roseveari* Monadjem, Richards, Taylor and Stoffberg, Zool. J. Linn. Soc., 167 (1): 191, 197, figs 4 - 7. Publication date: 18 January 2013. Type locality: Liberia: Nimba province: Yiti River [07 29 N 08 35 W] [Goto Description]. Holotype: DNSM 12617: ad ♂, skull and alcoholic. Collected by: Dr. Ara Monadjem; collection date: 23 December 2010; original number: AM2010_12_23_1. Presented/Donated by: ?: Collector Unknown.

Paratype: DNSM 13226: ad ♂. Collected by: Dr. Ara Monadjem; collection date: 23 December 2011; original number: AM2011_12_23_03. Presented/Donated by: ?: Collector Unknown. - Etymology: In honour of Donovan Reginald Rosevear who made a significant contribution to West African bat research in the 20th century, culminating in his book 'The bats of West Africa' (see Monadjem *et al.*, 2013c: 201). (Current Combination)

2019. *L[aephotis] roseveari:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

TAXONOMY:
Monadjem *et al.* (2013c) distinguish *Neoromicia roseveari* from other similar taxa on molecular grounds, craniodental morphology, and baculum structure.

COMMON NAMES:
German: Rosevears Zwergfledermaus.

GENERAL DISTRIBUTION:
Native: Guinea (Decher *et al.*, 2016: 273).

HABITAT:
This species has only been recorded in forested habitats at the base of Mount Nimba (Monadjem *et al.*, 2016y: 370).

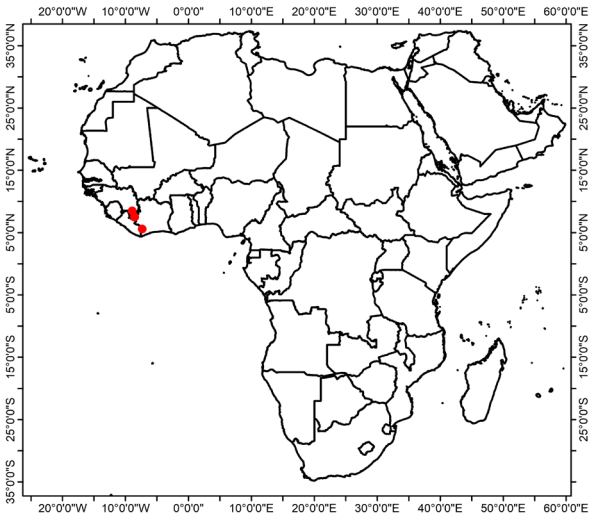


Figure 328. Distribution of *Neoromicia roseveari*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Côte d'Ivoire, Guinea, Liberia.

Neoromicia somalica (Thomas, 1901)

*1901. *Vespertilio minutus somalicus* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 32. Publication date: 1 July 1901. Type locality: Somalia: Northwest province: Hargeisa [09 33 N 44 04 E, 3 500 ft] [Goto Description]. Holotype: BMNH 1898.6.9.1: ad, skin and skull. Collected by: R. McDonald Hawker Esq. Collection date: 14 November 1897; original number: RH5. - Etymology: From the masculin scientific Latin adjecrive *somàlicus*, meaning "inhabiting Somalia", referring to the provenance of the type specimen (see Lanza *et al.*, 2015: 447).

1907. *Vespertilio somalicus:* Matschie, Liste der von Herrn V.B. Schillings gesammelten Säugetier-Arten, 534. (Name Combination)

1911. *Eptesicus minutus somalicus:* G.M. Allen, Bull. Mus. comp. Zool., 54 (9): 326. (Name Combination)

1916. *Eptesicus ugandæ*Hollister, Smiths. Misc. Coll., 66 (1) (2406): 3. Publication date: 10 February 1916. Type locality: South Sudan: [formerly in Uganda]: between Nimule and Gondokoro: Ledgus: Thorn *et al.* (2009: 54-6) indicate that Ledgus was situated within the Uganda protectorate at the time the taxon was described. Currently, this locality is in the Central Equatoria province of South Sudan (see also Fisher and Ludwig, 2015: 80). [04 11 N 31 32 E] [Goto Description]. Holotype: USNM 166520: ad ♀, skull and alcoholic. Collected by: John Alden Loring; collection date: 15 February 1910; original number: 9022. - Comments: Type locality might be in Uganda rather than Sudan as originally mentioned.

1918. *Eptesicus capensis somalicus:* Hollister, Bull. U.S. natl. Mus., 99: 92. (Name Combination)

1930. *Pipistrellus minutus somalicus:* Zammarano, Le colonie Italiane, ???. (Name Combination)

1962. *E[ptesicus] somalicus:* Rosevear, Mammalia, 26 (4): 457. (Name Combination)

1965. *[Eptesicus somalicus] ugandae:* Koopman, Am. Mus. Novit., 2219: 14. (Name Combination)

1969. *Eptesicus somalicus ugandae:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 175. (Name Combination)

1971. *Eptesicus (Eptesicus) somalicus somalicus:* Hayman and Hill, Mammals of Africa: Chiroptera, 44. (Name Combination)
1971. *Eptesicus (Eptesicus) somalicus ugandae:* Hayman and Hill, Mammals of Africa: Chiroptera, 44. (Name Combination)
1971. *Eptesicus (Eptesicus) somalicus:* Hayman and Hill, Mammals of Africa: Chiroptera, 44. (Name Combination)
1971. *Eptesicus somalicus somalicus:* Hill and Morris, Bull. Br. Mus. (nat. Hist.) Zool., 21 (2): 42. (Name Combination)
1987. *Nycterikaupius somalicus:* Menu, Palaeovert., 17 (3): 109. Publication date: 15 November 1987. (Name Combination)
1987. *Pipistrellus (Neoromicia) somalicus:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)
1993. *Eptesicus (Neoromicia) somalicus:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 203. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] s[omalicus] somalicus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] s[omalicus] ugandae:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)
1995. *P[ipistrellus] somalicus:* Barratt, Bruford, Burland, Jones, Racey, and Wayne, Symp. zool. Soc. Lond., 67: 380. (Name Combination)
1995. *P[ipistrellus] somalius:* Burland, Jones, Racey, and Wayne, Symp. zool. Soc. Lond., 67: 379. (Lapsus)
1995. *Pipistrellus somalicus:* Koopman, Kofron and Chapman, Am. Mus. Novit., 3148: 11. (Name Combination)
2003. *Neoromicia somalicus:* Hoofer and Van Den Bussche, Acta Chiropt., 5 (Suppl.): 19. (Name Combination, Current Combination, Alternate Spelling)
2004. *N[eoromicia] s[omalicus] somalicus:* Goodman and Ranivo, Mamm. biol., 69 (6): 434. (Name Combination)
2008. *N[eoromicia] somalica:* Riccucci and Lanza, Hystrix, It. J. Mamm., (n.s.) 19 (2): 176. - Comments: Riccucci and Lanza (2008: 176) indicate that the genus *Neoromicia* is feminine, therefore the spelling of the species ending must also be feminine according to Art. 31.2 of the ICZN (1999). (Name Combination)
2019. *L[aephotis] somalica:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)
? *Eptesicus somalicus:* (Name Combination)
? *Neoromicia somalica:* (Current Spelling)
? *Neoromicia somalicus somalicus:* (Name Combination, Alternate Spelling)
? *Neoromicia somalicus ugandae:* (Name Combination, Alternate Spelling)
? *Neoromicia somalicus vansoni:* (Name Combination, Alternate Spelling)

TAXONOMY:
Koopman (1993a: 203) included *zuluensis*; see Koopman (1975: 404, 405), but see Peterson *et al.* (1995), Simmons (2005). Mentioned in the genus *Pipistrellus* by Koopman (1994: 117). The subspecific allocations of West African and Tanzanian populations are uncertain (Koopman, 1994: 117).

Riccucci and Lanza (2008) indicated that the genus *Neoromicia* is feminine, therefore the ending of the species name *somalicus* must be *somalica*.

Helbig *et al.* (2010: 168) suggest transferring *somalica* to the genus *Laephotis*.

COMMON NAMES:
Afrikaans: Somali-dakvlermuis. Chinese: 索马里伏翼. Czech: netopýr somálský. English: Somali Serotine, Somali Pipistrelle Bat, Somalian Pipistrelle Bat, Somali Serotine Bat. French: Sérotine de Somalie, Pipistrelle de Somalie. German: Somalia-Zwergfledermaus, Somalia-Pipistrelle. Italian: Pipistrèllo sòmalo.

CONSERVATION STATUS:
Global - Although this species is known mainly from patchy records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, tolerance of a broad range of habitats, presumed large overall population, and because it is unlikely to be declining fast enough

to qualify for listing in a more threatened category (Jacobs, 2008g; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus somalicus*] (Jacobs, 2008g; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessed as *Neoromicia somalicus*] (Jacobs, 2004c; IUCN, 2004). 1996 - LR/lc [assessed as *Eptesicus somalicus*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Jacobs, 2008g; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs (2008g) [in IUCN (2009)] report that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected area, although it seems likely to occur in some East African parks. Further studies are needed into the taxonomy, distribution, natural history and threats to this species.

GENERAL DISTRIBUTION:
Neoromicia somalica has been recorded over much of West, Central and East Africa. It ranges from Guinea Bissau in the west, to Sudan, Eritrea and Somalia in the east, being found as far south as Tanzania and southern Democratic Republic of the Congo adjacent to the border with northern Angola.

Happold and Happold (1997b: 825) record *N. somalica* in Malawi, with reservations.
Specimens from southern Africa might possibly represent *Neoromicia zuluensis*, since the distinction between the two species (*zuluensis* and *somalica*) has not been made throughout the literature.
Earlier records from Madagascar are now assigned to *Neoromicia malagasyensis*.

Native: Benin; Botswana; Burkina Faso (Kangoyé *et al.*, 2015a: 621); Cameroon; Central African Republic; Chad; Congo (The Democratic Republic of the); Côte d'Ivoire; Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 147); Ghana; Guinea (Decher *et al.*, 2016: 273); Guinea-Bissau (Veiga-Ferreira, 1949; Lopes and Crawford-Cabral, 1992; Koopman, 1993a; Rainho and Ranco, 2001:64); Kenya; Liberia; Malawi (Happold and Happold, 1997b: 825); Namibia; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; Sudan; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 62); Zimbabwe (Cotterill, 2004a: 261).

Bates *et al.* (2013: 339) reject the presence of *N. somalica* in the Republic of Congo as Van Cakenberghe and Happold (2013q: 654) only marked a locality on their map, but did not provide further details.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) line drawing of tragi of specimen DNSM 12612 from Mount Nimba, Liberia.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:

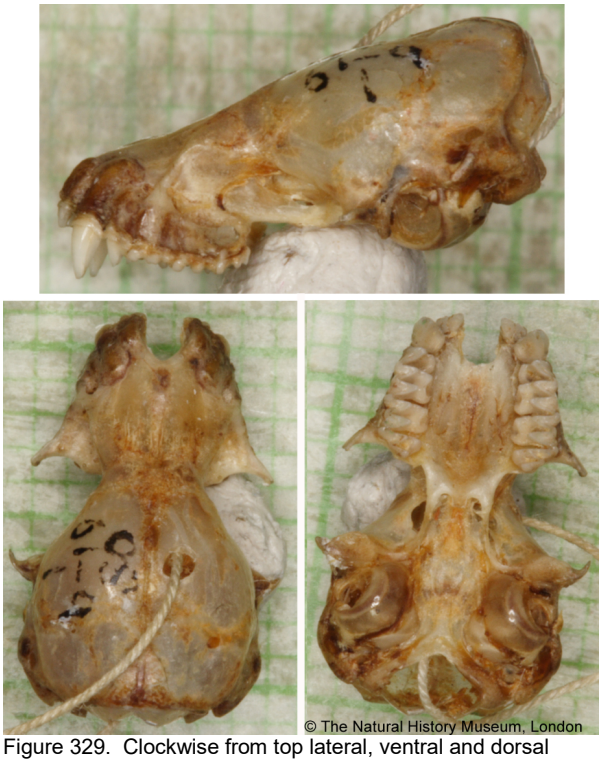


Figure 329. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1898.6.9.1, holotype of *Vespertilio* (*minutus*) *somalicus* Thomas, 1901.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) for the results of a specimen from Kenya.

Karyotype - McBee *et al.* (1987) reported 2*n* = 26, FN = 48, BA = 24, a subtelocentric X chromosome, and an acrocentric Y chromosome.

From Senegal, Koubínová *et al.* (2013: 3) report the following karyotype for 13 ♂♂ and 7 ♀♀: 2*n*: 28, FNa = 50, FN = 54, X = metacentric, Y = submetacentric. There is one additional pair of acrocentric autosomes as compared to specimens from Cameroon. Koubínová *et al.* (2013: 10) assign these Senegalese specimens to *N.* cf. *somalica*.

Protein / allozyme - Unknown.

HABITAT:
Monadjem *et al.* (2016y: 370) recorded this species from an urban environment in the Mount Nimba area, whereas it is otherwise known from savanna areas.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species. It may be locally rare, or at least rarely recorded (Jacobs, 2008g; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs, 2008g; IUCN, 2009).

PARASITES:
Protozoa
Kassahun *et al.* (2015: 168) examined 6 Ethiopian specimens and found two of them (from Aba-Roba) to be infected by *Leishmania* parasites.

INSECTA:
Siphonaptera: Hastriter (2016: 16) reported *Lagaropsylla consularis* Smit, 1957 from a *N. somalica* specimen from Maji Moto, Kenya.

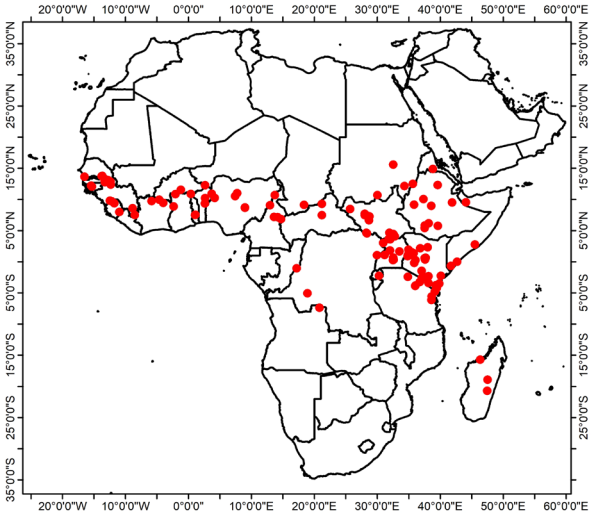


Figure 330. Distribution of *Neoromicia somalica*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Côte d'Ivoire, Eritrea, Ethiopia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Mali, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda.

Neoromicia stanleyi Goodman, Kearney, Ratsimbazafy and Hassanin, 2017

1971. *Eptesicus melckorum:* Hayman and Hill, in: Meester and Setzer, Order Chiroptera., 44. - Comments: in part. (Name Combination)
1987. *Pipistrellus (Neoromicia) melckorum:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52: 249, 274. - Comments: in part. (Name Combination)
1993. *Eptesicus (Neoromicia) melckorum:* Koopman, in: Wilson and Reeder, Order Chiroptera., 202.. - Comments: in part. (Name Combination)
1993. *Pipistrellus cf. melckorum:* Rautenbach, Bronner and Schlitter, Koedoe, 36 (2): 93. (Name Combination)
1995. *Eptesicus cf. melckorum:* Rautenbach, Fenton and Braack, Koedoe, 28: ???. (Name Combination)
2002. *Neoromicia cf. melckorum:* Kearney, Volleth, Contrafatto and Taylor, Acta Chiropt., 4 (1): 58. (Name Combination)
2005. *Neoromica melckorum:* Simmons, in: Wilson and Reeder, Order Chiroptera., 494. - Comments: in part. (Name Combination)
2011. *Neoromicia sp. aff. melckorum:* ACR, African Chiroptera Report 2011. (Name Combination)
*2017. *Neoromicia stanleyi* Goodman, Kearney, Ratsimbazafy and Hassanin, Zootaxa, 4236 (2): 351, 361, figs 2A, 4, 5, 6A, 7,. Type locality: Botswana: Okavango Delta, Chitabe, Gomoti River, Highbanks [19.41979 S 23.40413 E, 950m] [Goto Description]. Holotype: TM 48487: ad ♂, skull and alcoholic. Collected by: Dr. Teresa Catherine Kearney and Ernest Charles James Seamark; collection date: 11 April 2009; original number: ECJS 48/2009. Presented/Donated by: ?: Collector Unknown. - Etymology: Named in honour of the William ("Bill") T. Stanley (1957 - 2015), who conducted active field and systematic research on African small mammals, particularly in east Africa, until his sudden death. (Current Combination)
2017. *Pipistrellus krugeri* Herkt, Skidmore and Fahr, Global Ecol. Biog., 26 (8): Appendix S9. Publication date: 16 June 2017. - Comments: Herkt *et al.* (2017: Appendix S9) refer to the IUCN (2013) attribute table for the shapefile for "*Pipistrellus melckorum*", which notes "that

these records must be referred to *Pipistrellus* sp., which will probably become *Pipistrellus krugeri*". As such, the name has no taxonomic value whatsoever.

2019. *L[aephotis] stanleyi:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

? *Eptesicus melckorum subsp.:*

? *Pipistrellus melckorum:*

TAXONOMY:

Bronner *et al.* (2003) state that most previous authors recognised *Eptesicus (=Neoromicia) melckorum* as distinct from *N. capensis* (Roberts, 1951); Ellerman *et al.*, 1953; Hayman and Hill, 1971; Corbet and Hill, 1980; Meester *et al.*, 1986). Koopman (1982), however, questioned the status of *N. melckorum*, since it cannot be clearly distinguished from *N. capensis*. Specimens from the type locality (Kersefontein Farm in the Western Cape Province) are morphologically and karyotypically indistinguishable from *N. capensis*, but specimens from the Kruger National Park with a unique karyotype (2*n* = 40, aFN = 50) agree with the original description of *melckorum* (Rautenbach *et al.*, 1993; Kearney *et al.*, 2002 for Kersefontein chromosomal data). The Kruger National Park specimens are also well differentiated from *N. capensis* by allozymes (Morales *et al.*, 1991). *Neoromicia melckorum* should thus be synonymised under *N. capensis*, whereas specimens from the Kruger National Park probably represent a distinct species that remained unnamed (Koopman, 1994), and which were referred to as *Neoromicia cf. melckorum*. It seems likely that the Zimbabwe specimens reported by Cotterill (1996a) represent this latter species. Goodman *et al.* (2017a) studied these (and other southern African) specimens and provided a name and description for this taxon: *Neoromicia stanleyi*.

COMMON NAMES:

English: Kruger serotine bat (Taylor, 2005: 305 - first use). French: Pipistrelle des Melcks. German: Stanleys Serotine bat.

CONSERVATION STATUS:

Global - DD ver 3.1 (2001) assessed as *Pipistrellus melckorum* (IUCN, 2009).

Regional -

South Africa: 2016 - LC ver 3.1 (2001) [assessed as *Neoromicia* cf. *melckorum*] (Taylor *et al.*, 2016c). 2004 - considered a vagrant (*Pipistrellus spp* - Kruger Serotine bat) not assessed, single locality (Friedmann and Daly, 2004).

GENERAL DISTRIBUTION:

Kenya to Zambia and N South Africa (Simmons, 2005). For South Africa, Babiker Salata (2012: 49) found that "*N. melckorum*" has a distribution which is strongly associated with the amount of precipitation in the coldest quarter of the year.

Native: Botswana (Monadjem *et al.*, 2010d: 568); Malawi (Happold *et al.*, 1988: 568); South Africa (Monadjem *et al.*, 2010d: 568); Zambia (Ansell, 1967; Monadjem *et al.*, 2010d: 568); Zimbabwe (Monadjem *et al.*, 2010d: 568).

DETAILED MORPHOLOGY:

Baculum - In general appearance, this is very similar to the bacula of the closely related *N. capensis, N. matroka, N. robertsi* and *N. malagasyensis*. They all have a ventrally deflected tip, with a small dorsally projecting heel. Compared with the one of *capensis*, its longer and has a broader, shorter tip. The lateral tip flanges in *N. stanleyi* are only curved or notched on the distal edge, whereas there are distally and proximally curved edges on the tip flanges of *N. capensis*. The shaft in *stanleyi* is slender and eveny wide from end to end (see Fig. 2 in Goodman *et al.*, 2017a)..

MOLECULAR BIOLOGY:

DNA - Unknown.

Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 40; FN = 50, BA = 12, a metacentric X chromosome, and an acrocentric Y chromosome, for specimens from Zimbabwe and South Africa.

Protein / allozyme - See Morales *et al.* (1991) for results from nine specimens from South Africa.

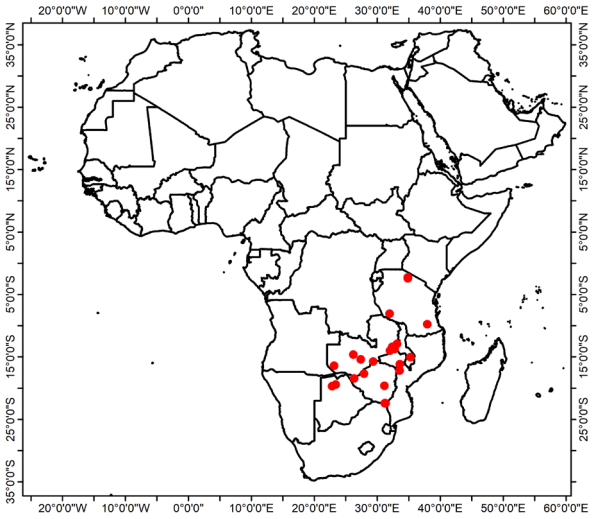


Figure 331. Distribution of *Neoromicia stanleyi*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Botswana, Kenya, Malawi, Mozambique, South Africa, Tanzania, Zambia, Zimbabwe.

Neoromicia tenuipinnis (Peters, 1872)

*1872. *Vesperus tenuipinnis* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 263. Publication date: 1872. Type locality: Guinea: "Guinea" [Goto Description]. Holotype: ZMB 4096: ad ♀. Presented/Donated by: Schlegel. See Turni and Kock (2008), who report it as missing. Neotype: DNSM 13235: ad ♂, skull and alcoholic. Collected by: Dr. Ara Monadjem; collection date: 7 January 2012. Presented/Donated by: ?: Collector Unknown. Neotype designated by Decher *et al.* (2016: 270). Locality: Liberia: base of Mount Nimba: near Yekepa. - Comments: The publication covers a meeting held on 18 April 1872. Kock (1969a: 162) indicated that the type locality quoted by Ellerman *et al.* (1953: 77, Kuilu River, Congo [B]) is an unjustified assumption. - Etymology: From the feminine scientific Latin adjective *tenuipìnnis*, meaning "slender-winged", made up of the Latin adjective *tènuis*, meaning "slender" and the Latin substantive *pìnna*, meaning "wing": the adjective refers to the slender shape of the wings (see Lanza *et al.*, 2015: 455).

1878. *Vesperugo (Vesperus) tenuipinnis:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 200. (Name Combination)

1889. *Vesperus bicolor* Bocage, J. Sci. mat. phys. nat., ser. 2, 1 (1): 5. Publication date: March 1889. Type locality: Angola: Caconda [13 42 S 15 05 E, 1 900 m] [Goto Description]. Syntype: BMNH 1889.5.1.3: ad ♂, skull and alcoholic. Collected by: José Alberto de Oliveira Anchieta. Syntype: BMNH 1889.5.1.5: ad ♂. Presented/Donated by: ?: Collector Unknown. - Comments: Bocage (1889a: 6) mentions 2 ♀♀ specimens.

1889. *Vesperus tenuipennis:* Noack, Zool. Jb. Syst., 4: 215, 239, 261. (Lapsus)

1897. *Eptesicus tenuipinnis:* Matschie, Arch. Naturgesch. Berlin, 63 (1): ??. (Name Combination)

1897. *Vesperugo (Vesperus) bicolor:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, fasc. I: 110.

1900. *Vespertilio tenuipennis:* Miller, Proc. Wash. Acad. Sci., 2: 649. Publication date: 28 December 1900. (Lapsus)

1916. *E[ptesicus] bicolor:* Wettstein, Anz. kais. Akad. Wiss., Wien, 53: 201.

1917. *Eptesicus ater* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 443. Publication date: 29 September 1917. Type locality: Congo (Democratic Republic of the): Oriental province: Uele district: Faradje [03 44 N 29 43 E] [Goto Description]. Holotype: AMNH 48988: ad ♂, skin and skull. Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition; collection date: 1 March 1911; original number: 1466. Topotype: AMNH 49423: alcoholic (skull not removed). Collected by: Herbert Lang, James Paul Chapin and The American Museum Congo Expedition. Presented/Donated by: ?: Collector Unknown.

1923. *Eptesicus tenuipennis:* Kershaw, Rev. Zool. afr., 11 (4): 358. (Lapsus)

1935. *Pipistrellus bicolor:* Monard, Arq. Mus. Bocage, 6: 31.

1936. *Eptesicus bicolor:* St. Leger, Novit. Zool., 40: 79.

1950. *Eptesicus tenuipinnis ater:* Sanborn, Publ. Cult. Comp. Diamantes Angola, Lisboa, 10: ???. (Name Combination)

1952. *Eptesicus tennuipinnis:* Cozens and Marchant, Niger. Fld. , 17 (3): 127. (Lapsus)

1953. *Eptesicus (Eptesicus) bicolor:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77.

1953. *Eptesicus (Eptesicus) tenuipinnis ater:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77. (Name Combination)

1953. *Eptesicus (Eptesicus) tenuipinnis tenuipinnis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77. (Name Combination)

1953. *Eptesicus (Eptesicus) tenuipinnis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77. (Name Combination)

1956. *Ephesicus tenuipinnis:* Theodor, Parasitology, 46: ???. (Lapsus)

1956. *Eptesicus tenuipinnis tenuipinnis:* Eisentraut, Zool. Jb. Syst., 84 (3): 531. (Name Combination)

1987. *Nycterikaupius tenuipinnis:* Menu, Palaeovert., 17 (3): 109. Publication date: 15 November 1987. (Name Combination)

1987. *Pipistrellus (Neoromicia) tenuipinnis:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)
1992. *Pipistrellus tenuipinnis:* Duckworth and Timmins, The bats of Nechisar National Park, 36. (Name Combination)
1993. *Eptesicus (Neoromicia) tenuipinnis:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 218. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] t[enuipinnis] ater:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] t[enuipinnis] tenuipinnis:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)
1994. *P[ipistrellus (Pipistrellus)] bicolor:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 114.
2002. *Eptesicus tennnuipinnis:* Fenton and Bogdanowicz, Can. J. Zool., 80: 1008. (Lapsus)
2002. *Eptesicus tenuippinis:* Fenton and Bogdanowicz, Can. J. Zool., 80: 1013. (Lapsus)
2006. *Neoromicia tenuipinnis:* Van Cakenberghe, Kearney and Seamark, African Chiroptera Project, Pretoria, 140 -142. (Name Combination, Current Combination)
2008. *Vesperus hösemanni* Turni and Kock, Zootaxa, 1869: 82. - Comments: Turni and Kock (2008: 82) mention this name as a label name, introduced by Matschie, on ZMB 10096 from Tanzania, Lake Tanganyika, Ujiji, an adult male, skull and alcoholic. Since this name has not been published before, Turni and Kock should be considered the authors.
2019. *L[aephotis] tenuipinnis:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)
? *Neoromicia tenuipinnis ater:* (Name Combination)
? *Neoromicia tenuipinnis tenuipinnis:* (Name Combination)

GENERAL COMMENTS:
Bocage (1889a: 6) mentions two female specimens only.

TAXONOMY:
Eptesicus bicolor was tentatively included here by Hayman and Hill (1971: 43), but this may be an older name for *Pipistrellus anchietai*; see Koopman (1975: 404). Koopman (1994: 117) mentions this species in the genus *Pipistrellus*.

Helbig *et al.* (2010: 168) suggest that *tenuipinnis* needs to be transferred to a genus that needs to be newly created or resurrected from the current synonymy.

COMMON NAMES:
Chinese: 白翼伏翼. Czech: netopýr běloblanný. English: Slender-winged Pipistrelle Bat, White-winged Pipistrelle Bat, White-winged Serotine, White-winged Bat. French: Sérotine à ailes blanches, Pipistrelle à ailes blanches. German: Weißflügel-Zwergfledermaus, Weißflügel Pipistrelle, Weissfluegel-Hausfledermaus. Italian: Pipistrèllo di Peters. Spanish (Castillian): Murciélago.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus tenuipinnis*] (Fahr, 2008a; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Fahr, 2004j; IUCN, 2004). 1996 - LR/lc [assessed as *Eptesicus tenuipinnis*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Fahr, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008a) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It is not known if the species is present in any protected areas.

GENERAL DISTRIBUTION:
Neoromicia tenuipinnis is a sub-Saharan species which is widely distributed through West, Central and parts of East Africa. It ranges from Senegal in the west, through West Africa, to Cameroon and Central Africa including much of the Congo basin, into Uganda and East Africa including Ethiopia, Kenya and Tanzania. It has been recorded as far south as southern Democratic Republic of the Congo and northern Angola. It occurs at elevations of up to 3,200 m asl.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 569); Burundi; Cameroon; Central African Republic; Congo (Bates *et al.*, 2013: 337); Congo (The Democratic Republic of the) (Schouteden, 1944; Hayman *et al.*, 1966; Van Cakenberghe *et al.*, 1999; Dowsett *et al.*, 1991: 259; Monadjem *et al.*, 2010d: 569); Côte d'Ivoire; Equatorial Guinea; Ethiopia (Lavrenchenko *et al.*, 2004b: 147); Gabon; Gambia; Ghana; Guinea (Konstantinov *et al.*, 2000: 145); Guinea-Bissau (Rainho and Ranco, 2001: 66); Kenya; Liberia (Monadjem and Fahr, 2007: 50); Nigeria; Rwanda; Senegal; Sierra Leone; Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 62).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) gives a line drawing of the tragus of specimen DNSM 13235 from Mount Nimba, Liberia.

DETAILED MORPHOLOGY:
Baculum - The basal lobes of *N. tenuipinnis* were long and elongate, terminating in a rounded lobular structure, the total length (1.97 mm), the angle of shaft curvature, measured from mid-shaft to the shaft base, was more acute in *N. tenuipinnis* (43°) than in *N.* cf. *rendalli* (58°) (Monadjem *et al.*, 2013c: 197). Line drawing of dorsal and ventral of specimen DNSM 13235 from Mount Nimba, Liberia are shown in Monadjem *et al.* (2013c: 204). See Hill and Harrison (1987).

ECHOLOCATION:
Musila *et al.* (2018c: 43) [referring to Monadjem *et al.* (2010d: 478)] mention a shallow, frequency modulate call, which sweeps down from 62 to 37 kHz.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - McBee *et al.* (1987) reported 2*n* = 36, FN = 52, BA = 18, a submetacentric X chromosome and an acrocentric Y chromosome.
Protein / allozyme - Unknown.

HABITAT:
In their study at the Mount Nimba area, Monadjem *et al.* (2016y: 370) recorded this species in two small settlements.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator of "*E. tenuipinnis*".

POPULATION:
Structure and Density - This species is rather common in suitable habitat. It is most often found in small groups of fewer than 20 animals (Fahr, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008a; IUCN, 2009).

PARASITES:
ACARI
Sarcoptidae: Fain (1959d: 145) described *Notoedres (Notoedres) schoutedeni* from "*Eptesicus tenuipinnis*" and "*E. ater*" from Buta, Stanleyville (=Kisangani), Mauda, and Tshuapa, DRC.

HEMIPTERA
Cimicidae: *Aphrania recta* Ferris and Usinger, 1957, recorded from Sierra Leone (Haeselbarth *et al.*, 1966: 12), and DRC (Kock and Aellen, 1987: 876).

DIPTERA
Streblidae: *Raymondia intermedia* Jobling, 1936 in Sierra Leone (Haeselbarth *et al.*, 1966: 102).
Nycteribiidae: *Basilia ansifera* Theodor, 1956 mainly a West African species, reaching Lake Victoria in the east and Lake Nyasa in the south, nearly all localities lie between 15° latitude north and south (Haeselbarth *et al.*, 1966: 110). *Basilia robusta* Theodor, 1956 (Haeselbarth *et al.*, 1966: 111).

VIRUSES:
In their overview table, Maganga *et al.* (2014a: 8) reported that no viruses were ever found in this bat species.

Coronaviridae
None of the 33 Kenyan bats tested by Tao *et al.* (2017: Suppl.) was positive for CoV.

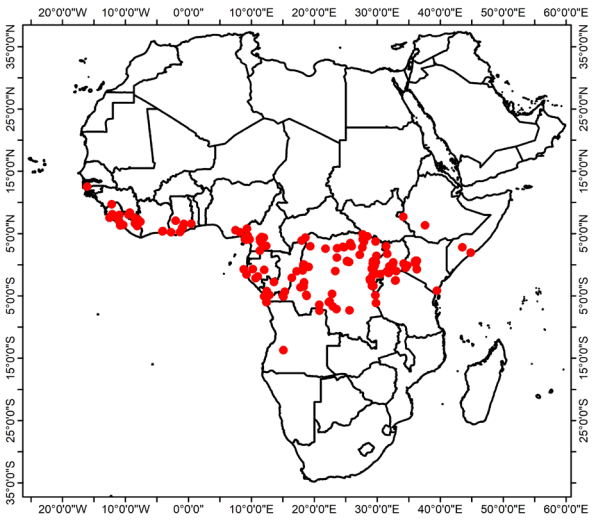


Figure 332. Distribution of *Neoromicia tenuipinnis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Burundi, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Ethiopia, Gabon,

Ghana, Guinea, Kenya, Liberia, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, Tanzania, Togo, Uganda.

Neoromicia zuluensis (Roberts, 1924)

*1924. *Eptesicus zuluensis* Roberts, Ann. Transv. Mus., 10: 60, text-fig. 1. Publication date: 31 January 1924. Type locality: South Africa: KwaZulu-Natal: White Umfolosi Game Reserve [28 19 S 31 50 E] [Goto Description]. Holotype: TM 3024: ad ♀, skin and skull. Collected by: Austin Roberts; collection date: 29 June 1922; original number: 14. [Second label has G.M. Allen as collector]; note: shot at dusk.

1926. *[Neoromicia] zuluensis:* Roberts, Ann. Transv. Mus., 11: 245. (Name Combination, Current Combination)

1932. *Neoromicia vansoni* Roberts, Ann. Transv. Mus., 15 (1): 15. Publication date: 1 October 1932. Type locality: Botswana: Ngamiland: N of Tsotsoroga Pan: Zweizwe river waterhole [18 36 S 24 22 E] [Goto Description]. Holotype: TM 6553: ad ♀, skin and skull. Collected by: The Vernay-Lang Kalahari Expedition 1930; collection date: 7 July [June on label] 1930; original number: 882.

1934. *Neoromicia pusilla vansoni:* Shortridge, Mammals of South West Africa, 59.

1939. *Eptesicus vansoni:* G.M. Allen, Bull. Mus. comp. Zool., 83: 92.

1951. *Neoromicia zuluensis vansoni:* Roberts, Mammals of South Africa, 85. (Name Combination)

1951. *Neoromicia zuluensis zuluensis:* Roberts, Mammals of South Africa, 84. (Name Combination)

1953. *Eptesicus (Eptesicus) zuluensis vansoni:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77. (Name Combination)

1953. *Eptesicus (Eptesicus) zuluensis zuluensis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77. (Name Combination)

1953. *Eptesicus (Eptesicus) zuluensis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 77. (Name Combination)

1962. *[Eptesicus zuluensis] zuluensis:* Meester, Ann. Transv. Mus., 24 (2/3): 242. (Name Combination)

1970. *Eptesicus zuluensis vansoni:* Roer, Bijdr. Dierk., 40 (1): 71. (Name Combination)

1978. *Eptesicus somalicus zuluensis:* Ansell, Mammals of Zambia, 25. (Name Combination)

1984. *Eptesicus (Eptesicus) somalicus zuluensis:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., 244. (Name Combination)

1987. *Pipistrellus (Neoromicia) zuluensis:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)

1988. *P[ipistrellus] zuluensis:* Thorn, Mammalia, 52 (2): ???. (Name Combination)

1992. *Eptesicus zulensis:* Freitas, Bogo, and Christoff, Z. Säugetierk., 57: 331. (Lapsus)

1994. *P[ipistrellus (Neoromicia)] s[omalicus] zuluensis:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 117. (Name Combination)

2017. *Neoromicia zuluensisin:* Han, Wen, Zhao, Liu, Luo, Zhou, Qin, Zhu, Liu, Qi, Li, Yu, and Yu, Zoonoses Public Health, 64 (5): 643. Publication date: 1 April 2017. (Lapsus)

2019. *L[aephotis] zuluensis:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. (Name Combination)

? *Neoromicia zuluensis:* (Name Combination)

TAXONOMY:



Figure 333. A female *Neoromicia zuluensis* (TM 48097) caught at Lapalala Wilderness Area, Limpopo Province, South Africa.

Bronner *et al.* (2003) state that although Ellerman *et al.* (1953) and Hayman and Hill (1971) recognised *Eptesicus (=Neoromicia) zuluensis* as a distinct species, Koopman (1975, 1982, 1993a), Meester *et al.* (1986) and Corbet and Hill (1992) treated it as a subspecies of *Eptesicus* (=*Pipistrellus*) *somalicus*. Rautenbach *et al.* (1993) confirmed its distinctness from the latter on the grounds of interspecific chromosomal differences.

As a separate species by many authors, e.g. Volleth *et al.* (2001: 44), who assigned it to the genus *Neoromicia*.

COMMON NAMES:
Afrikaans: Aalwyndakvlermuis; Aalwynvlermuis. Chinese: 祖鲁伏翼. Czech: netopýr zuluský. English: Zulu Pipistrelle Bat, Aloe Bat, Aloe Serotine, Aloe Serotine Bat, Zulu Serotine Bat. French: Sérotine des aloes, Pipistrelle zouloue. German: Zulu-Zwergfledermaus, Zulu-Pipistrelle.

ETYMOLOGY OF COMMON NAME:
Roberts (1924) collected the original specimen at his camp and records in his description of the species that it was the Cape serotine bat, *N. capensis*, that he found in an aloe. He used the name aloe bat and it has remained associated with *N. zuluensis* (Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs and Cotterill, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as *Pipistrellus zuluensis*] (Jacobs and Cotterill, 2008b; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs and Cotterill, 2004b; IUCN, 2004). 2000 - LR/nt [assessed as *Eptesicus zuluensis*] (Hilton-Taylor, 2000).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016n). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Jacobs and Cotterill, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs and Cotterill (2008b) [in IUCN (2009)] report that it seems probable that this adaptable species is present within a number of protected areas. It has been recorded from Kruger National Park, South Africa. No direct conservation measures are currently needed for the species as a whole.

GENERAL DISTRIBUTION:
Neoromicia zuluensis is widespread in East and southern Africa. The eastern distribution ranges from Ethiopia and South Sudan to Uganda and Kenya. The southern range extends from Zambia and southern parts of the Democratic Republic of the Congo to southern South Africa, and from eastern Angola to central Zambia and Zimbabwe. In the RSA, the species' distribution is linked with land use/land cover (Babiker Salata, 2012: 50).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,198,714 km^2.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d:570; Taylor *et al.*, 2018b: 60); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 570); Congo (The Democratic Republic of the); Ethiopia (Lavrenchenko *et al.*, 2004b: 153; 2011: 54); Kenya; Malawi (Ansell and Dowsett, 1988: 42); Mozambique (Monadjem *et al.*, 2010d: 570; Monadjem *et al.*, 2010c: 384); Namibia (Monadjem *et al.*, 2010d: 570); South Africa (Monadjem *et al.*, 2010d: 570); Sudan; Swaziland (Monadjem *et al.*, 2010d: 570); Uganda; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 570); Zimbabwe (Monadjem *et al.*, 2010d: 570).

ECHOLOCATION:
In Waterberg, South Africa, Taylor *et al.* (2013b: 17) recorded the following parameters for 5 calls: F_{max}: 73.8 ± 14.93 (59.1 - 92.8) kHz, F_{min}: 48.1 ± 1.94 (45.7 - 50.5) kHz, F_{knee}: 51.3 ± 2.85 (48.4 - 55.8) kHz, F_{char}: 49.0 ± 1.81 (46.3 - 51.2) kHz, duration: 2.4 ± 0.52 (1.7 - 3.0) msec.

At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 51 (48 - 56) kHz.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg range (RSA): F_{min}: 46 - 50 kHz, F_{char}: 46 - 51 kHz, F_{knee}: 48 - 56 kHz, Slope: 487 - 867 OPS, duration: 2 - 3 msec. 20 calls were recorded by Parker and Bernard (2018: 57) in the Mapungubwe National Park (RSA): F_{char}: 48.11 ± 1.17 kHz, F_{max}: 63.23 ± 4.44 kHz, F_{min}: 47.70 ± 1.36 kHz, F_{knee}: 52.09 ± 2.33 kHz, duration: 4.91 ± 1.36 msec, at 7.47 ± 2.12 calls/sec.
At Telperion Nature Reserve (RSA), Kearney *et al.* (2019: 37) recorded a release call (6 pulses) with the following characteristics: F_{char}: 45.89 ± 0.43 (45.45 - 46.51) kHz, slope at start of call: 52.41 ± 16.85 (31.71 - 68.40), time between start of call and F_{char}: 3.43 ± 0.84 (2.26 - 4.83) msec and duration: 3.82 ± 0.58 (3.13 - 4.83) msec.

From Swaziland, the following parameters were reported by Monadjem *et al.* (2017c: 179): F_{min}: 46.1 ± 2.82 (39.9 - 45.3) kHz, F_{knee}: 46.6 ± 2.91 (43.3 - 48.5) kHz, F_c: 43.6 ± 3.10 (40.1 - 45.9) kHz and duration: 3.7 ± 0.67 (3.0 - 4.2) msec.

General description of cranial and dental morphology:

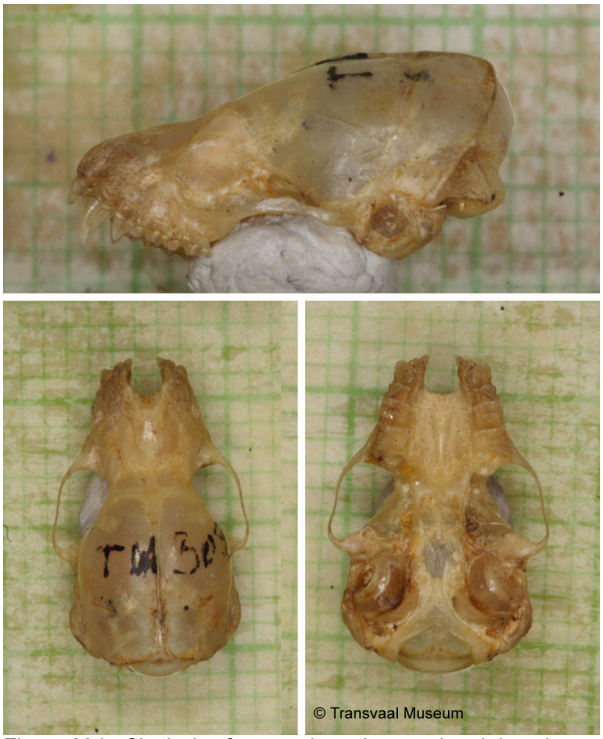


Figure 334. Clockwise from top lateral, ventral and dorsal skull images of TM 3024, holotype of *Eptesicus zuluensis* Roberts, 1924.

Detailed morphology:

Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

Molecular Biology:

DNA - Unknown.
Karyotype - Both Rautenbach *et al.* (1993) and Kearney *et al.* (2002) recorded 2*n* = 28, FN = 48, BA = 22, and a subtelocentric X chromosome. However, as can been seen from Figure 9 in Kearney *et al.* (2002), the FN number was incorrectly reported and should be FN = 50, and BA = 24. Rautenbach *et al.* (1993) also reported an acrocentric Y chromosome. GTG-bands identified three Robertsonian fusion chromosomes (7/11, 8/9, 10,12), considered as distinguishing characters for the genus *Neoromicia* Kearney *et al.* (2002).
Protein / allozyme - See Morales *et al.* (1991) for results from three specimens from South Africa.

Habitat:

In southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) found that *N. zuluensis* is primarily present in Savanna (81 %) and SW arid (10 %) habitats.

Population:

Structure and Density - In general, this is a locally uncommon species (Jacobs and Cotterill, 2008b; IUCN, 2009).
Trends - 2008- Unknown (Jacobs and Cotterill, 2008b; IUCN, 2009).

Reproduction and ontogeny:

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births from late November to early December.

Parasites:

Protozoa:
Harris *et al.* (2018: 2, 3) reported the presence of *Hepatozoon* sp. From a *Neoromicia zuluensis* from Louis Trichardt, in the Limpopo province (RSA).

Viruses:

Coronaviridae - Coronaviruses
The report of a new virus by Ithete *et al.* (2013: 1697) that was closely related to Middle East respiratory syndrome (MERS)-CoV, the host was incorrectly identified and is related to *N. capensis*.

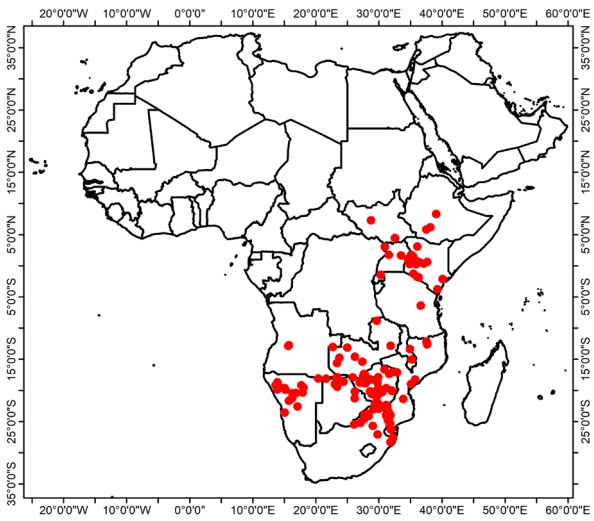


Figure 335. Distribution of *Neoromicia zuluensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Botswana, Ethiopia, Kenya, Malawi, Mozambique, Namibia, Rwanda, South Africa, South Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

Neoromicia "incertae-sedis"

1857. *Vespertilio pusillus* Leconte, Proc. Acad. nat. Sci. Philad., 10. Type locality: "Africa": "Western Africa". - Comments: Kock (1969a: 228) indicates that this paper was published in 1858.
1897. *Vesperugo (Vesperus) pusillus:* Trouessart, Catalogus Mammalium tam viventium quam fossilium, fasc. I: 110. (Name Combination)
1929. *Eptesicus pusillus:* Thomas, Proc. zool. Soc. Lond., 101. - Comments: Thomas (1929: 101) assigned this name to Noack. (Name Combination)
1953. *Eptesicus (Eptesicus) pusillus:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 76. (Name Combination)
2013. *Neoromicia cf. nana:* Koubínová *et al.*, Front. Zool., 10: 1-48. - Comments: Koubínová *et al.* (2013: 7) found found differences in dipoloid chromosome number and/or in chromosome morphology between the populations from Senegal and other regions in Africa. (Name Combination)
2013. *Neoromicia cf. somalica:* Koubínová *et al.*, Front. Zool., 10: 1-48. - Comments: Koubínová *et al.* (2013: 7) found found differences in dipoloid chromosome number and/or in chromosome morphology between the populations from Senegal and other regions in Africa. (Name Combination)
? *Neoromicia "incertae-sedis"* (Current Combination)
? *Neoromicia capensis B:*

TAXONOMY:
Allen (1939a: 86) indicates that *Vespertilo pusillus* might possibly be the same form as *Vesperugo pusillus* Noack, 1887, but that the description is insufficient to identify the species. Ansell (1978: 25) - referring to Rosevear (1962) and Hayman and Hill (1971) - indicates that the status of *pusillus* Leconte is uncertain in relation to *Eptesicus minuta* Temminck, *"Eptesicus" somalicus* and *"Eptesicus" capensis*. Crawford-Cabral (1989) also points out that in southern Africa, *"Eptesicus" zuluensis* might be involved too.

Koopman (1965) and Kock (1969a: 138) consider this name to be indeterminable, and they suggest placing the small northern African *Eptesicus* specimens in the species *guineensis* Bocage, 1889.

According to Kock it is even uncertain that *pusillus* Leconte represents *Eptesicus* [= *Neoromicia* in the current context].

Kock (1969a: 159) also pointed out that the skull of the type of *Vesperugo pusillus* Noack, 1887 actually represents a non-adult *Pipistrellus nanus*.

The fact that *pusillus* Leconte and *pusillus* Noack have been considered synonymys throughout the literature, also render much of the literature data indeterminable, unless these are supported by voucher specimens.

PARASITES:
In their description of the Nematode parasite *Molinostrongylus richardae*, Durette-Desset and Chabaud (1975: 312) also mention an "*Eptesicus pusillus* from Tananarive, Madagascar as an

additional host. From the same host (species) and locality, Richard (1966: 413, 419) reported the Trematode *Plagiorchis (Plagiochis) vespertilionis* (Müller, 1784) Braun, 1900 and described another one: *Papillatrium (Papillatrium) inversum*.

Genus ***Nyctalus*** Bowdich, 1825

*1825. *Nyctalus* Bowdich, Excur. Madeira and Porto Santo, 36, and footnote. Publication date: 1825. - Comments: Type species: *Nyctalus verrucosus* Bowdich, 1825 (=*Vespertilio leisleri* Kuhl, 1817). - Etymology: From the Greek "*νυκταλός*" (="*νυσταλός*"), meaning drowsy, referring to its crepuscular habits (see Palmer, 1904: 464). From the Greek "*nyctos*" meaning night and "*ala*" meaning wing (see Kapteyn, 1995: 115). (Current Combination)

1829. *Pterygistes* Kaup, Skizzierte Entwicklungs-Geschichte Natürliche Systematik der Europäische Thierwelt, 1: 90. Publication date: 1829. - Comments: Type species: *Vespertilio noctula* Schreber, 1774. - Etymology: From the Greek "*πτερυγίζω*", meaning to flutter, referring to the manner of flight (see Palmer, 1904: 596).

1839. *Vesperugo* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 312. Publication date: 1839. - Comments: In part (see Allen, 1939a: 92; Pavlinov *et al.*, 1995: 104). Included 13 species now referred to *Eptesicus, Pipistrellus, Neoromicia, Hypsugo*.

1842. *Noctulinia* Gray, Ann. Mag. nat. Hist., [ser. 1], 10 (65): 258. Publication date: 1 December 1842. - Comments: Mentioned as "in part" by Allen (1939a: 92). Contained two species (*Noctulinia proterus* Kuhl, 1818 =*Nyctalus noctula* Schreber, 1774, and *N. fulvus* Grey, 1843 =*Scotophilus kuhlii* Leach, 1821; see Allen (1939a: 92), one a synonym of *Vespertilio noctula* Schreber, 1774 (see Corbet and Hill, 1992: 143). - Etymology: From the Latin of, or belonging to night (from "*noctus*" = "*nox*", meaning night), referring to the animal's crepuscular habits (see Palmer, 1904: 461).

1856. *Panugo* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Type species: *Vespertilio noctula* Schreber, 1774 and *Vespertilio leisleri* Kuhl, 1817.

1914. *Noctulinia* Cabrera, Fauna Ibérica, 123. - Comments: (also mentioned by Allen (1939a: 92), Corbet (1978: 54), and Simmons (2005))?.

2002. *Nyctalis:* Sheshurak and Kedrov, Plecotus et al., pars spec.: 62. (Lapsus)

2019. *Nyactulus:* Fagre and Kading, Viruses, 11 (3): 215 (p. 4). Publication date: 3 March 2019. (Lapsus)

? *Noctulina* Macalister, Ann. Mag. nat. Hist., ser. 4, 9 (53): 402. Publication date: 1 May 1872.

TAXONOMY:
Species referred by Koopman (1994) in the *Stenopterus* group are placed into *Pipistrellus* by Corbet and Hill (1992) and Hoofer and Van Den Bussche (2003: 38). Whereas Simmons (2005) placed it as a subgenus of *Hypsugo*.

Known species of the genus *Nyctalus*: ***azoreum*** Thomas, 1901; ***lasiopterus*** Schreber, 1780; ***leisleri*** Kuhl, 1817; *noctula* Schreber, 1774.

COMMON NAMES:
Czech: lesní netopýři (lesní létači). English: Noctules, Noctule Bats. French: Noctules, Chauves-souris à nez large. German: Abendsegler.

GENERAL DISTRIBUTION:
Species of the genus *Nyctalus* are distributed across the entire Palaerctic region, and enter only marginally into the Indomalay region (Koopman, 1994; Simmons, 2005)

Nyctalus azoreum (Thomas, 1901)

*1901. *Pterygistes azoreum* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 33. Publication date: 1 July 1901. Type locality: Azores (Portugal): St. Michael [Goto Description]. Holotype: BMNH 1865.10.2.1: ♂. Collected by: Frederick DuCane Godman Esq. Presented/Donated by: Frederick DuCane Godman Esq. - Etymology: The name refers to the Island group where the species occurs.

? *Nyctalus azoreum:* (Name Combination, Current Combination)

? *Nyctalus leisleri azoreum:* (Name Combination)

TAXONOMY:
Listed as a subspecies of *N. leisleri* by Corbet (1978) and Koopman (1994: 118). But recognised as a species by Palmeirim (1991), Koopman (1993a: 216), Horácek *et al.* (2000: 133), Salgueiro *et al.* (2004: 3357), Simmons (2005: 471), Salgueiro *et al.* (2006: 169) and Salgueiro *et al.* (2008: 1163; 2010: 26).

COMMON NAMES:
Albanian: Noktulë e Azoreve. Armenian: Ազորյան իրիկնաչղջիկ Azerbaijani: Azor axşam yarasası. Basque: Gau-saguzar azoretar. Belarusian: Вячэрніца азорская. Bosnian: Azorski noćni šišmiš. Breton: Nozigell an Azorez. Bulgarian: Азорски вечерник. Castilian: Nóctulo de Azores. Catalan: Nòctul de les Azores. Croatian: Azorski večernjak. Czech: Netopýr azorský. Danish: Azorflagermus. Dutch: Azoren rosse vleermuis, Azorenvleermuis. English: Azorean Noctule Bat, Azores noctule. Estonian: Assoori videvlane. Finnish: Azorienisolepakko. French: Noctule des Açores. Frisian: Azoaren reade flearmûs. Galician: Nóctulo das Azores. Georgian: აზორული მელამურა. German: Azoren-Abendsegler. Greek: Νυκτοβάτης των Αζόρων. Hungarian: Azori-szigeteki koraidenevér. Irish Gaelic: Ialtóg Asórach. Italian: Nottola delle Azzorre. Latvian: Azoru vakarsikspārnis. Lithuanian: Azorinis nakviša. Luxembourgish: Azoren-Bëschfliedermaus. Macedonian: Азорски вечерник. Maltese: Noktula ta' l-Azores. Montenegrin: Azorski noćnik. Norwegian: Asorflaggermus. Polish: Borowiec azorski. Portuguese: Morcego dos Açores. Rhaeto-Romance: Sgolanotg da las Azoras. Romanian: Liliacul de amurg din Azore. Russian: Вечерница азорская. Serbian: Азорски ноћник [= Azorski noć nik]. Scottish Gaelic: Ialtag Asorach. Slovak: Raniak azorský. Slovenian: Azorski mračnik. Swedish: Azorfladdermus. Turkish: Azorlar Akşamcı Yarasası. Ukrainian: Вечірниця азорська. Welsh: Ystlum mawr yr Asores.

SIMILAR SPECIES:
Salgueiro *et al.* (2010: 26) provide a summary of the differences between *N. azoreum* and its closest relative *N. leisleri*. *N. azoreum* is darker and considerably smaller. It is also present in a broader ecological niche, occupying a variety of roosts like buildings, coastal cliffs and trees, whereas *leisleri* is primarily a tree dweller. Finally, it has an echolocation call with a higher peak frequency than its continental counterpart, and it is often active during the day.

CONSERVATION STATUS:
Global - Endangered (EN) (Conenna *et al.*, 2017: Suppl.)
Assessment History -
1994 - VU A2c, B1+2c ver 2.3 (1994).

MAJOR THREATS:
Sherwin *et al.* (2012: 174) identified the small distribution range, the species's aerial hawking feeding style and its long-distance dispersal to be the major risk factors linked with climatic change.

GENERAL DISTRIBUTION:
Nyctalus azoreum is endemic to the archipelago of the Azores, where it is present on seven of the nine islands (Rainho, 2017: 161).

Native: Azores (Palmeirim, 1991; Koopman, 1993a: 216; Speakman and Webb, 1993; Horácek *et al.*, 2000: 133; Salgueiro *et al.*, 2004: 3357; Simmons, 2005: 471; Salgueiro *et al.*, 2006: 169; Salgueiro *et al.*, 2008: 1163).

BIOGEOGRAPHY:
Molecular data suggest that *N. azoreum* originated from a European population of *N. leisleri*, and that the colonisation of the Azores occurred at the end of the Pleistocene (Salgueiro *et al.*, 2006). Salgueiro *et al.* (2006) suggest the minimum divergence time of insular (Azores) and continental lineages is comprised between 0 and 55,000 years BP. This corresponds roughly to a late Pleistocene/Holocene divergence, which is consistent with previous estimates based on demographic parameters (12,000 and 25,000 years BP) calculated by Salgueiro *et al.* (2004). As humans only colonized the Azores less than 600 years ago, molecular estimates of divergence times suggest that the first bats which arrived on the archipelago were unlikely to be brought by man (Salgueiro *et al.*, 2006).

MOLECULAR BIOLOGY:
Moussy *et al.* (2012: 188), referring to Salgueiro *et al.* (2004; 2008), indicate that *N. azoreum* is one of the species that shows significant genetic differentiation and/or haplotype segregation between islands or groups of islands but not within them.

Boston *et al.* (2015) examined the mitochondrial DNA of *N. azoreum* and *N. leisleri* and found that two separate lineages were present and that *N. azoreum* forms one lineage with *N. leisleri* from Britain and Ireland, whereas the second lineage consists of continental European *N. leisleri*.

HABITS:
Speakman and Webb (1993: 28) refer to Moore (1975) to point out that *N. azoreum* is one of those exceptional bats, which fly during the day. Irwin

and Speakman (2003: 185) furthermore found that *N. azoreum* clusters when emering from their roosts. This was quite unexpected as no flying predators are present on the Azores which could capture bats while leaving the roosts.

POPULATION:
Based on a survey, conducted in September-October 1988, Speakman and Webb (1993: 27) estimated the population of *N. azoreum* to consists of between 1,750 (from daytime activity) and 23,650 (from nighttime activity) animals. The latter figure would lead to a population density of 1 bat per 10 ha.

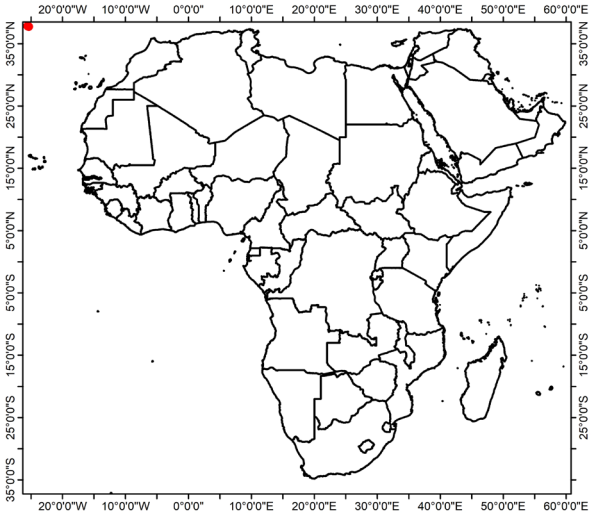


Figure 336. Distribution of *Nyctalus azoreum*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Azores (Portugal).

Nyctalus lasiopterus (Schreber, 1780)

*1780. *Vespertilio lasiopterus* Schreber, in: Zimmerman, Geographische Geschichte der Mensch und Vierfussige Thiere, 2: 412. Type locality: Italy: Northern Italy. - Comments: The type locality indication as "Northern Italy" is uncertain. Horácek *et al.* (2000: 132) mention "? Pisa". - Etymology: From the Greek "*lasios*", meaning hairy and "*pteros*", meaning wing (see Kapteyn, 1995: 154).
1827. *Vespertilio ferrugineus* Brehm, Ornis, 3: 26. Type locality: Germany: Thuringia: Renthendorf.
1868. *V[espertilio noctula] var. sicula* Mina-Palumbo, Cat. Mammif. della Sicilia, 13. Type locality: Italy: Sycily: Le Madonie. - Comments: For restriction to "Le Madonie" see Miller (1913: 80). - Etymology: From the Latin "*siculus*" for Sicily (see Kozhurina, 2002: 18).
1869. *Vesperugo noctula var. maxima* Fatio, Faune des Vertébrés de la Suisse, 1: 57. Type locality: Switzerland: Uri: Amsteg.
2002. *Nyctalus lasiopetrus:* Monsalve, Almenar, Alcocer and Monsorio, Sedeck, 4: 24. (Lapsus)
? *Nyctalus lasiopterus:* (Name Combination, Current Combination)

TAXONOMY:
Reviewed by Corbet (1978: 55 - 56). See Simmons (2005: 471)

COMMON NAMES:
Albanian: Noktulë gjigante. Armenian: Հսկա իրիկնաչղջիկ. Azerbaijani: Nəhəng axşam yarasası. Basque: Gau-saguzar handi. Belarusian: Вячэрніца гіганцкая. Bosnian: Veliki noćni šišmiš. Breton: Nozigell vras. Bulgarian: Голям вечерник. Castilian: Nóctulo gigante, Nóctulo grande. Catalan: Nòctul gegant, Rat penat nóctul gran. Croatian: Veliki već ernjak. Czech: Netopýr obrovský. Danish: Stor brunflagermus. Dutch: Grote rosse vleermuis. English: Giant Noctule Bat, Giant noctule, Greater noctule, Greater Noctule Bat. Estonian: Hiidvidevlane. Finnish: Rusoisolepakko. French: Grande noctule, Noctule géante. Frisian: Grutte reade flearmûs. Galician: Nóctulo xigante. Georgian: გიგანტური მღამურა. German: Riesenabendsegler, Riesen Abendsegler, Großabendsegler. Greek: Μεγάλος νυκτοβάτης. Hungarian: Óriás koraidenevér, Nycteris pterygisti i megali. Irish Gaelic: Ollialtóg nochtúil. Italian: Nottola gigante. Latvian: Lielais vakarsiksparnis. Lithuanian: Didysis nakviša. Luxembourgish: Riseg Bëschfliedermaus. Macedonian: Голем вечерник. Maltese: Noktula Kbir. Montenegrin: Veliki noćnik. Norwegian: Riseflaggermus. Polish: Borowiec olbrzymi. Portuguese: Morcego-arboricola-gigante. Rhaeto-Romance: Sgolanotg gigant. Romanian: Liliacul mare de amurg. Russian: Вечерница гигантская, Гигантская вечерница [= Gigantskaya vechernicha]. Serbian: Велики ноћник [= Veliki noćnik]. Scottish Gaelic: Mòr-ialtag oidhcheach. Slovak: Raniak obrovský. Slovenian: Veliki mračnik. Swedish: Pälsvingad brunfladdermus. Turkish: Büyük Akşamcı Yarasa.

Ukrainian: Вечірниця гігантська. Welsh: Ystlum mwyaf.

CONSERVATION STATUS:
Global - Deforestation, particularly the loss of old trees, is a problem in many parts of the range and is likely to be causing a population decline. The range is fragmented and the colonies tend to be mainly small. Although there are no precise figures on population decline it seems reasonable to list this species as Near Threatened (NT ver 3.1 (2001)) given what is currently known about the threats, the population numbers and the range. Almost qualifies as VU under criteria A4c (Hutson *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - NT ver 3.1 (2001) (Hutson *et al.*, 2008a; IUCN, 2009). 1996 - LR/nt ver 2.3 (1994).

MAJOR THREATS:
Little is known about potential threats, but loss of mature woodland and loss of or disturbance to roost sites (in old trees and buildings) may have a negative impact on the species. Some individuals were found dead at wind farms in Spain (J.T. Alcalde *pers. comm.,* 2006 in Hutson *et al.* (2008a) in IUCN (2009)), and all pups were found dead in 2005 at one of the two known colonies in Spain (located in a city park). The cause of these deaths was not known (J.T. Alcalde *pers. comm.,* 2006 [in Hutson *et al.* (2008a) in IUCN (2009)]). In Spain cutting of old trees, which are used as roosts, is a threat (Hutson *et al.*, 2008a; IUCN, 2009).

Small distribution range, cave/tree roosting, and the aerial hawking feeding style were considered to be risk factors linked with climatic change by Sherwin *et al.* (2012: 174).

CONSERVATION ACTIONS:
Hutson *et al.* (2008a) [in IUCN (2009)] report that it is protected by national legislation in most range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention, in parts of its range where these apply. It is included in Annex IV of EU Habitats and Species Directive. No specific conservation actions are known. It occurs in a number of national parks and protected areas within its range (K. Tsytsulina *pers. Comm.,* 2005). However, in Spain the two known colonies are outside protected areas (J.T. Alcalde *pers. Comm.,* 2006). More information is needed on population size and trends, ecology, and potential threats.

GENERAL DISTRIBUTION:
Nyctalus lasiopterus has a very scattered distribution through central and southern Europe (Iberia to the Balkans, Urals) and north Africa (Morocco [only three records in northwest Morocco, the first of which was reported as *N. noctula* by Laurent (1937d), but see Palmeirim (1982: 402)], Libya [five records in Cyrenaica], and possibly Algeria [possibly one record in Algeria identified as *Nyctalus noctula* by Loche (1867), the specimen is lost]). There are an increasing number of records from Turkey (Karatas *et al.*, 2007). Outside the Mediterranean region the range extends eastwards through Asia Minor to the Caucasus, northern Iran, Kazakhstan and the Urals in Russia. Of the Mediterranean islands, recorded on Sicily. Until 1999, it had been recorded in 120-130 localities in Europe (Benzal, 1999). It occurs up to 1,900 m in Switzerland

Native: Azerbaijan; Belarus; Bulgaria; Cyprus (Benda *et al.*, 2007: 71); Croatia; Czech Republic; France; Georgia; Germany; Gibraltar; Greece; Hungary; Iran, Islamic Republic of; Italy (Sicilia); Kazakhstan; Libyan Arab Jamahiriya; Macedonia, the former Yugoslav Republic of; Moldova; Monaco; Morocco (El Ibrahimi and Rguibi Idrissi, 2015: 363); Poland; Portugal; Romania; Russian Federation; Slovakia; Slovenia; Spain; Switzerland; Turkey; Turkmenistan; Ukraine.
Presence uncertain: Algeria; Andorra; Bosnia and Herzegovina; Uzbekistan.

ECHOLOCATION:
Walters *et al.* (2012: suppl.) report the following figures for 26 calls (22 sequences) from French bats: duration: 22.87 ± 2.92 msec, F_{max}: 17.00 ± 4.68 kHz, F_{min}: 13.28 ± 1.55 kHz, bandwidth: 3.72 ± 3.24 kHz, F_{peak}: 14.29 ± 1.66 kHz.

MOLECULAR BIOLOGY:
Karyotype - Arslan and Zima (2014: 12) reported $2n$ = 42, FNa = 50, FN = 54, a medium-sized metacentric X, and a small acrocentric Y. The autosomal complement contains four large metacentric, one small submetacentric and 15 acrocentric autosomal pairs.

ROOST:
The only specimen found in a roost in Libya by Benda *et al.* (2014c: 87) was in a fist-sized hole in an overhang, some 6 m above the ground. This represented the first non-tree roost site found for this species.

DIET:
In Russia, Smirnov and Vekhnik (2013: 207) found that the diet of *N. lasiopterus* included the following orders of insects: Orthoptera, Coleoptera, Lepidoptera, Diptera, Homoptera, and Neuroptera. They also found an amount of feathers: Out of 14 fecal pellets, the feathers made up 80 - 90 % of the total fecal volume in six pellets, 50 - 60 % in three

pellets, 20 - 40 % in four pellets, and less than 10 % in one pellet.

Andreas (2010: 266) referred to three hypotheses concerning the occurrence of feathers in the bat's feaces: "The first possibility was that *N. lasiopterus* is not able to distinguish between flying feathers and its usual preys and eats a lot of this indigestible material. The second possibility was that *N. lasiopterus* regularly feeds on birds and consumes prey that can represent some 30 % of its body weight on the wing. The third possibility can be a predation in tree hollows.", of which Popa-Lisseanu *et al.* (2007: 1) proved the second to be correct, especially during the migration season of the small passerine birds. Benda *et al.* (2012a: 455) furthermore indicate that carnivory is probably a local and/or seasonal phenomenon.

Digestive tracts from five bats collected in Cyrenaica, Libya, contained moths, carabid beetles, heteropterans, neuropterans, and cockroaches (Benda *et al.*, 2014c: 93). 30 faecal pellets from Cyprus contained mainly Hymenoptera, Auchenorrhyncha and Scarabaeid beetles, and also some moths and heteropterans Andreas (2010: 266).

POPULATION:
Structure and Density - The patchy distribution and low population density in most of range suggest a relatively small global population. Breeding colonies are typically small (up to 35 females), and few are known. Only two larger-sized (50 - 100 females) breeding colonies are known in the world. It is rare throughout the range in the Russian Federation (K. Tsytsulina *pers. comm.,* in Hutson *et al.*, 2008a) [in IUCN, 2009)]). There is a strong population in northern Hungary (Hutson *et al.*, 2008a; IUCN, 2009).
Trend - 2008 - Decreasing (Hutson *et al.*, 2008a; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Tuttle and Stevenson (1982: 123) indicate that females are sexually mature at about four months, and males at about 16 months.
From Japan, Maeda (1972: 270) reported that in captivity, young were born between 26 June and 13 July. Six of the nine captive females had two young each, while the others had one. The dissection of 10 free-living females indicated that seven had twin embryos (one in each uterine horn). Of the fifteen young born in the laboratory, 10 were females, but of eight embryos from free-living females, five were males. This resulted in an overall sex ratio (♂/♀) of 0.77.

POSTNATAL DEVELOPMENT:
Maeda (1972: 272 - 276) reported that twin young were born either naked or with very few hairs on their backs, whereas single young had scattered, thin hairs. The body hair starts to grow from the dorsal side of the rump to the head and to the ventral sides, and reaches the same length as in the adults at about 40 days, but its colour is still darker. For singletons, the eyes opened after four to seven days, but in twins this happened only after seven to 11 days. In some animals there were four days between the opening of one of the eyes and the second. The body size of the single youngs was larger than for twins. Single young grew up to become larger adults. At birth, the young's hind foot already measured 83 % of the adult size, and their thumbs were 77 % of the adult size, whereas the forearm length was only 36 %, and the fingers were even smaller (23, 24 and 27 % respectively for fingers 3, 4 and 5). At 40 to 45 days, the forearm reaches almost adult size. For the fifth finger, this takes 45 to 50 days and for the third and fourth fingers, this is 50 to 55 days. The hind feet and thumbs were almost fully grown after 20 to 28 days. The body weight increases to about 22 to 30 grams at about 30 days after birth and then decreases until the young starts to feed itself. The young started to fly between 40 and 45 days of age.

VIRUSES:
Coronaviridae
Alphacoronavirus
Kohl and Kurth (2014: 3112) report this virus from bats in Spain.

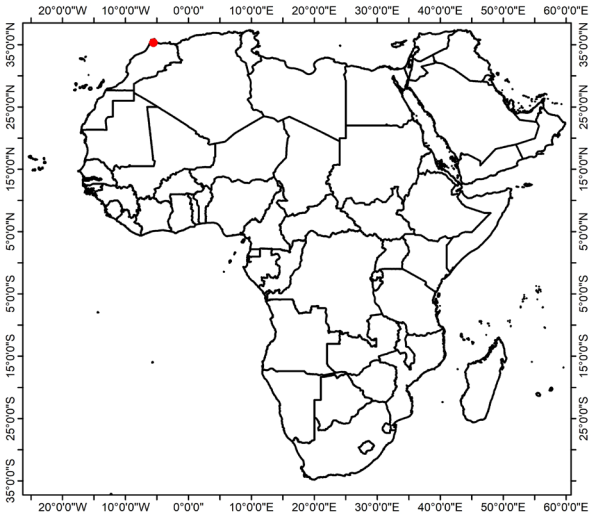


Figure 337. Distribution of *Nyctalus lasiopterus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Morocco.

Nyctalus leisleri (Kuhl, 1817)

*1817. *Vespertilio Leisleri* Kuhl, Die Deutschen Fledermäuse, Hanau, 14, 46. Type locality: Germany: Hessen: Hanau [50 07 N 08 56 E]. Syntype: ZMB 471: skin and skull. See Turni and Kock (2008). Syntype: ZMB 472: skull only. See Turni and Kock (2008). - Comments: Koopman (1992) mentions 1817 as year of publication. Corbet and Hill (1992: 144), however, mention "1819: 46". Baagøe (2001: 90) mentions 1818. - Etymology: In honour of Philipp Achilles Leisler (1772 - 1813) (see Kozhurina, 2002: 16).

1819. *Vespertilio dasykarpos* Kuhl, Die Deutschen Fledermäuse, Hanau, 49. - Comments: Alternative for *leisleri*: see Ellerman and Morrison-Scott (1951: 159).

1825. *Nyctalus verrucosus* Bowdich, Excur. Madeira and Porto Santo, 36, and footnote. Publication date: 1825. Type locality: Madeira (Portugal): "Madeira" [32 44 N 15 58 W] [Goto Description].

1839. *Vespertilio pachygnathus* Michahelles, in: Wagner, Schreber's Säugeth, Suppl. 1: pl. 55b. Type locality: Croatia: Dalmatia.

1906. *Pterygistes madeiræ* Barrett-Hamilton, Ann. Mag. nat. Hist., ser. 7, 17 (97): 98. Publication date: 1 January 1906. Type locality: Madeira (Portugal): "Madeira" [32 44 N 15 58 W] [Goto Description]. Holotype: BMNH 1907.1.1.392: ♀, skull and alcoholic. - Comments: Type specimen procured by Mason, nr 1 Tomes collection (see Barrett-Hamilton, 1906: 99).

? *Nyctalus leisleri:* (Name Combination, Current Combination)

TAXONOMY:
Includes *verrucosus*, see Corbet (1978: 55), who also included *azoreum*; but see Palmeirim (1991) and Salgueiro *et al.* (2006). Based on mitochondrial DNA, Boston *et al.* (2007: 120) indicate that Irish populations belong to the same lineage as *azoreum* and differ from *leisleri* in the rest of Europe, but this is not confirmed by Boston *et al.* (2008).

Simmons (2005: 472) recognises *verrucosus* Bowditch, 1825 as a valid subspecies.

COMMON NAMES:
Albanian: Noktulë e Leisler-it. Armenian: Փոքր իրիկնաչղջիկ. Azerbaijani: Kicik axşam yarasası. Basque: Leisler gau-saguzar. Belarusian: Вячэрніца малая. Bosnian: Mali noćni šišmiš, Mali Lajslerov šišmiš. Breton: Nozigell Leisler. Bulgarian: Лайслеров (малък) вечерник. Castilian: Murciélago nocturno, Noctulo de Leisler, Nóctulo menor, Nóctulo pequeño. Catalan: Rat penat nóctul petit, Nòctul petit. Croatian: Mali večernjak. Czech: Netopýr stromový, Nedopír chlupatopě stný, N. chlupatopestrý, Netopýr Leislerův, Letouň lesní. Danish: Leislers flagermus, Leisler's flagermus. Dutch: Bosvleermuis. English: Leisler's Bat, Lesser Noctule Bat, Lesser noctule, Leisler's noctule, Hairy-armed bat. Estonian: Väikevidevlane. Finnish: Metsälepakko. French: Noctule de Leisler, Petite Noctule, le vespertilion de Leisler. Frisian: Boskflearmûs. Galician: Nóctulo pequeno, Morcego de Leisler. Georgian: მცირე მელამურა. German: Kleinabendsegler, Kleine Abendsegler, Kleiner Abendsegler, Kleine Waldfledermaus, Leislersche Fledermaus. Greek: Μικρονυκτοβάτης Hungarian: Szőröskarú koraidenevér, Szőröskarú denevér, Nycteris pterygisti i mikra. Irish Gaelic: Ialtóg Leisler. Italian: Nottola di Leisler. Latvian: Mazais vakarsikspārnis. Lithuanian: Mažasis nakviša. Luxembourgish: Kleng Bëschfliedermaus. Macedonian: Шумски вечерник [= Shumski Vechernik]. Maltese: Noktula Żgħir. Montenegrin: Šumski noćnik. Norwegian: Vetteflaggermus. Polish: Borowiaczek. Portuguese: Morcego-arboricola-pequeno. Rhaeto-Romance: Sgolanotg pitschen. Romanian: Liliacul mic de amurg. Russian: Вечерница малая, Малая вечерница [= Mapaya vechernicha]. Serbian: Мали ноћник [= Mali noćnik]. Scottish Gaelic: Ialtag Leisler. Slovak: Netopier stromový, Raniak malý. Slovenian: Gozdni mračnik. Swedish: Mindre brunfladdermus, Leislers fladdermus. Turkish: Küçük Ağaç Yarasası. Ukrainian: Вечірниця мала. Welsh: Ystlum Leisler.

CONSERVATION STATUS:
Global - The species is widespread and abundant, and there is no evidence of current significant population decline. Consequently, it is assessed as Least Concern LC ver 3.1 (2001) (Hutson *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Hutson *et al.*, 2008l; IUCN, 2009). 1996 - LR/nt ver 2.3 (1994).

MAJOR THREATS:
Threats include disturbance to and destruction of roosts in trees and buildings, and loss or degradation of foraging habitat. However, these

are not thought to be major threats at present (Hutson *et al.*, 2008l; IUCN, 2009).

The major risk factors related to climatic change were identified by Sherwin *et al.* (2012: 174) as being cave/tree roosting and aerial hawking.

CONSERVATION ACTIONS:
Hutson *et al.* (2008l) [in IUCN (2009)] reported that it is protected by national legislation in most range states. There are also international legal obligations for its protection through the Bonn Convention (Eurobats) and Bern Convention, in parts of its range where these apply. It is included in Annex IV of EU Habitats and Species Directive, and there is some habitat protection through Natura 2000. It occurs in protected areas throughout its range. No specific conservation actions known.

GENERAL DISTRIBUTION:
Nyctalus leisleri is largely a western Palaearctic species (Europe and north-west Africa), with scattered records in the western parts of the eastern Palaearctic (Pakistan, Afghanistan, the Himalayas). It is widely distributed in Europe from southern Scotland and Ireland more or less along southern edge of the Baltic Sea south and parts of Mediterranean coast to western Russia. It is present on Madeira and the Canary Islands (on Tenerife and La Palma only) but absent from southwestern Italy and Sicily, eastern Spain, most of Fennoscandia and northern Russia. In North Africa it is recorded from Mediterranean montane Morocco and Algeria and there is one record from Cyrenaica (Libya). It occurs from sea level to 2,400 m.

Native: Afghanistan; Albania; Algeria (Hanák and Gaisler, 1983: 585; Gaisler, 1984: 89); Andorra; Armenia; Austria; Azerbaijan; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; China; Croatia; Cyprus (Benda *et al.*, 2007: 71); Czech Republic; France (Corse); Georgia; Germany; Gibraltar; Greece; Hungary; India; Iran, Islamic Republic of; Ireland; Italy; Kazakhstan; Latvia; Libyan Arab Jamahiriya (Hanák and Gaisler, 1983: 585); Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Yugoslav Republic of; Moldova; Montenegro; Morocco (Benda *et al.*, 2004d; 2010a: 158; El Ibrahimi and Rguibi Idrissi, 2015: 363); Netherlands; Pakistan; Poland; Portugal (Madeira); Romania; Russian Federation; Serbia; Slovakia; Slovenia; Spain (Canary Is.); Sweden; Switzerland; Turkey; Ukraine; United Kingdom.

BIOGEOGRAPHY:
Molecular data suggest that *N. leisleri* from the Canary Islands probably came from North Africa (Morocco) population (Salgueiro *et al.* (2006).

DENTAL FORMULA:
Matthews (1950: 12) describes the milk dentition, consisting of two trilobed incisors, one canine with one large central lobe and two very small lateral lobes, and two trilobed premolars in the upper cheek. The lower cheek contains two trilobed incisors and one bilobed one, a well developed, trilobed canine, and two trilobed premolars (but the posterior lobe of the second one is very much reduced).

ECHOLOCATION:
For 6 Greek specimens, Papadatou *et al.* (2008b: 132) report a start frequency of 47.5 ± 3.67 kHz, a terminating frequency of 27.0 ± 1.10 kHz, a peak frequency of 31.7 ± 0.87 kHz, and a bandwidth of 12.3 ± 2.96 kHz. The duration of the call is 4.2 ± 1.30 msec, and the interpulse interval is 153.4 ± 62.36 msec.
Walters *et al.* (2012: suppl.) present the following numbers for 76 calls from bats from France, Greece, Switzerland and the UK: duration: 9.39 ± 3.86 msec, F_{max}: 42.20 ± 14.77 kHz, F_{min}: 25.75 ± 2.75 kHz, bandwidth: 16.45 ± 12.45 kHz, F_{peak}: 28.61 ± 5.27 kHz.

Benda *et al.* (2012a: 183) present two series of data for specimens from Iran: **1**: F_{start}, 47.4 ± 4.2 (41.7 - 56.2) kHz, F_{end}: 30.3 ± 0.8 (28.7 - 31.3) kHz, F_{peak}: 34.0 ± 1.1 (31.2 - 35.2) kHz, duration: 3.8 ± 1.1 (2.6 - 6.8) msec, and interpulse interval: 112.8 ± 63.2 (48.2 - 262.9) msec; **2** (hand released): F_{start}: 43.3 ± 2.7 (40.4 - 46.7) kHz, F_{end}: 26.3 ± 0.8 (24.8 - 26.8) kHz, F_{peak}: 28.4 ± 0.4 (28.0 - 28.9) kHz, duration: 6.1 ± 0.3 (5.7 - 6.5) msec, and interpulse interval: 106.2 ± 2.0 (104.9 - 109.3) msec.

MOLECULAR BIOLOGY:
Karyotype - Arslan and Zima (2014: 12) reported $2n$ = 44 + Bs, FNa = 50, FN = 54, a medium-sized metacentric X, and a dot-like acrocentric Y. The autosomal component consists of three large metacentric, one small submetacentric and 17 acrocentric autosomal pairs. They also indicate that this set can also include 1 to 3 dot-like supernumerary chromosomes (Bs). In one Turkish male, Arslan and Zima (2014: 12) furthermore found a dot-like supernumerary chromosome, leading to $2n$ = 45.

Molecular analyses performed by Boston *et al.* (2015: 1) revealed that two distinct mitochondrial DNA lineages are present: an eastern lineage of *N. leisleri* distributed throughout continental

Europe and a western lineage, including *N. leisleri* from Ireland and Britain, but also *N. azoreum* from the Azores.

HABITAT:
In Switzerland, Szentkuti *et al.* (2013: 110) found that foraging *N. leisleri* selected deciduous woodlands over other habitat types (pasture, confirous forest and settlements). They also reported that the bat's nightly mean (± SE) distance travelled was 1,969 ± 1,754 m, and that the maximum distance between the most distant location and the previous roost was on average (4,678 ± 1,082; 1,080 - 13,614 m).

ROOST:
In southern Switzerland, Spada *et al.* (2008: 81) found that *N. leisleri* prefers to roost in live chestnut trees (*Castanea sativa*), with large diameter and in absence of vegetation near the entrance.

DIET:
Kanuch *et al.* (2005: 253) identified seven orders of insects in 154 faecal pellets examined from Slovakian bats. These belonged to the Aphididae (Homoptera), Heteroptera, Chrysopidae (Neuroptera), Coleoptera, Ichneumonidae and Formicidae (Hymenoptera), Lepidoptera, Nematocera and Brachycera (Diptera). The most important group (in both frequency [100 %] and volume [55.7 %]) were Lepidoptera.
Benda *et al.* (2012a: 460 - 461) indicate that European studies showed that this species' diet is relatively variable depending on the foraging habitat. In forests, Lepidoptera and nematoceran Diptera are most often present, whereas in the landscapes with a larger proportion of pastures the dung flies (Scatophagidae) and scarabaeid beetles were more significantly represented. Other groups that were present include Trichoptera, Neuroptera, and Hymenoptera. In more arid habitats in the Middle East, Hymenoptera (Formicoidea), Trichoptera, and Coleoptera (namely Carabidae and Curculionidae) are the main groups present in the diet.

POPULATION:
Structure and Density - It is widespread although patchily distributed in Europe. Common in parts of range (e.g., Ireland), scarce in other parts (Stebbings and Griffith, 1986). Local extinctions have been reported for the central part of Russian Federation (K. Tsytsulina *pers. comm.* 2005), although the species remains common in other parts of Russia and the Caucasus (S. Kruskop *pers. comm.,* 2005). In North Africa it is limited by the distribution of suitable habitat, but is particularly abundant in Djurdjura, NE Algeria (Hutson *et al.*, 2008l; IUCN, 2009).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 16 years.

PARASITES:
The Nematode *Molinostrongylus vespertilionis* Morosov and Spassky, 1961 was reported by Genov *et al.* (1992) from Hungary, Moldova and Ukraine.

Estrada-Peña and Sanchez (1988: 305) described *Steatonyssus (Steatonyssus) balcellsi* from a *N. leisleri* specimen from Frontera, Canary Islands.

In Slovakia, Kanuch *et al.* (2005: 252) reported the presence of the following ectoparasites:
mites: *Steatonyssus spinosus* (family Dermanyssidae), *Macronyssus flavus* (Macronyssidae), *Spinturnix helvetiae* (Spinturnicidae); fleas: *Ischnopsyllus intermedius, I. variabilis* (Ischnopsyllidae); and flies: *Nycteribia latreillii, N. (Acrocholidia) vexata* (Nycteribiidae).
They found that 100 out of 177 (56.5 %) of the examined bats carried at least one parasite, but only 15.3 % of these had two different species of parasites. Only *S. spinosus* and *S. helvetiae* were found abundantly (resp. 31.3 and 55.4 %), all other species occurred on less than 5 % of the bats.

VIRUSES:
Coronaviridae
Alphacoronavirus
This virus was reported from bats from Germany by Kohl and Kurth (2014: 3112).
Betacoronavirus
The virus was reported by Kohl and Kurth (2014: 3112) from Bulgaria and Germany.

Orthomyxoviridae
Despite sampling and testing of 64 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

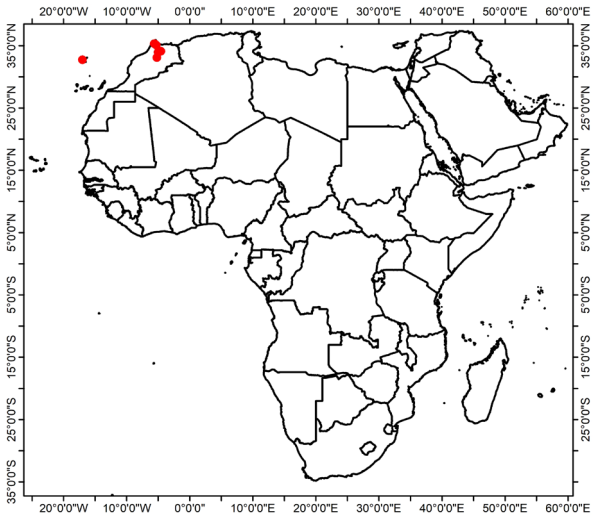


Figure 338. Distribution of *Nyctalus leisleri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS: "Africa", Azores (Portugal), Madeira (Portugal), Morocco.

Genus ***Nycticeinops*** Hill & Harrison, 1987

*1987. *Nycticeinops* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 254. - Comments: Type species: *Nycticejus schlieffeni* Peters, 1859. - Etymology: Lanza *et al.* (2015: 364) mention the following: "masculin scientific Latin substantive made up of the masculine scientific Latin substantive *Nycticeius* (Nicticèius) and the feminine Greek substantive "*ὄφις*" (ópsis) 'aspect, appearance', referring to the likeness of the genus *Nycticeinops* to the genus *Nycticeius*, The etymology proposed by Hill and Harrison (1987) is imperfect". (Current Spelling)

TAXONOMY:
Bronner *et al.* (2003) state that the genus *Nycticeius* has long been considered to comprise two species: *N. humeralis*, from North America, and *N. schlieffenii* from Africa and Arabia. Koopman (1978) found these species so similar that he retained them in the same genus, a treatment disputed by Kitchener and Caputi (1985). Hill and Harrison (1987) demonstrated consistent differences between these species in baculum morphology and proposed the allocation of *schlieffeni* to the distinct genus *Nycticeinops*. Extensive karyotypic differences between the American *humeralis* (2*n* = 46 and FN = 48; Baker and Patton, 1967; Bickham, 1979) and East African *schlieffeni* (2*n* = 34 and FN = 52) provide additional evidence that the two species are not congeneric (Ruedas *et al.*, 1990) and mtDNA sequence divergence data strongly support their allocation to distinct genera (Hoofer and Van Den Bussche, 2001). However, Rautenbach *et al.* (1993) report an intermediate karyotype of 2*n* = 42 and FN = 50 for *schlieffeni* from South Africa. This not only suggests the existence of two species in Africa, but also casts some doubt on the karyotypic basis for generic distinction between these forms. We nevertheless recognise these as distinct genera owing to clearcut differences in bacular and mtDNA properties.

Meester *et al.* (1986) state that *Scoteinus* Dobson, 1875 has frequently been included in this genus for the species *schlieffenii*, either as a subgenus (Ellerman *et al.*, 1953; Hayman and Hill, 1971), or as a synonym (Rosevear, 1965). Allen (1939a) and Roberts (1951) regard *Scoteinus* as a valid genus, which includes *schlieffenii*. However, Sinha and Chakraborty (1971) place *Nycticeius emarginatus* (Dobson, 1871), the type species of *Scoteinus*, in the distinct Indo-Malayan genus *Scotomanes*, and Koopman (1975, 1978) accordingly regards *schlieffenii* as a *Nycticeius* sensu stricto.

Known species of the genus *Nycticeinops*: ***schlieffeni*** (Peters, 1859), ***†serengetiensis*** Gunnell, Butler, Greenwood and Simmons, 2015.

COMMON NAMES:
Czech: Schlieffenovi netopýři. English: Twilight bats. French: Nycticeinops. German: Abendfledermäuse. Italian: Nitticèinopi, Nicticèinopi.

†***Nycticeinops serengetiensis*** Gunnell, Butler, Greenwood and Simmons, 2015

*2015. *Nycticeinops serengetiensis* Gunnell, Butler, Greenwood and Simmons, Am. Mus. Novit., 3846: 1, 17, figs 9C-H, 10. Publication date: 16 December 2015 [Goto Description]. - Etymology: Named for the famed Serengeti region in northern Tanzania where Olduvai Gorge is located (Gunnell *et al.* (2015a: 18).

SIMILAR SPECIES:
The teeth of *N. serengetiensis* are on average 20 % larger than those of *N. schlieffeni*.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe: Pleistocene.

Nycticeinops schlieffenii (Peters, 1859)

*1859. *Nycticejus Schlieffenii* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, p. 224. Type locality: Egypt: Cairo [30 03 N 31 15 E] [Goto Description]. Holotype: ZMB 585: ad ♂, alcoholic and cranium only (no mandibula). Collected by: Graf Afred von Schlieffen. See Turni and Kock (2008: 53). - Comments: Allen (1939a: 97) mentioned 1860 as year of publication, Kock (1969a: 186) mentions 1859. The publication covers a meeting held on 28 February 1859. - Etymology: In honour of the collector Count Wilhelm von Schlieffen-Schlieffenburg (Smithers, 1983: 111). Johnston (2006: 3) mentions Schlieffen-Schlieffiennburg. Lanza *et al.* (2015: 366) [referring to Beolens *et al.* (2009)] mention Graf Wilhelm Schlieffen von Schlieffenberg (1833 - ?).

1877. *N[ycticejus] adovanus* Heuglin, Reise in Nordost Afrika, 2: 34. Publication date: 1877. Type locality: Ethiopia: Tigre province: As(s)am river: Adowa [14 10 N 38 54 E, 1 900 m] [Goto Description].

1887. *Scotophilus minimus* Noack, Zool. Jb. Syst., 2 (2): 280, pl. 10, fig. 36 - 37. Publication date: 7 May 1887. Type locality: Tanzania: (formerly indicated as in Democratic Republic of the Congo): Marungu: Qua Mpala [06 43 S 29 31 E] [Goto Description]. - Comments: Kock (1969a: 187), Meester *et al.* (1986: 62) situate Qua Mpala in the Democratic Republic of the Congo, not in Tanzania. Noack (1887: 280) refers to the type specimen as a female with separate skull.

1905. *Scotophilus schliefferri:* Schwann, Novit. Zool., 12 (1): 1. (Lapsus)

1908. *Scoteinus schlieffeni albiventer* Thomas and Wroughton, Proc. zool. Soc. Lond., 1908, III: 540. Publication date: 30 October 1908. Type locality: Sudan: Northern province: Naikhala.

1908. *Scoteinus schlieffeni australis* Thomas and Wroughton, Proc. zool. Soc. Lond., 1908, III: 539. Publication date: 30 October 1908. Type locality: Mozambique: 120 km SW Inhambane: Coguno [24 23 S 34 32 E] [Goto Description]. - Comments: Considered a valid subspecies of *Nycticeius schlieffeni* by Taylor (1998: 56).

1908. *Scoteinus schlieffeni bedouin* Thomas and Wroughton, Proc. zool. Soc. Lond., 1908, III: 540. Publication date: 30 October 1908. Type locality: : Jemen, Aden, Lahej.

1911. *Nycticeius africanus* G.M. Allen, Bull. Mus. comp. Zool., 54 (6): 328. Publication date: December 1911. Type locality: Kenya: Northern Guaso Nyiro: Meru River: effluent of northern Guaso Nyiro [=Ewaso Ngiro] [00 03 N 37 39 E] [Goto Description]. Holotype: MCZ 8272: ♂, skin and skull. Collected by: Glover Morrill Allen; collection date: 11 August 1909; original number: 113. See Allen (1911: 328); Helgen and McFadden (2001: 147). - Comments: Thorn *et al.* (2009: 57) mention 00 29 N 37 40 E as coordinates for the type locality.

1916. *Scotoecus cinnamomeus* Wettstein, Anz. kais. Akad. Wiss., Wien, 53: 191. Publication date: 1916. Type locality: Sudan: Kordofan province: Nubbaka [=En Nabbaka] [12 35 N 29 55 E] [Goto Description]. - Comments: Thorn *et al.* (2009: 57) mention 12 47 N 30 46 E as coordinates for the type locality. Type specimen: ♀, collected by Prof. Dr. Franz Werner, collection date 17 March 1914. Two cotypes [= paratypes], 1 ♀ from Nubbaka, collection date 17 March 1914; 1 ♀ from Dilling, collection date: 20 March 1914 (see Wettstein, 1916: 191).

1926. *Scoteinus schleiffeni:* Cabrera and Ruxton, Ann. Mag. nat. Hist., ser. 9, 17 (103): 594. Publication date: 1 May 1926. (Lapsus)

1932. *Scoteinus schlieffenii fitzsimonsi* Roberts, Ann. Transv. Mus., 15 (1): 17. Publication date: 1 October 1932. Type locality: Botswana: N Bechuanaland, Ngamiland,: Tsotsoroga Pan [18 40 S 24 25 E] [Goto Description]. Holotype: TM 6550: ad ♂, skin and skull. Collected by: The Vernay-Lang Kalahari Expedition 1930; collection date: 19 June 1930; original number: 833. . Cotype: TM 6551: ad ♂, skin and skull. Collected by: The Vernay-Lang Kalahari Expedition 1930; collection date: 19 June 1930; original number: 830.
2010. *Nycticeinops schlieffeni:* Monadjem, Taylor, Cotterill and Schoeman, Bats of Southern and Central Africa. A biogeographic and taxonomic synthesis. Wits University Press, Johannesburg, 486. (Alternate Spelling)
2012. *Nycticeinops schilieffeni:* Manga Mongombe, Master's thesis. University of Maroua, Cameroon, 12. (Lapsus)
2016. *Nycticeius schleifeni:* Mikula, Morelli, Lucan, Jones and Tryjanowski, Mammal Rev.. Publication date: 20 January 2016. (Lapsus)
? *Nycticeinops schlieffeni albiventer:* (Name Combination)
? *Nycticeinops schlieffeni fitzsimonsi:* (Name Combination)
? *Nycticeinops schlieffeni schlieffeni:* (Name Combination)
? *Nycticeinops schlieffenii:* (Name Combination, Current Combination)
? *Nycticeius (Scoteinus) schleiffenii:* (Name Combination)
? *Nycticeius schlieffeni australis:* (Name Combination)
? *Nycticeius schlieffeni:* (Alternate Spelling)
? *Nycticeius schlieffenii:* (Name Combination)

TAXONOMY:



Figure 339. A female *Nycticeinops schlieffenii* (TM 48141) caught at Makalali-GR, Limpopo, South Africa.

Includes *cinnamomeus*; see Koopman (1975: 412 - 413). Assigned to the genus *Nycticeinops* by Harrison and Bates (1991: 94) and Hutson *et al.* (2001: 29), which is considered a subgenus of *Nycticeius* by Pavlinov *et al.* (1995: 116).

COMMON NAMES:
Afrikaans: Schlieffen se vlermuis, Schlieffen-vlermuis, Klein dakvlermuis. Chinese: 施氏墓蝠. Czech: netopýr Schlieffenův, netopýr krátkouchý. Dutch: Schlieffens vleermuis. English: Schlieffen's Bat, Schlieffen's Twilight Bat. French: Nycticeinops de Schlieffen, Chauve-souris du crépuscule, Chauve-souris de Schlieffen. German: Schlieffens Abendfledermaus. Italian: Nitticèinope di Schlieffen, Nicticèinope di Schlieffen. Kiluba (DRC): Kasusu. Portuguese: Morcego de Schlieffens.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Butler and Greenwood (1965) found material in the early Pleistocene at Olduvai, which they referred to as "cf *Nycticeius* (*Scoteinus*) *schlieffeni* (Peters)" (see Butler (1978).

CONSERVATION STATUS:
Global - Widespread and rather common, with no major threats. Assessed as Least Concern LC ver 3.1 (2001) (Jacobs *et al.*, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [as *Nycticeinops schlieffeni*] (Jacobs *et al.*, 2008b; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004am; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016o). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
None known (Jacobs *et al.*, 2008b; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008b; IUCN, 2009).

GENERAL DISTRIBUTION:
Distribution is split into two: one range in W Africa (including N Senegal, S Mauritania, Burkina Faso, Togo, Benin, and Nigeria), and one covering much of E and S Africa (as far south as NE Swaziland). The species is absent from much of the Horn of Africa, NE Ethiopia, E Tanzania, and NE Mozambique. There is a smaller central African range in NE Democratic Republic of the Congo (DRC). There are also records from Niger, Central

African Republic (CAR), and the Nile delta in Egypt.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 1,003,159 km^2. Babiker Salata (2012: 50) indicated that the distribution in the RSA is mostly affected by the annual mean temperature.

Native: Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 570; Taylor *et al.*, 2018b: 63); Benin (Capo-Chichi *et al.*, 2004: 163); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 570); Burkina Faso (Kangoyé *et al.*, 2015a: 621); Cameroon; Central African Republic; Chad; Congo (The Democratic Republic of the) (Noack, 1887; Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 570); Djibouti (Pearch *et al.*, 2001: 388); Egypt; Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 147); Ghana; Kenya; Malawi (Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 570); Mali (Meinig, 2000: 105); Mauritania (Allegrini *et al.*, 2011: 3); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 570; Monadjem *et al.*, 2010c: 384); Namibia (Monadjem *et al.*, 2010d: 571); Niger; Nigeria; Saudi Arabia; Senegal; Somalia; South Africa (Monadjem *et al.*, 2010d: 571); Sudan; Swaziland (Monadjem *et al.*, 2010d: 571); Tanzania; Togo; Uganda (Kityo and Kerbis, 1996: 62); Yemen (Benda *et al.*, 2011b: 41); Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 571); Zimbabwe (Monadjem *et al.*, 2010d: 571).

GEOGRAPHIC VARIATION:
Koubínová *et al.* (2013: 9) indicate that *N. schlieffenii* is distributed in three areas in Africa: West, East, and South (respectively represented by Senegal, Somalia, and South Africa in their study) and found that the West and East areas differed in karyotype from the South, and that West and East differed in their *S12* gene.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
Scott *et al.* (2012: 2943) report that the mandibular symphyse is fully fused in *N. schlieffenii*.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

SEXUAL DIMORPHISM:
In Burkina Faso, Kangoyé *et al.* (2015a: 621) found the average body (except Tragus and 3ph3) and cranial (except CM) measurements in females to be larger than in males.

ECHOLOCATION:
See Taylor (1999b) and Taylor *et al.* (2005).

From Maroua, Cameroon, Manga Mongombe (2012: 79) reported a FM call type for 1 call and the following parameters: F_{max}: 51.3 kHz, F_{min}: 40.0 kHz, F_{mean}: 45.7 kHz, F_{knee}: 51.3 kHZ, F_{char}: 41.0 kHz, and duration: 0.91 msec.

In Swaziland, Monadjem *et al.* (2017c: 179) recorded F_{min}: 40.1 ± 1.48 (38.7 - 42.4) kHz, F_{knee}: 43.4 ± 1.67 (41.7 - 45.4) kHz, F_c: 40.3 ± 1.29 (39.2 - 42.4) kHz and duration: 3.1 ± 0.64 (2.4 - 4.0) msec. They could detect the calls up to a distance of 15 m.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003).

Karyotype - Ruedas *et al.* (1990) reported 2*n* = 34, FN = 52, and BA = 20, for specimens from Somalia, whereas Rautenbach *et al.* (1993) reported 2*n* = 42, FN = 50, and BA = 10, for specimens from South Africa. However, both Ruedas *et al.* (1990) and Rautenbach *et al.* (1993) reported submetacentric X, and acrocentric Y chromosomes. Unfortunately, Rautenbach *et al.* (1993) do not identify the actual voucher specimens associated with the work, since further work should be done to ascertain whether this variation is an indication of two distinct species.

From Senegal, Koubínová *et al.* (2013: 3) report the following karyotype for 4 ♂♂ and 1 ♀: 2*n* = 34, Fna = 52, FN = 56, X = metacentric, Y = dot-like. They also found a 5.56 - 5.91 % difference in the *12S* gene as compared with conspecifics from other areas available in GenBank.

Protein / allozyme - Unknown.

HABITAT:
In southern Africa, it primarily occurs in Savanna habitats (86 %; Cooper-Bohannon *et al.*, 2016: Tabls S2).

PREDATORS:
Nyffeler and Knörnschild (2013: 4) refer to Happold *et al.* (1988: 369) for one of two records of an identified African bat becoming entangled in a spider's web (the other being *Neoromicia nana*).

Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - Rather common (Jacobs *et al.*, 2008b; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008b; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
van der Merwe and Rautenbach (1987: 41) reported that in *N. schlieffenii* spermatogenesis occurs over a 10-month period with the first signs of spermatozoa in the epididymides by the end of April. From the end of April until the beginning of September, they found spermatozoa in the epididymides. Copulation begins during June (early winter in Transvaal) and the females have spermatozoa in the uterine horns from then until the end of August (late winter) when ovulation occurs. *N. schlieffenii* is seasonally monoestrous and most of the births occur in November.

van der Merwe and Rautenbach (1986: 48; 1990: 540) reported that "*Nycticeius schlieffeniii*" commonly gives birth to twins and occasionally even triplets. For 11 females, they found an average of 3.1 corpora lutea and 2.8 fetuses.

PARASITES:
HEMIPTERA
Cimicidae: *Aphrania recta* Ferris and Usinger, 1957 recorded 35 miles east of Kordofan, Sudan (Haeselbarth *et al.*, 1966: 11).

DIPTERA
Ischnopsyllidae: *Lagaropsylla consularis* Smit, 1957. Traditional host being Molossid Bats, but has been recorded from this taxa (Haeselbarth *et al.*, 1966: 1990). *Lagaropsylla idea* Smit, 1957, of which the primary host are molossids but recorded from this taxon (Haeselbarth *et al.*, 1966: 190).

SYPHONAPTERA
Hastriter (2016: 18) reported the flea *Lagaropsylla idae* Smit, 1957 from a *N. schlieffenii* specimen from Majo Moto, Kenya.

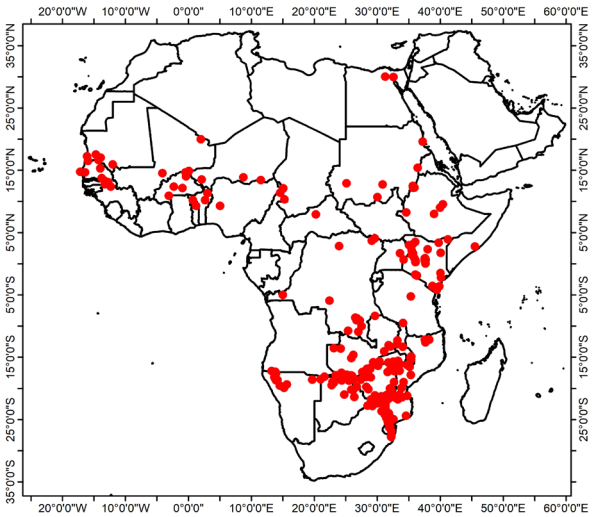


Figure 340. Distribution of *Nycticeinops schlieffenii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Botswana, Burkina Faso, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Côte d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Senegal, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Nycticeinops "incertae-sedis"

2013. *Nycticeinops cf. schlieffenii:* Koubínová *et al.*, Front. Zool., 10: 1-48. - Comments: Koubínová *et al.* (2013: 7) found found differences in dipoloid chromosome number and/or in chromosome morphology between the populations from Senegal and other regions in Africa. (Name Combination)

Genus ***Otonycteris*** Peters, 1859

*1859. *Otonycteris* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 223. Publication date: 1859 [Goto Description]. - Comments: Type species: *Otonycteris hemprichi* Peters, 1859. This publication covers a meeting held on 28 February 1859. - Etymology: From the Greek "*ούς*" or "*ώτός*", meaning ear and "*νυκτερις*", meaning bat (see Palmer, 1904: 489; Gharaibeh and Qumsiyeh, 1995: 3). (Current Combination)

TAXONOMY:
Koopman (1993a) and McKenna and Bell (1997) placed it in the tribe Nycticeini, but recent phylogentic analysis have grouped this taxon within the tribe Plecontini (Bogdanowicz *et al.*, 1998; Qumsiyeh and Bickham, 1993; Simmons, 2005: 481). Pine *et al.* (1971) and Hoofer and Van Den Bussche (2001) who suggest a close relationship between *Otonycteris* and *Antrozous* which presently is within the subfamily Antrozoinae (Simmons, 2005). Simmons (2005: 498) places the subfamily Antrozoinae within the

Vespertilionidae based on recent molecular studies based on DNA sequence data (Hoofer and Van Den Bussche, 2001), a placement in line with more traditional classifications (Miller, 1897; Hill and Smith, 1984; Koopman, 1993a, 1994; McKenna and Bell, 1997). But, Simmons (1998) who raised this group to to family level also moved it to the family Molossidae. Simmons (2005: 498) retained Antrozoinae as a subfamily level within the Vespertilionidae, but its placement is unclear and further studies are needed to clarify it.

Miller (1907) suggested *Otonycteris* shares relationships with *Eptesicus*, *Scoetocus* and *Scotomanes*. Hill and Harrison (1987) included *Otonycteris* in the Plecotini but included *Rhogeessa*, *Baedon*, and *Nycticeis*. While Koopman (1993a) suggested that the genus *Otonycteris* is a distinct genus with no relationship to other vespertilionidae species.

Earlier systematics recognised six species, which Ellerman and Morrison-Scott (1951) synonomised all recognised forms within a single species *O. hemprichii*. Benda and Gvoždík (2010: 97) showed using morphological and molecular data, that a second species should be recognised *O. leucophaea* (Severcov, 1873) from central Asia.

Known species of the genus *Otonycteris*: ***hemprichii*** Peters, 1859.

COMMON NAMES:
Czech: pustinní ušani. English: Desert Bats, Desert Long-eared Bats, Long-eared Desert Bats, Desert Big-eared Bats. French: Oreillards du désert. German: Wüsten-Großohren.

GEOGRAPHIC VARIATION:
Benda and Gvoždík (2010: 87) using morphological comparison across the entire genus range supports the existance of three morphotypes which correspond to their geographic origin:
O. h. hemprichii Peters, 1859 - small and medium-sized bats from North Africa and the Levant with relatively wide and short rostra, wide braincases, large tympanic bullae and high coronoid processes of the mandible and rather small and robust bacula.
O. h. cinerea Satunin, 1909 and *O. h. jin* Cheesman and Hinton, 1924 - large bats from Iran and Saudi Arabia with relatively narrow and short rostra, narrow braincases, large tympanic bullae and high coronoid processes of the mandible and rather small, robust bacula.
O. leucophaea (Severcov, 1873) - medium-sized bats from Central Asia with relatively wide and long rostra, medium-wide braincase, small tympanic bullae, and low coronoid process of the mandible and rather large and narrow bacula.

Otonycteris hemprichii Peters, 1859

*1859. *Otonycteris Hemprichii* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 223. Publication date: 1859. Type locality: Egypt: Nile Valley S of Assuan (Egypt) & Chondek (Sudan) [Goto Description]. Syntype: ZMB 441: skull in skin. Collected by: Friedrich Wilhelm Hemprich and Christian Gottfried Ehrenberg; collection date: September 1821 - 21 July 1822. See Qumsiyeh (1985: 59); Turni and Kock (2008). Syntype: ZMB 442: skull in skin. Collected by: Friedrich Wilhelm Hemprich and Christian Gottfried Ehrenberg; collection date: September 1821 - 21 July 1822. See Qumsiyeh (1985: 59); Turni and Kock (2008). - Comments: This publication covers a meeting held on 28 February 1859. Type locality restricted by Kock (1969a: 183 - 184), since originally no locality was given. - Etymology: In honour of Friedrich Wilhelm Hemprich (1796 - 1825) (see Kozhurina, 2002: 15). (Current Combination)

1866. *Plecotus ustus* Fitzinger and Heuglin, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 546. Publication date: 1866. Type locality: Sudan: Northern province: Wadi Halfa [21 55 N 31 20 E]. Holotype: NMW 8604: skull only. Collected by: Theodor Von Heuglin. See Benda and Gvoždík (2010: 101). - Comments: *Nomen nudum*: see Anderson and de Winton (1902: 118), Ellerman and Morrison-Scott (1951: 180), Allen (1939a: 93), Kock (1969a: 183), Qumsiyeh (1985: 59), Gharaibeh and Qumsiyeh (1995: 1).

1902. *Otonycteris petersi* Anderson, Zoology of Egypt: Mammalia. Revised and completed by W.E. de Winton, F.Z.S. Hugh Ress, Ltd., London, 120. Type locality: Iraq: Fao: Persian Gulf.

1909. *Otonycteris cinereus* Satunin, Materials on the knowledge of mammals of Caucasus and Transcaspian Regions, XII-XVI. Izvestiya Kavkazskago Muzyeya (Tiflis). [in Russian, with German summary], 4: 281. Type locality: : "Nukendzag, Ge country, Persian Beluchestan". - Comments: Nevertheless, Ognev (1928: 579) restricted the type locality to "Zirkuh country, near Bamrud, Khorasan" (= Zarakkuh country, near Bamrud, Khorassan,

E Iran) and this change was accepted by subsequent authors (Etemad, 1967, 1969; DeBlase, 1980; Baranova et al., 1981; Gharaibeth and Qumsiyeh, 1995).

1924. *Otonycteris jin* Cheesman and Hinton, Ann. Mag. nat. Hist., Series 9, 14: 549. Type locality: Saudi Arabia: Hasa: Hufuf.

1936. *Plecotus auritus saharae* Laurent, Bull. Soc. Hist. nat. Afr. Nord, 27: 408, fig. Publication date: December 1936. Type locality: Algeria: El Goléa [30 35 N 02 53 E].

? *Otonycteris hemprichi hemprichi:* (Alternate Spelling)

? *Otonycteris hemprichi:* (Alternate Spelling)

? *Otonycteris hemprichii cinerea:* (Name Combination)

? *Otonycteris hemprichii hemprichii:* (Name Combination)

? *Otonycteris hemprichii jin:* (Name Combination)

? *Otonycteris hemprichii:* (Current Spelling)

TAXONOMY:

Reviewed by Harrison and Bates (1991), Horácek (1991), Bates and Harrison (1997) and Benda and Gvoždík (2010).

Most of the forms currently attributed to the species rank of *O. hemprichii* (Simmons, 2005: 481), were originally described as separate species: *O. petersi* Anderson, 1902 (Anderson and de Winton, 1902; Kinnear, 1916; Bianchi, 1917; Cheesman and Hinton, 1924; Ognev, 1928); *O. cinerea* Satunin, 1909 (Bobrinskoy, 1925; Noack, 1887; Kuzyakin, 1950, 1965; Strelkov, 1963; Strelkov *et al.*, 1978). Ellerman and Morrison-Scott (1951) synonomised all recognised forms within *Otonycteris* into a single species *O. hemprichii*, with tree subspecies (*hemprichii, cinerea, jin*), but marked this combination with a question mark. Kock (1969a: 183) did not recognise any subspecies within *O. hemprichii*. Although Corbet (1978: 59) recognised five valid subspecies (*hemprichii, jin, petersi, leucophaeus, cinerea*, he noted that "it seems likely that variation will prove to be continuous throughout the range". While Nader and Kock (1983c) stated that pelage coloration was inadequate for subspecies definition, Horácek (1991) and Horácek *et al.* (2000: 133) carried out a partial analysis of geographic variation where they found that the differences in pelage coloration and size was clinal, and did not support the recognition of separate subspecies. Benda *et al.* (2006) performed a simple comparison of a set of *Otonycteris* specimens from North Africa and the Middle East, which showed clear morphotypes that confirmed categorial variation recognising two subspecies (*hemprichii, cinerea*). In the past, five subspecies have been recognized (Atallah, 1977; Ellerman and Morrison-Scott, 1951; Harrison and Bates, 1991; Gharaibeh and Qumsiyeh, 1995; Koopman, 1993a) - the nominotypical form *O. h. hemprichii* Peters, 1859, *O. h. leucophaeus* (Severcov, 1873); *O. h. cinerea* Satunin, 1909; *O. h. petersi* Anderson, 1902; and *O. h. jin* Cheesman and Hinton, 1924.

Benda and Gvoždík (2010), examining both morphological and molecular data, concluded that one of the previously recognized subspecies, *O. h. leucophaeus* (Severcov, 1873), should be elevated to full species rank *O. leucophaea* (Severcov, 1873), from central Asia. In *Otonycteris hemprichii*, they recognized three distinct subspecies: *O. h. hemprichii* Peters, 1859 from North Africa, Levant and Mesopotamia; *O. h. cinerea* Satunin, 1909, from the mountainous areas of eastern Arabia and Iran; and *O. h. jin* Cheesman and Hinton, 1924, from the lowland deserts of eastern Arabia and southeasternmost Iran.

COMMON NAMES:

Albanian: Lakuriq nate veshgjatë i Hemprich-it. Arabian: Khafash abiad, Khaffash. Armenian: Սպիտակափոր սրականջ. Azerbaijani: Ağqarın oxqulaq yarasa. Basque: Hemprich belarrihandi. Belarusian: Стрэлавух Хемрыха. Bosnian: Hemprihov dugouhi šišmiš. Breton: Skouarnegell Hemprich. Bulgarian: Пустинен дългоух прилеп. Castilian: Orejudo de Hemprich. Catalan: Orellut d'Hemprich. Croatian: Hemprichov dugouhi šišmiš. Czech: Netopýr pustinný (ušan pustinný). Danish: Storøret flagermus. Dutch: Woestijngrootoorvleermuis. English: Hemprich's Long-eared Bat, Hemprich's Desert Bat, Hemprich's Desert Long-eared Bat, Hemprich's Long-eared Desert Bat, Long-eared Desert Bat, Desert Long-eared bat, Hemprich's Arrow-headed Bat, Hemprich's Big-eared Bat, Hemprich´s arrow-eared bat. Estonian: Suur-teravkõrv. Finnish: Aavikkolepakko. French: Chauve-souris à oreilles pointues de Hemprich, Oreillard d'Hemprich. Frisian: Woastyngrutearflearmûs. Galician: Orelludo de Hemprich. Georgian: ჰემპრიხის ისარყურა. German: Wüsten-Großohr, Hemprichs Wüstengroßohr. Greek: Ωτονυχτερίδα της ερήμου. Hebrew: Udnan. Hungarian: Sivatagi hosszúfülű-denevér. Irish Gaelic: Ialtóg fhadchluasach Hemprich. Italian: Orecchione di Hemprich. Latvian: Hempriha sikspārnis. Lithuanian: Strėliaausis lygianosis. Luxembourgish: Wüstegroussouer. Macedonian:

Хемпричиев долгоушест лилјак. Maltese: Farfett il-Lejl Widnejħ Twal tad-Deż ert. Montenegrin: Pustinjski š korpiojed. Norwegian: Orkenlangøre. Polish: Uszorek pustynny. Portuguese: Morcego de Hemprich. Rhaeto-Romance: Ureglia lunga da Hemprich. Romanian: Liliacul urecheat de desert. Russian: Стрелоух белобрюхий. Serbian: Пустињски дугоушан [= Pustinjski dugoušan]. Scottish Gaelic: Ialtag fhad-chluasach Hemprich. Slovak: Večernica šípouchá. Slovenian: Škorpjonojedi pušcavež. Swedish: Okenlångöra. Turkish: UzunkulaklıÇöl Yarasası. Ukrainian: Стріловух білочеревий. Welsh: Ystlum hirglust Hemprich.

CONSERVATION STATUS:
Global - This is a relatively common species in desert and sub-desert habitats of the SW Palaearctic. It has a presumed large population, but the current trend is unknown. However, if it is in decline, it is unlikely to be at a rate which would qualify it for inclusion in the threatened categories. There are no major threats to the species, although it may be affected by pesticides in some parts of its range. Therefore, it is listed as Least Concern (LC ver 3.1 (2001)) (Benda *et al.*, 2008c; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Benda *et al.*, 2008c; IUCN, 2009). 1996 - LR/lc [as *Otonycteris hemprichi*.

MAJOR THREATS:
Although not a major threat this species is affected by pesticides (Benda *et al.*, 2008c; IUCN, 2009). Sherwin *et al.* (2012: 174), furthermore, list the small distribution range, water stress and the aerial hawking feeding style to be the risk factors related to climatic change. Bilgin *et al.* (2012: 434) predict that climatic change will result in a major range contraction for *O. hemprichii*.

CONSERVATION ACTIONS:
Benda *et al.* (2008c) [in IUCN (2009)] report that the species presumably occurs in some protected areas across its range. No other specific measures are known, although it will be protected under national legislation in some of the range states. A study on the impacts of pesticides is required, especially ways in which the impact might be minimised.

GENERAL DISTRIBUTION:
Otonycteris hemprichii occurs in the southern desert and sub-desert belt of Western and Central Palaearctic from Morocco and Niger as far east as north-west India. It is possibly present in the whole of the desert area in the north of Africa where there is suitable habitat. In the Mediterranean region it is recorded from Morocco, Algeria, Tunisia, Libya, Niger, northern Sudan and Egypt. In the Middle East it is found in Israel, Palestine, Jordan, Lebanon, Syria and a single locality from southeastern Turkey. It has an area of occupancy of >20,000 km^2 and occupies an altitude of up to 2,400 m (in Pakistan).
Albayrak and Asan (1999: 65) mention one specimen from a locality in southern Turkey.

Benda and Gvoždík (2010: 95) allocate specimens previously refered to *O. hemprichii* from Central Asian should be rather refered to *Otonycteris leucophaea* (Severcov, 1873).

Native: Afghanistan; Algeria; Egypt; Iran, Islamic Republic of; Israel; Jordan; Kazakhstan; Libyan Arab Jamahiriya; Morocco (Benda *et al.*, 2010a: 158; El Ibrahimi and Rguibi Idrissi, 2015: 363); Niger; Oman; Qatar; Saudi Arabia; Sudan; Syrian Arab Republic; Tajikistan; Tunisia (Dalhoumi *et al.*, 2016b: 867); Turkey; Turkmenistan; United Arab Emirates (Anonymus, 2008: 38); Uzbekistan.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
In their study on the reversibility of the mandibular symphyseal fusion, Scott *et al.* (2012: 2943) mention that this symphyse is fully fused in *O. hemprichii*.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987), and Benda and Gvoždík (2010: 93). Benda and Gvoždík (2010: 87) found that the bacula from different parts of the distribution range were very similar in shape. The bones are simple, dorso-ventrally flattened, crescent-shaped sticks. The baculum length were 2.47 - 3.31 mm long. Slightly differing specimens, originating in northeastern Iran and Kirghizstan, possessed larger bacula (length= 3.02 - 3.31 mm), relatively narrower and in most cases also slightly less curved than bacula from other parts of the range (baculum length = 2.47 - 2.96 mm) (Benda and Gvoždík, 2010: 87).

FUNCTIONAL MORPHOLOGY:
In Israel, Marom *et al.* (2006: 954) found that the physiological responses of *O. hemprichii* to a range of ambient temperatures (both by night and by day) are characteristic of a mammal adapted to arid environments.

SEXUAL DIMORPHISM:
Bogdanowicz and Owen (1996: 494) found that females are approximately 4.4 % larger than males.

ECHOLOCATION:
Holderied *et al.* (2010: 425) indicate that *Otonycteris hemprichii* is a whispering bat (approx. 80 dB peSPL), with short, multiharmonic calls. The two dominant harmonics sweep from 39 to 22 kHz, and from 77 to 43 kHz, with average peak frequencies respectively 29.96 ± 5.3 kHz and 54.45 ± 5.5 kHz. The pulse duration is 2.46 ± 1.1 ms, the pulse interval 131.6 ± 82.0 ms.

In Jordan, Benda *et al.* (2010b: 204) recorded the following parameters for 66 calls: F_{start}: 46.8 ± 8.6 (34.2 - 68.3) kHz, F_{end}: 20.4 ± 3.0 (15.0 - 25.6) kHz, F_{peak}: 26.8 ± 3.2 (19.4 - 31.8) kHz, duration: 7.2 ± 2.4 (2.9 - 11.9) msec, and interpulse interval: 142.7 ± 52.9 (72.0 - 302.0) msec.

For Iran, Benda *et al.* (2012a: 183) provide two series of data: **1**: F_{start}: 38.8 ± 2.1 (28.6 - 32.8) kHz, F_{end}: 22.1 ± 0.2 (21.9 - 22.3) kHz, F_{peak}: 22.9 ± 6.1 (16.9 - 29.9) kHz, duration: 3.7 ± 0.3 (3.4 - 4.1) msec, interpulse interval: 157.9 ± 22.1 (143.0 - 190.1) msec; **2** (hand released in a close room): F_{start}: 35.0 ± 2.2 (30.5 - 38.6) kHz, F_{end}: 20.1 ± 0.7 (19.0 - 21.2) kHz, F_{peak}: 26.2 ± 2.6 (23.5 - 32.3) kHz, duration: 2.6 ± 0.5 (1.7 - 3.6) msec, interpulse interval: 44.4 ± 19.3 (26.8 - 80.5) msec.

From Israel, the following values were obtained by Hackett *et al.* (2016: 223) from 68 calls: Pulse duration: 5.19 ± 3.52 msec, F_{start}: 36.86 ± 2.95 (25.3 - 46.3) kHz, F_{end}: 20.94 ± 2.16 (18 - 25.3) kHz, F_{peak}: 24.45 ± 2.73 (20.5 - 34.1) kHz.

Disca *et al.* (2014: 226) indicate that the type of call is FM multi H for specimens from Morocco, with the following parameters: F_{start}: 42.4 ± 1.6 kHz, F_{end}: 17.0 ± 0.6 kHz, F_{peak}: 25.3 ± 1.0 kHz, $F_{max\ first\ harmonic}$: 45.3 ± 1.7 kHz, bandwidth: 25.3 ± 1.9 kHz, duration: 5.2 ± 0.3 msec.

In the United Arab Emirates, Davis (2007: 7) reports the ending frequency to be around 18 kHz.

Holderied *et al.* (2010: 425) also suggest that this bat is probably a passive gleaner, listening to noises generated by their prey. In a test environment, moving scorpions were found within 5 to 58 seconds, whereas non-moving or dead scorpions were not found at all.

Hackett *et al.* (2014: 3028), however, found that *O. hemprichii* switches between being a passive gleaner and an aerial hawker. Aerial hawking seems to occur when their usual prey becomes scarcer (e.g. desert scorpions - *Scorpio maurus palmatus* - at the end of a hot, dry summer) or less active (e.g. common yellow scorpions - *Buthus occitanus israelis* (Hackett *et al.*, 2014: 3031).

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003), Mayer *et al.* (2007), and Benda and Gvoždík (2010: 88).

Karyotype - Arslan and Zima (2014: 14) mention $2n$ = 28, FNa = 46, FN = 50, and a medium-sized submetacentric X. No data were available for the Y chromosome. The autosomal complement contains seven large metacentrics, two large submetacentrics, one small metacentric and three acrocentric pairs (of which one is dot-like). They also indicate that the karyotype with $2n$ = 30, FN = 48, BA = 20, a submetacentric X chromosome and a dot-like Y chromosome for specimens reported by Zima *et al.* (1992b) from Kyrgystan is actually for *O. leucophaea*.

Protein / allozyme - Unknown.

HABITS:
Horácek (1991) reported that *O. hemprichii* foraged in two different ways; very close to the ground (40 - 80 cm) or at a height of some 4 - 8 meters above the ground. Holderied *et al.* (2010: 429) reported a flight height of 2.19 ± 1.0 m above the ground while searching for prey at Park Sapir, Israel, and a flight speed of 3.52 ± 1.3 m/s.

Hackett *et al.* (2014: 3030) found that *O. hemprichii* specimens flew slower during aerial hawking than during their passive gleaning foraging flights.

ROOST:
Daniel *et al.* (2010: 295) found that during pregnancy, female bats roosted either alone, or in small groups of two to five individuals. While during lactation, female bats roosted without males in groups of two to five individuals. Korine *et al.* (2013: 131) reported that, in Israel, female bats roosted primarily in cracks during reproduction, and most of these were facing the morning sun. They also indicated that during pregnancy horizontal cracks were used, whereas vertical cracks were used by lactating females. Some of these roosts were used year after year.

DIET:
Studies from different parts of its range indicate that its prey includes mainly large ground arthropods (Coleoptera, Blattodae, Othoptera, Solpugida, Heteroptera, Hymenoptera, and Scorpionidae) (Horácek, 1991; Whitaker *et al.*, 1994: 75; Arlettaz *et al.*, 1995; Fenton *et al.*, 1999; Benda *et al.*, 2001, 2006, 2010: 83, 2012a: 469).

Andreas (2010: 265) mentions that it is suggested that *O. hemprichii* is a potential carnivore. However, there is no proof for this. Furthermore,

no perch feeding was observed for this species and this type of tactics is generally used when consuming relatively larger preys.

Holderied *et al.* (2010: 425) indicate that 70 % of the droppings can contain scorpion fragments. They also observed that while capturing the scorpions, the bats were frequently stung, even in their faces, without any indication of poisoning, and the scorpions' poison glands and stinger were eaten too.

Benda *et al.* (2014c: 100) analyzed 14 faecal pellets from one individual and found robust crickets (Ensifera; 97.1 % by volume), complemented by a small proportion of moth remnants (Lepidoptera; 2.9 %).

POPULATION:
Structure and Density - Mostly solitary animals, female colonies up to 18 individuals (Benda *et al.*, 2008c; IUCN, 2009).
Trend - 2008 - Unknown (Benda *et al.*, 2008c; IUCN, 2009). *O. hemprichii* populations within the Asia Minor and Levant region are unknown population trend, under predictive climate change scenarios (Bilgin *et al.*, 2012: 433).

ACTIVITY AND BEHAVIOUR:
Daniel *et al.* (2010: 296) showed that *O. hemprichii* delayed their forageing emergence time as gestation progressed from the first to the second trimester, while during nursing the bats' emergence time to forage did not change. Emergence time of female bats from their roosts during pregnancy was delayed from an average of 18h33 (about 40 min after sunset) in the first trimester of pregnancy (late March and beginning of April) to an average of 20h00 (about 1 h and 50 min after sunset) during the second trimester of pregnancy (Daniel *et al.*, 2010: 295). Contrary to the situation during pregnancy, emergence time of bats from their day roosts during nursing did not change with the sunset times, and was almost always between 20h00 and 21h00 (Daniel *et al.*, 2010: 295). Pregnant bats did not emerge to forage more than four times per night; the average was two bouts per night, whereas lactating bats made up to six foraging bouts per night (Daniel *et al.*, 2010: 296).

Daniel *et al.* (2010: 297) observed that female bats often used both deep and shallow daily torpor during the first two trimesters of pregnancy, with skin temperature frequently dropping as low as 15° C, while pregnant females used only shallow torpor during the last trimester of pregnancy and nursing.

Korine *et al.* (2015: 5) point out that the activity of *O. hemprichii* could be underestimated because of the whispering nature of their echolocation calls.

REPRODUCTION AND ONTOGENY:
Daniel *et al.* (2010: 295) estimated that pregnancy began by the end of March, and that parturition took place around the first week in June. Body mass of pregnant bats increased by over 50% from the beginning to the end of pregnancy (22 - 35 g).

In the United Arab Emirates, Davis (2007: 7) thinks the females are pregnant in May-June.

PARASITES:
The tick *Argas vespertilionis* (Latreille, 1802) was reported from Jordan by Benda *et al.* (2010b: 294), who also indicate that the only two other ectoparasites found in the Middle East are *Argas hermanni* Audouin, 1827 in Egypt, and the flea *Araeopsylla wassifi* Traub, 1954 in Turkey.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Algeria, Egypt, Libya, Morocco, Niger, Sudan.

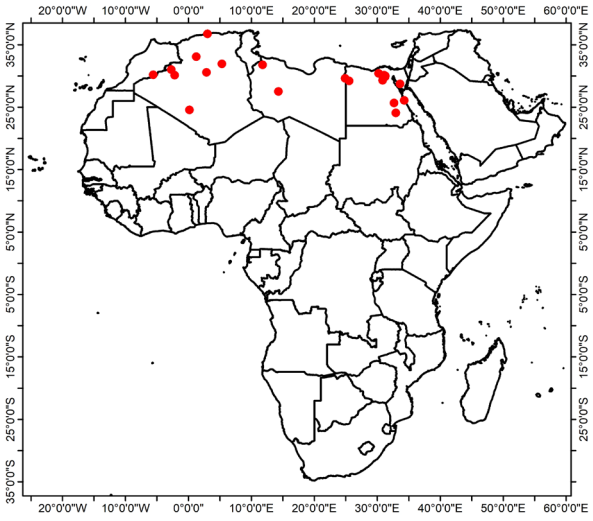


Figure 341. Distribution of *Otonycteris hemprichii*

Genus ***Pipistrellus*** Kaup, 1829

*1829. *Pipistrellus* Kaup, Skizzierte Entwicklungs-Geschichte Natürliche Systematik der Europäische Thierwelt, 1: 98. Publication date: 1829. - Comments: Type species: *Vespertilio pipistrellus* Schreber, 1774, by monotypy. Not *Pipistrellus* Gistel, 1848 (Insecta, Diptera, Hybotidae) (see Jackson and Groves, 2015: 274). - Etymology: From

the italian "*pipistrello*" meaning bat (see Fujita and Kunz, 1984: 4; Flannery, 1995a: 393). From the Latin "*pipio* meaning squeaking and "*strellus*", which is an attiona indicating a "small animal" (see Kapteyn, 1995: 83). - ZooBank: D3BD2230-B730-40BA-95D0-E95484EF21C7. (Current Combination)

1837. *Pipistrella* Bonaparte, Iconografia Fauna italiana. - Comments: Icon. fauna Ital.

1838. *Romicia* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 495. Publication date: 1 February 1838. - Comments: Type species: *Romicia calcarata* Gray, 1838 (=*Vespertilio kuhlii* Kuhl, 1817), by monotypy.

1839. *Vesperugo* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 312. Publication date: 1839. - Comments: In part (see Allen, 1939a: 92; Pavlinov *et al.*, 1995: 104). Included 13 species now referred to *Eptesicus, Pipistrellus, Neoromicia, Hypsugo*.

1840. *Romicius* Blyth, Cuvier's Animal Kingdom, 75. Publication date: 1840. - Comments: Variant of *Romicia* (see Allen, 1939a: 93; Meester *et al.*, 1986: 50), or invalid emendation (see Jackson and Groves, 2015: 274). (Emendation)

1856. *Nannugo* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (2): 131. Publication date: 1856. - Comments: Included *Vespertilio nathusii* Keyserling and Blasius, *V. kuhlii* Kuhl and *V. pipistrellus* Schreber (see Ellerman and Morrison-Scott, 1951: 152; Corbet and Hill, 1992: 133). - Etymology: From the Greek "*νάννος*", meaning dwarf and the suffix -ugo (in analogy with *Hypsugo* and *Vesperugo*) (see Palmer, 1904: 447).

1868. *Alobus* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 707 (for 1867). Publication date: 1868 [Goto Description]. - Comments: Type species: *Vespertilio temminckii* Cretzschmar, 1826 (=*Pipistrellus rueppellii* Fischer, 1829), by monotypy. Not of Le Conte, 1856 (Insecta, Coleoptera, Scarabaeidae) (see Jackson and Groves, 2015: 274).

1899. *Euvesperugo* Acloque, Faune de France, Mammifères, 35. - Comments: In part: Included six species, one of which was *Vespertilio pipistrellus* Schreber, 1774 (see Ellerman and Morrison-Scott, 1951: 162; Meester *et al.*, 1986: 50). Cabrera (1914: 123) also included it in part into *Nyctalus*.

1926. *Eptesicops* Roberts, Ann. Transv. Mus., 11: 245. Publication date: 14 September 1926. - Comments: Type species: *Scotophilus rusticus* Tomes, 1861, by original designation (see Jackson and Groves, 2015: 275).

1946. *Vansonia* Roberts, Ann. Transv. Mus., 20 (4): 304 [Goto Description]. - Comments: Type species: *Pipistrellus vernayi* Roberts, 1932 (=*Vespertilio rüppellii* Fischer, 1829), by original designation. Not *Vansonia* Schein, 1956 (Insecta, Coleoptera, Scarabaeidae) (see Jackson and Groves, 2015: 275). - Etymology: The name *Vansonia* refers to George van Son, entomologist of the Transvaal Museum (see Lanza *et al.*, 2015: 382).

1951. *Pipiestrellus:* Watson, Uganda J., 15 (1): xx. (Lapsus)

1987. *Attalepharca* Menu, Palaeovert., 17 (3): 78, 126. Publication date: 15 November 1987 [Goto Description]. - Comments: Not type species designated, therefore not available (see Corbet and Hill, 1992: 133).

1987. *Nycterikaupius* Menu, Palaeovert., 17 (3): 108, pl. 4, fig. 1. Publication date: 15 November 1987 [Goto Description]. - Comments: In part.

1992. *Attelepharca:* Corbet and Hill, The mammals of the Indomalayan Region: A systematic review, 131. (Lapsus)

1999. *Pipistallus:* Salleh, Hang, Rahman and Abdulla, ASEAN Review of Biodiversity and Environmental Conservation (ARBEC), 1. Publication date: September - October 1999. (Lapsus)

2000. *Pipistrellis:* Qui, Han, Qi and Yufen, Acta Anthrop. Sin., 4 (1): 19. (Lapsus)

2007. *Afropipistrellus* Thorn, Kock and Cuisin, Mammalia, 71 (1/2): 70, 75 [Goto Description]. - Etymology: From the combination of "Africa" and "Pipistrellus"; gender masculine (see Thorn *et al.*, 2007: 75).

2007. *Pipistrellus (Afropipistrellus):* Thorn, Kock and Cuisin, Mammalia, 71 (1/2).

2008. *Pipistrillus:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 247. (Lapsus)

2008. *Pipstrillus:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 247. (Lapsus)

2018. *Pipistrelus:* Malekani, Musaba, Gembu, Bugentho, Toengaho, Badjedjea, Ngabu, Mutombo, Laudisoit, Ewango, Van Cakenberghe, Verheyen, Asimonyo, Masudi, Bongo and Ngbolua, Nat. Conserv. Res., 3 (2): 68. Publication date: January 2018. (Lapsus)

? *Pipistrellus sp.:*

? *Vansoni:* (Lapsus)

TAXONOMY:
For synonyms see Ellerman and Morrison-Scott (1951: 162); but also see Hill (1976: 25); Kitchener *et al.* (1986); and Menu (1984). *Hypsugo* was considered a full genus by Tiunov (1986). Hill and Harrison (1987) would transfer *Neoromicia* and *Vespadelus* to *Pipistrellus* from *Eptesicus*.

Known species of the genus *Pipistrellus*: *abramus* (Temminck, 1838) – southern Ussuri region (Russia and China), Taiwan, southern and central Japan, Korea, Vietnam, Burma, India (Simmons, 2005: 473); *adamsi* Kitchener, Caputi and Jones, 1986 – Queensland and Northern Territory (Australia) (Simmons, 2005: 473); ***aero*** Heller, 1912; *angulatus* Peters, 1880 – New Guinea, Bismarck Arch., Bougainville Isl and Solomon Isls, adjacent small islands (Simmons, 2005: 473); *ceylonicus* (Kelaart, 1852) – Pakistan, India, Sri Lanka, Bangladesh, Burma, Kwangsi and Hainan (China), Vietnam, Borneo (Simmons, 2005: 474); *collinus* Thomas, 1920 – Highlands of Papua New Guinea (Simmons, 2005: 474); *coromandra* (Gray, 1838) – Afghanistan, Bangladesh, India (including Nicobar Isls), Sri Lanka, Pakistan, Nepal, Bhutan, Burma, Cambodia, Thailand, southern China (Simmons, 2005: 474); ***deserti*** Thomas, 1902; *endoi* Imaizumi, 1959 – Honshu (Japan) (Simmons, 2005: 474); ***grandidieri*** (Dobson, 1876); ***hanaki*** Hulva and Benda, 2004; ***hesperidus*** (Temminck, 1840); *hesperus* H. Allen, 1864 – Washington to southwestern Oklahoma (USA) and Baja California, south to Hidalgo and Guerrero (Mexico) (Simmons, 2005: 475); ***inexspectatus*** Aellen, 1959; *javanicus* (Gray, 1838) – eastern Afghanistan, northern Pakistan, northern and central India, southeastern Tibet (China), Burma, Thailand, Vietnam, through southeast Asia to Lesser Sunda Isls and the Philippines (Simmons, 2005: 475); ***kuhlii*** (Kuhl, 1817); ***maderensis*** (Dobson, 1878); *minahassae* (Meyer, 1899) – northern Sulawesi (Simmons, 2005: 476); ***nanulus*** Thomas, 1904; *nathusii* (Keyserling and Blasius, 1839) – western Europe to Urals and Caucasus and western Asia Minor, southern England (Simmons, 2005: 476); *papuanus* Peters and Doria, 1881 – Seram, Aru Isls, Baik-Supiori, New Guinea, New Ireland (Bismarck Arch.) adjacent small islands (Simmons, 2005: 476); *paterculus* Thomas, 1915 – northern India, Burma, Thailand, Vietnam, and southwestern China (Simmons, 2005: 477); ***permixtus*** Aellen, 1957; ***pipistrellus*** (Schreber, 1774); *pygmaeus* (Leach, 1825) – British Isles, southern Scandinavia south to Spain, Portugal, Corsica, Sardinina, Italy, Slovenia and Greece, east to Ukaraine and western Russia, northern Algeria, Tunisia, Libya (Cyrenaica only) (Simmons, 2005: 477); ***rueppellii*** (J. Fischer, 1829); ***rusticus*** (Tomes, 1861); *stenopterus* (Dobson, 1875) – western Malaysia, Sumatra, Riau Arch., northern Borneo, Mindanao (Philippines) (Simmons, 2005: 478); *sturdeei* Thomas, 1915 – Bonin Isls (Japan) (Simmons, 2005: 478); *subflavus* (F. Cuvier, 1832) – Nova Scotia, southern Qubec (Canada) and Minnesota, south to Florida (USA) and Honduras (Simmons, 2005: 479); *tenuis* (Temminck, 1840) – Afghanistan to the Moluccas, southern China, Laos, Vietnam, Cocos Keeling Isl and Christmas Isl (Simmons, 2005: 479); *wattsi* Kitchener, Caputi and Jones, 1986 – southeastern Papua New Guinea and Sanari Isl (Simmons, 2005: 479); *westralis* Koopman, 1984 – northern Australia from Kimberly to eastern Gulf of Carpentaria (Simmons, 2005: 479).

COMMON NAMES:
Czech: zakrslí netopýři. English: Pipistrelle Bats, Pipistrelles. French: Pipistrelles. German: Zwergfledermäuse, Pipistrellen. Italian: Pipistrèlli.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) line drawing of tragi of specimen DNSM 13220 referred to a *Pipistrellus* 1 from Mount Nimba, Liberia.

ECHOLOCATION:
Rakotondramanana *et al.* (2014: 80) studied the echolocation calls of Madagascan "*Pipistrellus sensu lato"* bat (including *Pipistrellus, Neoromicia* and *Hypsugo* in two different flight cages: A (12 x 3 x 3 m) and B (5.4 x 1.4 x 1.5 m), and found that the same bats used different types of calls depending on the cage they were flying in. In the large cage (A), the signal showed a frequency-modulated part followed by a short quasi-constant frequency (FM/QCF) component, whereas in the small cage (B) the QCF component was lacking. These authors, therefore, also warn against extrapolating the results of echolocation calls captured in flight cages.

PREDATORS:
Demeler (1981: 133) found remains of a "*Pipistrellus*" in pellets of *Bubo africanus* in the Yankari Game Reserve (Nigeria).

Mikula *et al.* (2016: Supplemental data) mention a *Pipistrellus* sp. being taken by a Grey-headed bushshrike (*Malaconotus blanchoti* Stephens, 1826).

In Algeria, Djilali *et al.* (2016: 161) found remains of 6 *Pipistrellus* specimens in 516 preys (1.2 %) captured by the Short-eared Owl (*Asio flammeus*).

Goodman *et al.* (2015c: 78) found the remains of five *Pipistrellus/Neoromicia* sp. individuals in pellets of Bat Hawk *Macheiramphus alcinus* Bonaparte, 1850 in western central Madagascar.

VIRUSES:
Paramyxoviridae

Mortlock *et al.* (2015: 1841) reported that twenty out of fourty examined "*Pipistrellus*" specimens from the same colony in the DRC tested positive for *Paramyxovirus* sequences, all of which were nearly identical.

ZOOBANK:
D3BD2230-B730-40BA-95D0-E95484EF21C7

Pipistrellus aero Heller, 1912

*1912. *Pipistrellus aero* Heller, Smiths. Misc. Coll., 60 (12): 3. Publication date: 4 November 1912. Type locality: Kenya: Mathews Range: Mount Gargues [00 57 N 37 24 E, 7 100 ft] [Goto Description]. Holotype: USNM 181812: ad ♂, skin and skull. Collected by: Edmund Heller; collection date: 26 August 1911; original number: 4110. (Current Combination)

1971. *Pipistrellus [(Pipistrellus)] aero:* Hayman and Hill, Mammals of Africa: Chiroptera, 41. (Name Combination)

1971. *Pipistrellus altae:* Hayman and Hill, Mammals of Africa: Chiroptera, 43. - Comments: Hayman and Hill (1971) refer to specimens in the BMNH labeled as "*P. altae*" but do not mention an original author.

TAXONOMY:
The Ethiopian specimens in the British Museum are clearly *P. kuhlii*; see Hayman and Hill (1971: 41). Koopman (1994: 114) states that this species is probably a subspecies of *P. aegyptius* (=*deserti*).

COMMON NAMES:
Chinese: 东非伏翼. Czech: netopýr gargueský. English: Mt Gargues Pipistrelle Bat, Aerial Pipistrelle Bat, Mt Gargues Pipistrelle, Mount Gargues Pipistrelle, Kenya Pipistrelle. French: Pipistrelle du Kenya. German: Luftige Zwergfledermaus, Luftige Pipistrelle.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Jacobs *et al.*, 2008q; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008q; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Jacobs *et al.*, 2004ae; IUCN, 2004). 1996 - DD (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not known (Jacobs *et al.*, 2008q; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008q) [in IUCN (2009)] report that it has been recorded in the Matthews Range Forest Reserve and Marsabit National Reserve. Further studies are needed into the distribution, natural history and possible threats to this little-known species.

GENERAL DISTRIBUTION:
Pipistrellus aero is endemic to northwestern Kenya, where it is known only from three localities (Mount Garguez; Marsabit Lake and Ngong). It is also present in adjacent Ethiopia.

Native: Ethiopia (Lavrenchenko *et al.*, 2004b: 135); Kenya.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Jacobs *et al.*, 2008q; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008q; IUCN, 2009).

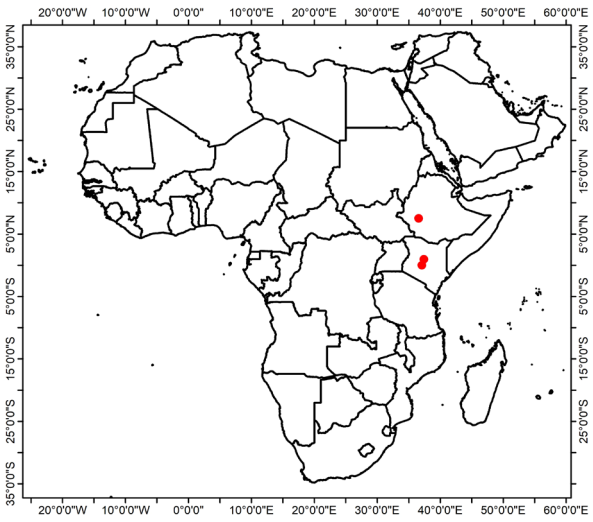


Figure 342. Distribution of *Pipistrellus aero*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia, Kenya.

Pipistrellus grandidieri (Dobson, 1876)

*1876. *Vesperugo (Vesperus) grandidieri* Dobson, Ann. Mag. nat. Hist., ser. 4, 18 (108): 500. Publication date: 1 December 1876. Type locality: Tanzania: Zanzibar [ca. 06 10 S 39 12 E] [Goto Description]. Holotype: MNHN ZM-MO-1996-2129: ad ♀, skull and alcoholic. Collected by: Alfred Grandidier; collection date: 1864. Number 215 in Rode (1941). Opened ventrally, one foetus in uterus, skull extracted in 1999.
1895. *Vesperus grandidieri:* Matschie, Säugethiere Deutsch-Ost-Afrikas, 23. (Name Combination)
1897. *Eptesicus grandidieri:* Matschie, Zur Faunistik Deutsch-Ost-Afrikas. 5. Säugethiere, 84. (Name Combination)
1900. *Vesperugo (Vesperus) flavescens* Seabra, J. Sci. mat. phys. nat., ser. 2, 6: 23. Publication date: 1900. Type locality: Angola: Benguela district: East of Hanha: Galanga [12 04 S 15 09 E]. Cotype: MNHN ZM-MO-1900-536: ad? ♂, skull and alcoholic. Collected by: José Alberto de Oliveira Anchieta. Co- or topotype. Cotype: MNHN ZM-MO-1900-537: ad? ♂, skull and alcoholic. Collected by: José Alberto de Oliveira Anchieta. Co- or topotype. - Etymology: From the feminine scientific Latin adjective *flavèscens*, meaning "yellowish", referring to the colour of fur and membranes (see Lanza *et al.*, 2015: 401).
1900. *Vesperugo flavescens:* Bocage, Bull. Mus. natn. Hist. nat., Paris, 6: 164. (Name Combination)
1935. *Pipistrellus flavescens:* Monard, Arq. Mus. Bocage, 6: 31. (Name Combination)
1937. *Eptesicus capensis angolensis* J.Eric Hill, Am. Mus. Novit., 916: 1, fig. 1. Publication date: 17 April 1937. Type locality: Angola: Chitau [11 15 S 17 01 E, 4 900 ft] [Goto Description]. Holotype: AMNH 85535: ad ♂, skin and skull. Collected by: Herbert Lang and The Vernay Angola Expedition; collection date: 5 August 1925; original number: 620. Co- or Topotype: AMNH 88096: ad ♀. Co- or Topotype: CM 7018b: ♀.
1939. *Eptesicus flavescens:* G.M. Allen, Bull. Mus. comp. Zool., 83: 83. (Name Combination)
1953. *Eptesicus (Eptesicus) flavescens:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 76. (Name Combination)
1984. *Eptesicus (Eptesicus) capensis grandidieri:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch.. (Name Combination)
1987. *[Attalepharca] flavescens:* Menu, Palaeovert., 17 (3): 126. (Name Combination)
1987. *Pipistrellus (Neoromicia) flavescens:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 282. (Name Combination)
1993. *Eptesicus (Neoromicia) flavescens:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 201. (Name Combination)
1994. *P[ipistrellus (Neoromicia)] c[apensis] grandidieri:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 55. (Name Combination)
2006. *Neoromicia flavescens:* Van Cakenberghe, Kearney and Seamark, African Chiroptera Project, Pretoria, 132 - 133. (Name Combination, Current Combination)
2007. *Pipistrellus (Afropipistrellus) grandidieri angolensis:* Thorn, Kock and Cuisin, Mammalia, 72 (1/2): 76. (Name Combination)
2007. *Pipistrellus (Afropipistrellus) grandidieri grandidieri:* Thorn, Kock and Cuisin, Mammalia, 71 (1/2): 76. (Name Combination)
2007. *Pipistrellus (Afropipistrellus) grandidieri:* Thorn, Kock and Cuisin, Mammalia, 71 (1/2): 73. (Name Combination)
2019. *L[aephotis] flavescens:* Taylor and Tuttle, Bats: An illustrated guide to all species, 283. Publication date: 11 April 2019. - Comments: Taylor and Tuttle (2019 283) consider *flavescens* to be a species separate from *grandidieri*. (Name Combination)
? *Neoromicia grandidieri:* - Comments: . (Lapsus)
? *Pipistrellus grandidieri:* (Name Combination, Current Combination)

TAXONOMY:
Thorn *et al.* (2007: 73) recognize two subspecies: *P.* (*A.*) *g. grandidieri* for East African specimens and *P.* (*A.*) *g. angolensis*, a slightly larger western and southern African subspecies (Angola, Malawi and Cameroon).

Monadjem *et al.* (2013c: 194) mention a specimen from Mount Nimba as "*Pipistrellus* sp. 1", which was in a later publication (Monadjem *et al.*, 2016y: 370) assigned to "*Pipistrellus* cf. *grandidieri*". The latter authors indicate that the specimen involved has very similar cranial characters as *P. grandidieri*, but that species occurs only in eastern Africa, some 2,500 km away. Pending further genetical characterisation, they tentatively named it "cf. *grandidieri*".

Thorn *et al.* (2007: 70 - 71) consider "*flavescens*" to be a *nomen dubium*, since its description does not agree with the two "syntypes" attributed to it. They indicate that one syntype (MNHN ZM-MO-1900-536) is actually a representative of *Pipistrellus* (*Afropipistrellus*) *grandidieri* Dobson, 1876.

COMMON NAMES:
Czech: netopýr galangánský. Chinese: 黄伏翼. English: Grandidier`s Pipistrelle, Yellow Pipistrelle Bat, Yellow Serotine. French: Pipistrelle de Grandidier, Sérotine de Grandidier, Sérotine jaune, Pipistrelle jaune. German: Grandidiers Zwergfledermaus, Gelbe Zwergfledermaus, Gelbe Pipistrelle. Italian: Pipistrèllo giallàstro.

CONSERVATION STATUS:
Global - (as *Pipistrellus flavescens*) Listed as Data Deficient (DD ver 3.1 (2001)) in view of continuing problems with its taxonomy as well as absence of recent information on its extent of occurrence, status, ecological requirements and threats (Jacobs *et al.*, 2008s; IUCN, 2009).

Assessment Histroy -
2008 - DD ver 3.1 (2001) [assessed as *Pipistrellus flavescens*] (Jacobs *et al.*, 2008s; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004aa; IUCN, 2004). 1996 - DD [assessed as *Eptesicus flavescens*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are not known (Jacobs *et al.*, 2008s; IUCN, 2009) (as *Pipistrellus flavescens*).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008s) [in IUCN (2009)] report that it (as *Neoromicia flavescens*) has been recorded from the Kambai Forest Reserve in Tanzania by Cunneyworth (1996b). There is a need to clarify the taxonomic status of animals currently allocated to this species, and thereby better understand the distribution, natural history and potential threats to it.

GENERAL DISTRIBUTION:
Ethiopia to SE Democratic Republic of the Congo, including Unguja [=Zanzibar]. Possibly Liberia (1st record, Monadjem and Fahr, 2007: 47; as "*Neoromicia* aff. *guineensis*"). Decher *et al.* (2016: 273) report *N.* cf. *grandidieri* specimens from Guinea. As *Pipistrellus/Neoromicia flavescens* recorded from Angola (type locality at Galanga), Burundi, Cameroon, Malawi (including the Shire Highlands (Happold and Happold, 1997b: 81), Mozambique, Uganda (Kampala) and Somalia (Shonto Forest).

Native: Angola (Crawford-Cabral, 1989; Thorn *et al.*, 2007; Monadjem *et al.*, 2010d: 571); Burundi; Cameroon; Congo (Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 571); Malawi (Happold and Happold, 1997b: 81; Thorn *et al.*, 2007; Monadjem *et al.*, 2010d: 571); Mozambique; Somalia; Tanzania; Uganda.

DETAILED MORPHOLOGY:
Baculum - Thorn *et al.* (2007).

POPULATION:
Structure and Density - There are few details available on the population status of this species (Jacobs *et al.*, 2008s; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008s; IUCN, 2009 - as *Pipistrellus flavescens*).

PARASITES:
Schaer *et al.* (2013a: 17416) report the presence of hemosporidian parasites of the genus *Polychromophilus* in three out of three investigated *P.* aff. *grandidieri* specimens from West Africa, but they indicate that the bat might respresent an undescribed species. Rosskopf *et al.* (2018: Suppl.) refer to the same specimens, and mention them from Guinea.

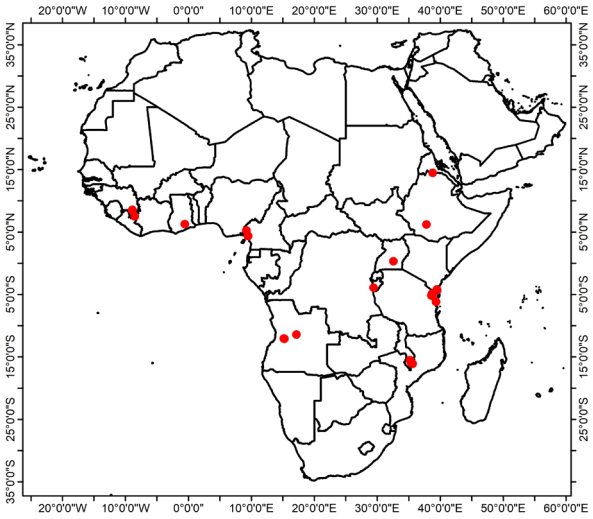


Figure 343. Distribution of *Pipistrellus grandidieri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Burundi, Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Liberia, Malawi, Tanzania, Uganda.

Pipistrellus hanaki Hulva and Benda, 2004

*2004. *Pipistrellus hanaki* Hulva and Benda, in: Benda, Hulva and Gaisler, Acta Chiropt., 6 (2): 207. Type locality: Libya: Cyrenaica: Al Jabal Al Akhdar district:: (ca. 5 km) SW of Al Bayda: Wadi al Kuf [32 44 N 21 41 E, 495 m] [Goto Description]. Holotype: NMP 49897: ad ♂, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 19 May 2002. 3 paratypes: see Benda *et al.* (2004b: 207). Paratype: NMP 49890: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 18 May 2002; original number: pb2135. Presented/Donated by: ?: Collector Unknown. Collected at: 'Arqub Ash Shafshaf, ca. 3 km south of Al Hilal, Cyrenaica, Libya; 32.87°N, 22.18°E. (see Benda in Mlíkovský *et al.*, 2011: 136). Paratype: NMP 49891: ad ♂, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 18 May 2002; original number: pb2136. Presented/Donated by: ?: Collector Unknown. Collected at: 'Arqub Ash Shafshaf, ca. 3 km south of Al Hilal, Cyrenaica, Libya; 32.87°N, 22.18°E. (see Benda in Mlíkovský *et al.*, 2011: 136). Paratype: NMP 49892: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 18 May 2002; original number: pb2137. Presented/Donated by: ?: Collector Unknown. Collected at: 'Arqub Ash Shafshaf, ca. 3 km south of Al Hilal, Cyrenaica, Libya; 32.87°N, 22.18°E. (see Benda in Mlíkovský *et al.*, 2011: 136). Paratype: NMP 49894: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 19 May 2002; original number: pb2142. Presented/Donated by: ?: Collector Unknown. Paratype: NMP 49895: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 19 May 2002; original number: pb2143. Presented/Donated by: ?: Collector Unknown. Paratype: NMP 49896: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 19 May 2002; original number: pb2144. Presented/Donated by: ?: Collector Unknown. Paratype: NMP 49902: sad ♂, alcoholic (skull not removed). Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2150. Presented/Donated by: ?: Collector Unknown. Collected at a small cave in the central part of Wadi Al Kuf, 8 km southwest of Massah, Cyrenaica, Libya; 32.70 N 21.58 E (see Benda in Mlíkovský *et al.*, 2011: 136). Paratype: NMP 49903: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2151. Presented/Donated by: ?: Collector Unknown. Collected a :a small cave in the central part of Wadi Al Kuf, 8 km southwest of Massah, Cyrenaica, Libya; 32.70 N 21.58 E (see Benda in Mlíkovský *et al.*, 2011: 136). Paratype: NMP 49904: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2152. Presented/Donated by: ?: Collector Unknown. Collected at a small cave in the central part of Wadi Al Kuf, 8 km southwest of Massah, Cyrenaica, Libya; 32.70 N 21.58 E (see Benda in Mlíkovský *et al.*, 2011: 136). - Etymology: In honour of prof. Vladimír Hanák (Prague, Czech Republic), who signficantly contributed to the knowledge of the Palaearctic bat fauna (see Benda *et al.*, 2004b: 208). (Current Combination)

TAXONOMY:
See Benda *et al.* (2004b; 2009a).

Evin *et al.* (2011: 2095 - 2097) confirm that *hanaki* is composed of two different lineages: *P. hanaki hanaki* from Libya and *P. hanaki creticus* Benda, 2008 from Crete, which differ also in size and shape of the skull.

COMMON NAMES:
Albanian: Pipistrel i Hanak-ut. Armenian: Հանակի փոքրաչղջիկ. Azerbaijani: Hanaki cı rtdan şəbpərəsi. Basque: Hanak pipistrelo. Belarusian:

Нетапыр Ганака. Bosnian: Hanakov šišmiš. Breton: Pipistrell Libia. Bulgarian: Прилепче на Ханак. Castilian: Murciélago de Hanak. Catalan: Pipistrella de Hanak. Croatian: Hanakov patuljasti šišmiš. Czech: Netopýr Hanákův, Netopýr kyrénský. Danish: Hanaks flagermus. Dutch: Hanaks dwergvleermuis, Hanak's dwergvleermuis. English: Hanak's Pipistrelle. Estonian: Liibüa nahkhiir. Finnish: Libyanlepakko. French: Pipistrelle de Libye. Frisian: Hanaks dwerchflearmûs. Galician: Morcego de Hanak. Georgian: ჰანაკის ღამორი. German: Hanaks Zwergfledermaus, Hanaks Pipistrelle. Greek: Νανονυχτερίδα του Hanak. Hungarian: Hanák-törpedenevér. Irish Gaelic: Ialtóg Hanak. Italian: Pipistrello di Hanak. Latvian: Hanaka sikspārnis. Lithuanian: Hanako šikšniukas. Luxembourgish: Libesch Zwergfliedermaus. Macedonian: Ханаков лилјак. Maltese: Pipistrell ta' Hanak. Montenegrin: Libijski patuljasti slijepi mišić. Norwegian: Kyrenaikaflaggermus. Polish: Karlik cyrenejski. Portuguese: Morcego de Hanak. Rhaeto-Romance: Pipistrel da Hanak. Romanian: Liliacul pitic a lui Hanak. Russian: Нетопырь Ганака. Serbian: Либијски сл[ij]епи мишић [= Libijski sl[ij]epi mišić]. Scottish Gaelic: Ialtag Hanak. Slovak: večernica Hanákova. Slovenian: Libijski drobni netopir. Swedish: Kretapipistrell. Turkish: Hanak'ın Cüce Yarasası. Ukrainian: Нетопир Ганака. Welsh: Ystlum lleiaf Hanak.

SIMILAR SPECIES:
Pipistrellus hanaki differs from its nearest relatives *P. pipistrellus* and *P. pygmaeus* chromosomally, and by its larger skull and teeth, and a number of other characters (Benda *et al.*, 2004b).

CONSERVATION STATUS:
Global - This recently described species, little or no data is available on population size and trend, distribution, or potential threats. Assessed as Data Deficient DD ver 3.1 (2001) (Aulagnier and Palmeirim, 2008a; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Aulagnier and Palmeirim, 2008a; IUCN, 2009).

MAJOR THREATS:
Unknown (Aulagnier and Palmeirim, 2008a; Thorn *et al.*, 2009).

CONSERVATION ACTIONS:
Unknown (Aulagnier and Palmeirim, 2008a; IUCN, 2009).

GENERAL DISTRIBUTION:
Pipistrellus hanaki is known only from a small area on the Libyan coast (in the Cyrenaica area) (Benda *et al.*, 2004b), and from Crete (Greece) (see Benda *et al.*, 2009b).

Native: Greece (Benda *et al.*, 2009b); Libyan Arab Jamahiriya (Benda *et al.*, 2004b).

DETAILED MORPHOLOGY:
Herdina *et al.* (2013: 68) indicate that *P. hanaki* can not be separated from either *P. pipistrellus* or *P. pygmaeus* by the shape of its baculum. They found that the proximal third of the baculum shows the most interspecifice variation between these three species, whereas the shape of the curve in lateral view shows the most individual variation.

ECHOLOCATION:
Georgiakakis and Russo (2012: 168) report that the echolocation call has a FM-QCF structure, consisting of a frequency modulated component followed by an almost constant frequency part. They (p. 169) also were able to distinguish two types of social calls: type 'A' (primarily emitted by foraging bats) with a maximum energy frequency (FMAXE) of about 27.7 kHz, and a duration of 19.9 ms, of which type 'B' had a maximum energy frequency of all components (Freq) of about 20.9 kHz and a bandwidth of 28 kHz, and a duration of 24.8 ms. The number of calls of type 'B' increased from July to October and then decreased again, whereas those of type 'A' decreased from July to November.

MOLECULAR BIOLOGY:
DNA - See Benda *et al.* (2004b), Hulva *et al.* (2004).
Karyotype - Unknown
Protein / allozyme - Unknown.

DIET:
From Libya, Benda *et al.* (2014c: 60) reported the following food items: Smaller Lepidoptera and small Coleoptera (Scarabaeidae, Carabidae, Staphylinidae). Two digestive tracts contained high volumes of cockroaches (Blattodea), and small amounts of Nematocera (Culicidae and Chironomidae) as well as Hymenoptera (Ichneumonoidea).

POPULATION:
Structure and Density - Unknown (Aulagnier and Palmeirim, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Aulagnier and Palmeirim, 2008a; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Smotherman *et al.* (2016: 537) refer to Georgiakakis and Russo (2012) in describing the song structure for this species as consisting of different syllable types in basic motif. These bats sing while flying.

REPRODUCTION AND ONTOGENY:
Benda *et al.* (2014c: 55) reported pregnant females (each containing one foetus) collected on 17, 18, and 19 May 2002 at different localities in Libya.

PARASITES:
Benda *et al.* (2014c: 60) reported the presence of two Nycteribiid bat flies: *Basilia daganiae* Theodor and Moscona, 1954 and *Basilia mediterranea* Hurka, 1970.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Libya.

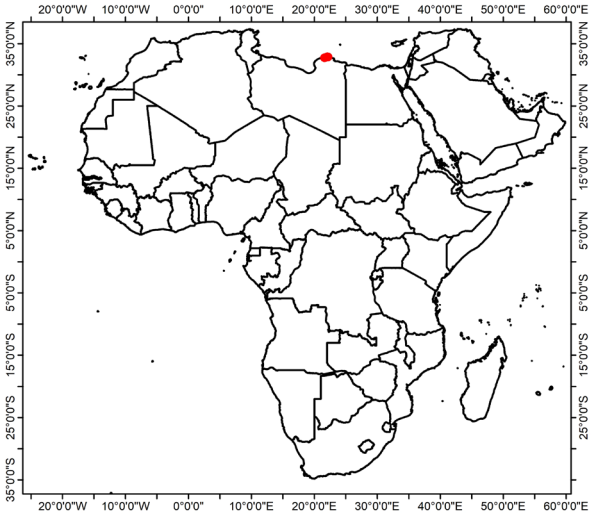


Figure 344. Distribution of *Pipistrellus hanaki*

Pipistrellus hesperidus (Temminck, 1840)

1832. *Vespertilio platycephalus* Temminck, in: Smuts, Enumer. Mamm. Capensium, 107. Type locality: South Africa: Cape Town [33 56 S 18 28 E].
*1840. *Vespertilio hesperida* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe, 2: 211. Type locality: Eritrea: Abyssinia: Red Sea, shores of the [ca. 09 N 39 E] [Goto Description]. Lectotype: SMF 12381: ad ♂, skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1842. Old catalog number II.N.9*. - Etymology: From the feminine scientific Latin adjective *hespèrida*, meaning "evening animal", deriving from the feminine Greek substantive "*ἑσπέρα*" (hespèra), meaning "evening", as this bat, as almost all Chiroptera, begins to fly at dusk (see Lanza *et al.*, 2015: 410).
1969. *Vesperugo hespirida:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 206. (Name Combination, Lapsus)
2001. *Pipistrellus hesperidus:* Kock, Senckenb. biol., 81 (1/2): 277. (Name Combination, Current Combination)
2002. *Pipistrellus cf. kuhlii:* Kearney, Volleth, Contrafatto and Taylor, Acta Chiropt., 4 (1): 55. - Comments: Not of Kuhl, 1817.
? *Pipistrellus (Pipistrellus) kuhlii:*
? *Pipistrellus hesperidus 3:*
? *Pipistrellus hesperidus fuscatus:* (Name Combination)
? *Pipistrellus kuhlii:* - Comments: Not of Kuhl, 1817.

TAXONOMY:
Pipistrellus hesperidus was separated from *kuhlii* by Kock (2001b: 277).

Vespertilio platycephalus Temminck, 1832 is according to Roberts (1951) a synonym of *P. kuhlii*, which would make this the senior synonym. However, both Allen (1939a) and Ellerman *et al.* (1953) regard this taxon as unidentifiable, besides which it seems to fall outside the known distribution of this species (Meester *et al.*, 1986: 52).

Koubínová *et al.* (2013: 8) suggest that three subspecies might deserve elevation to species rank: *hesperidus* (North-eastern Africa), *fuscatus* (Afro-tropical regions other than Southern Africa and Madagascar), and *subtilis* (Southern Africa and Madagascar), but they also indicate that the cyt *b* of Senegalese "*hesperidus*" differs considerably (13 %) from that in populations from South Africa, and might nieed to be considered a distinct species.

COMMON NAMES:
Chinese: 暗黑伏翼. Czech: netopýr jižní. English: African pipistrelle, dusky pipistrelle. French: Pipistrelle hespéride. German: Abendstern-Zwergfledermaus, Abendstern-Pipistrelle, Netzhäutigen Dämmerungsfledermaus, Flachköpfige Dämmerungsfledermaus. Italian: Pipistrèllo seràle.

ETYMOLOGY OF COMMON NAME:
Since sub-Saharan Africa populations are specifically distinct from Kuhl's pipistrelle occuring in the Palaeartic region (Kock 2001?a), the name African pipistrelle serves to distinguish it from Kuhl's pipistrelle (Bronner *et al.*, 2003; Taylor, 2005).

CONSERVATION STATUS:
Global - Listed as Least Concern in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Mickleburgh *et al.*, 2008dp; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Mickleburgh *et al.*, 2008dp; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessed as part of *P. kuhlii*] (IUCN, 2004).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016p). 2004 - LC ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate [assessed as *P. kuhlii*] (Smithers, 1986).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Mickleburgh *et al.*, 2008dp; IUCN, 2009).

CONSERVATION ACTIONS:
Mickleburgh *et al.* (2008dp) [in IUCN (2009)] report that in view of the species wide range it is presumably present in a number of protected areas. It has been recorded from the Parc National de Kirindy-Mitea on Madagascar (Bates *et al.*, 2006). Additional taxonomic studies are needed to better define the extent of the species range relative to other species of *Pipistrellus*.

GENERAL DISTRIBUTION:
Pipistrellus hesperidus has been recorded over much of sub-Saharan Africa. It ranges from the Cape Verde Islands, to Liberia and Côte d'Ivoire, to Nigeria, Cameroon and Equatorial Guinea (Bioko), western Democratic Republic of the Congo, southern Sudan, Ethiopia, Eritrea and Somalia, into Kenya and Uganda, Rwanda, Burundi, Tanzania, Malawi, Mozambique, Zambia, Zimbabwe, Angola being found as far south as eastern and southern South Africa and possibly Swaziland. There are a few records of this species from central western Madagascar (Bates *et al.*, 2006: 317).

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 820,815 km^2.

In the RSA, the species' distribution is strongly associated with annual precipitation (Babiker Salata, 2012: 49).

The current identity of bats from the Arabian Peninsula formerly allocated to *Pipistrellus kuhlii* is unclear and some records might refer to *P. hesperidus*. Simmons (2005) also indicates that this species is present in the Canary Islands (Spain). However, this distribution needs to be confirmed. Records from North Africa are referable to *Pipistrellus kuhlii*.

Taylor *et al.* (2018b: 63) predict the species might occur in Angola.

Native: Botswana (Monadjem *et al.*, 2010d: 571); Burundi; Cameroon (Eisentraut, 1968: 171 - as "*P. kuhlii* - 1st record from West Africa); Cape Verde; Congo (The Democratic Republic of the); Equatorial Guinea (Bioko); Eritrea; Ethiopia (Lavrenchenko *et al.*, 2004b: 134); Kenya; Liberia (Fahr, 2007a: 104); Madagascar (Bates *et al.*, 2006: 317); Malawi (Ansell, 1974; Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 571); Mozambique (Smithers and Lobão Tello, 1976; Monadjem *et al.*, 2010d: 571; Monadjem *et al.*, 2010c: 384); Nigeria; Rwanda; South Africa (Monadjem *et al.*, 2010d: 571); Swaziland (Monadjem *et al.*, 2010d: 572); Tanzania (Stanley and Goodman, 2011: 47); Uganda; Zambia (Ansell, 1978; Monadjem *et al.*, 2010d: 572); Zimbabwe (Cotterill, 2004a: 261; Monadjem *et al.*, 2010d: 572).
Presence uncertain: Spain (Canary Isands).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) as *P. kuhlii* and Kearney *et al.* (2002) as *P* cf. *kuhlii*.

ECHOLOCATION:
Schoeman and Waddington (2011: 291) mention a peak frequency of 56.3 ± 2.1 kHz and a duration of 2.2 ± 0.2 msec for specimens from Durban, South Africa.

In Soutpansberg, South Africa, Taylor *et al.* (2013b: 17) recorded the following parameters for 19 calls: F_{max}: 66.9 ± 8.91 (48.5 - 82.0) kHz, F_{min}: 44.9 ± 1.53 (41.3 - 47.2) kHz, F_{knee}: 50.3 ± 2.50 (44.9 - 54.7) kHz, F_{char}: 45.8 ± 1.78 (41.5 - 49.1) kHz, duration: 2.6 ± 0.85 (1.7 - 5.0) msec.
Linden *et al.* (2014: 40) reported the following parameters from the Soutpansberg area (RSA): F_{min}:41 - 47 kHz, F_{char}: 42 - 49 kHz, F_{knee}: 45 - 55 kHz, Slope: 154 - 829 OPS, duration: 2 - 5 msec.
At Farm Welgevonden, South Africa, Taylor *et al.* (2013a: 556) report a F_{knee} value of 50 (45 - 55) kHz.

Monadjem *et al.* (2017c: 179) reported the following values for Swaziland: F_{min}: 45.3 ± 1.87 (41.7 - 49.1) kHz, F_{knee}: 49.6 ± 2.42 (44.6 - 54.3) kHz, F_c: 46.0 ± 1.83 (42.5 - 50.0) kHz, and duration: 3.1 ± 0.63 (2.3 - 4.5) msec.

Adams and Kwiecinski (2018: 4) recorded two calls in the Kalahari Desert: F_{char}: 43.3 ± 3.1 kHz, F_{max}: 53.6 ± 1.6 kHz, F_{min}: 42.9 ± 3.4 kHz, duration: 2.3 ± 0.3 msec.

MOLECULAR BIOLOGY:
DNA - Unknown.

Karyotype - Rautenbach *et al.* (1993), Volleth *et al.* (2001) and Kearney *et al.* (2002) all reported 2*n* = 42, FN = 50, BA = 10, and a metacentric X chromosome, for specimens from South Africa and Madagascar. These results were the same as those obtained for *P. rusticus* (Kearney *et al.*, 2002). Rautenbach *et al.* (1993) also reported an acrocentric Y chromosome. GTG banding also identified that *P. hesperidus* and *P. rusticus* share the same Robertsonian fusion of chromosomes 11/12 (Kearney *et al.*, 2002). Volleth and Eick (2012: 169) indicate that the EMA segment order on chromosomal arm 2 of *P. hesperidus* is the same as that on human chromosome 4, but differs from that on chromosome 10 of *Rhinolophus hipposideros*, and conclude that the EMA segment order in the Vespertilioniformes is probably the ancentral one.

Koubínová *et al.* (2013: 3) report a different karyotype for 3 ♂♂ and 1 ♀ from Senegal: 2*n* = 46, Fna = 58, FN = 62, X = metacentric, and Y = dot-like. They also found that the cytochrome *b* in their specimens differed for about 13 % from that of South African specimens, which led them to the conclusion that Senegalese *P.* cf. *hesperidus* likely represents a different species.

Protein / allozyme - Unknown.

HABITAT:
Cooper-Bohannon *et al.* (2016: Table S2) indicate that, in southern Africa, *P. hesperidus* occurs primarily in Savanna (47 %), SW arid (20 %) and Afromontane (15 %) habitats.

In Madagascar, Ravelomanantsoa *et al.* (2019: 110) caught it in open spaces in a dry deciduous forest and near a banana plantation.

DIET:
Naidoo *et al.* (2011: 26) reported the following volume percentages from the Umbilo River (KwaZulu Natal, RSA): during summer: Lepidoptera (7.8 ± 2.8), Coleoptera (12.3 ± 5.5), Hemiptera (32.8 ± 2.8), Diptera (37.8 ± 8.1), and Trichoptera (9.2 ± 7.1); during winter: Lepidoptera (16.9 ± 19.0), Coleoptera (20.4 ± 20.3), Hemiptera (12.6 ± 13.2), Diptera (13.7 ± 5.1), and Trichoptera (36.4 ± 38.7). From the Westville River, they reported for the summer: Lepidoptera (10.0 ± 4.5), Coleoptera (8.0 ± 3.8), Hemiptera (31.2 ± 10.7), Diptera (42.7 ± 11.4), Trichoptera (2.7 ± 0), and Hymenoptera (5.4 ± 8.7).

From the Limpopo province (RSA), Taylor *et al.* (2017b: 245, 252 - 254) report the following food items, belonging to six insect orders: Lepidoptera (*Araeopteron* sp. + *Toxocampinae tathorhynchus* + *Eutelia polychorda* + *Chiasmia interrupta* + *Ennominae* sp. + *Isturgia roraria* + *Sena* sp. + *Sena prompta* + *Xenopseustis* sp. + *Athetis ignava* + *Copitarsia* sp. + *Cortyta canescens* + *Enmonodia capensis* + *Mythimna impura* + *Mythimna oxygala* + *Pandesma robusta* + *Pericyma atrifusa* + *Spodoptera exigua* + *Tycomarptes* sp. + *Maurilia arcuata* + *Pseudautomeris irene* + *Arotrura JFL201* + *Agrius convolvuli* + unmatched), Coleoptera (unmatched), Orthoptera (*Neoconocephalus spiza* + unmatched), Hemiptera (*Nezara viridula*), Diptera (*Culex quinquefasciatus* + 2 unmatched) and Blattodea (unmatched).

Bailey *et al.* (2019: 372) found that the Allotonic Frequency Hypothesis (eared moths are less available to syntonic bats due to their ability to detect these bat's echolocation, but become available around lights due to a reduction in efficacy of the moth's defences) is true for *Pipistrellus hesperidus*.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the following avian predators: Little sparrowhawk (*Accipiter minullus* (Daudin, 1800)); Southern fiscal (*Lanius collaris* Linnaeus, 1766). They also mention "*P. kuhli*" being preyed upon by the Lanner falcon (*Falco biarmicus* Temminck, 1825), the Eurasian hobby (*Falco subbuteo* Linnaeus, 1758), the Common kestrel (*Falco tinnunculus* Linnaeus, 1758), but some of these records might involve *P. hesperidus*. Their references to the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) probably all refer to *P. hesperidus* as these all point to sub-Saharan countries.

POPULATION:
Structure and Density - There is little information available on the abundance of this species, however, it is not very common in southern Africa (Skinner and Chimimba, 2005: 301; Mickleburgh *et al.*, 2008dp; IUCN, 2009).
Trend - 2008 - Unknown (Mickleburgh *et al.*, 2008dp; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
Stanley and Goodman (2011: 46 - 47) report on two females collected in early July 1991 in the West Usambara Mountains (Tanzania) of which one had an embryo in each uterine horn. Three other females, collected on 1 September 1992, did not show any signs of reproduction.

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned that pregnant females were collected in October.

PARASITES:
Basilia robusta Theodor 1956 (Haeselbarth *et al.*, 1966: 111 - host recorded as *P. kuhlii*). Beaucournu and Noblet (1985: 635) also mention the possible presence of *Basalia daganiae* Theodor and Moscona, 1954 on a "*P. kuhlii*" from Kenya.

The bat fly "*Basilia* sp. 3" was reported from "*Pipistrellus* cf. *hesperidus*" by Ramasindrazana *et al.* (2017: 4).

Ramasindrazana *et al.* (2016: 6) report the presence of *Litosoma* Clade 2 (Nematoda: Onchocercidae) in Madagascan "*P.* cf. *hesperidus*".

The flea *Ischnopsyllus emminus* Jordan and Rothschild, 1921 was reported on "*P. kuhlii*" from Malawi by Beaucournu and Kock (1996).

The bat bugs *Cacodmus ignotus* Rothschild, 1912 and *Cacodmus sparsilis* Rothschild, 1914 (Hemiptera: Cimicidae) were reported from South Africa by Hornok *et al.* (2017a: 3).

Hornok *et al.* (2017b: 3) found larvae of the tick *Argas transgariepinus* White, 1846 (Ixodida: Argasidae) on a *P. hesperidus* from Makhado, RSA. Hornok *et al.* (2019: 2) probably refer to the same bat and tick and indicate that the latter was infected with *Rickettsia* sp. bacteria.

VIRUSES:
Coronaviridae

Anthony *et al.* (2017b: Suppl.) mention the beta-coronavirus MERS_like_CoV. Anthony *et al.* (2017a: 1) described a MERS_like CoV (strain PREDICT/PDF-2180) from *P.* cf. *hesperidus* from Uganda.

Paramyxoviridae
1 out of 11 Madagascan specimens tested by Mélade *et al.* (2016b: 4) was positive for paramyxoviruses.

Rhabdoviridae - Rabies like viruses
Lyssavirus - Rabies related viruses
Rabies - Oelofsen and Smith (1993) tested [as *P. kuhlii*] one individual brain, from Christiana, Free State Province South Africa by means of the "Rapid rabies enzyme immunodiagnosis" (RREID) test (Diagnostic Pasteur), and this did not test positive.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Botswana, Burkina Faso, Cameroon, Cape Verde, Côte d'Ivoire, Djibouti, Eritrea, Ethiopia, Ghana, Kenya, Liberia, Madagascar, Malawi, Mozambique, Niger, Nigeria, Rwanda, Senegal, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

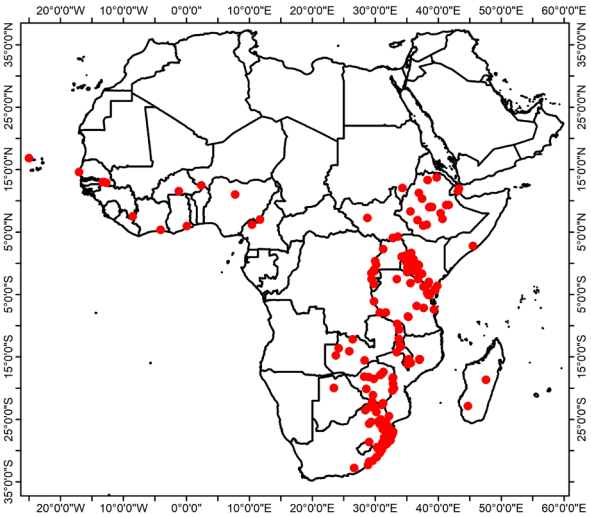


Figure 345. Distribution of *Pipistrellus hesperidus*

Pipistrellus hesperidus broomi Roberts, 1948

*1948. *Pipistrellus (Romicia) kuhlii broomi* Roberts, Special Publication of the Royal Society of South Africa, Robert Broom Commemorative volume, 9. Type locality: South Africa: KwaZulu-Natal: Durban: Malvern [29 53 S 30 56 E, 275 m]. Holotype: TM 1085: ad ♀. Collected by: Henry Paul William Lyster Jameson; collection date: 10 January 1908; original number: 425. Smithers *et al.* (1987: 463) also mention that three specimens have the number TM 1085 (both other specimens are probably TM 1081 [*P. nanus*] and TM 1087 [*P.* cf. *fuscatus* -> *P. hesperidus*]. - Comments: Type locality more likely to be Tzaneen Estates, Tzaneen, northeastern Transvaal (R.H.N. Smithers, in litt): see Meester

et al. (1986: 52). However, see also Smithers *et al.* (1987: 463) for a discussion on the type locality and type specimen. They confirm "Malvern" as type locality.

1951. *Romicia kuhlii broomi:* Roberts, Mammals of South Africa, 82. (Name Combination)
1953. *Pipistrellus (Pipistrellus) kuhli broomi:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination)
1957. *P[ipistrellus] k[uhli] broomi:* Ansell, Ann. Mag. nat. Hist., ser. 12, 10 (115): 538. Publication date: 29 October 1957. (Name Combination)
1968. *P[ipistrellus] k[uhlii] broomi:* Hill, Bonn. zool. Beitr., 19 (1/2): 44. (Name Combination, Alternate Spelling)
1969. *Pipistrellus (Romicia) kuhli broomi:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 167. - Comments: Alternate spelling for the name used by Roberts (1948). (Alternate Spelling)
1971. *Pipistrellus [(Pipistrellus)] kuhlii broomi:* Hayman and Hill, Mammals of Africa: Chiroptera, 40. (Name Combination, Alternate Spelling)
1992. *Pipistrellus kuhli broomi:* Trujillo, Murcielagos de las Islas Canarias, 23. (Name Combination)
? *Pipistrellus hesperidus broomi:* (Name Combination, Current Combination)
? *Pipistrellus kuhlii broomi:* (Name Combination)

GENERAL DISTRIBUTION:
KwaZulu-Natal (RSA).

Pipistrellus hesperidus hesperidus (Temminck, 1840)

*1840. *Vespertilio hesperida* Temminck, Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe, 2: 211. Type locality: Eritrea: Abyssinia: Red Sea, shores of the [ca. 09 N 39 E] [Goto Description]. Lectotype: SMF 12381: ad ♂, skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1842. Old catalog number II.N.9*. - Etymology: From the feminine scientific Latin adjective *hespèrida*, meaning "evening animal", deriving from the feminine Greek substantive "*ἑσπέρα*" (hespèra), meaning "evening", as this bat, as almost all Chiroptera, begins to fly at dusk (see Lanza *et al.*, 2015: 410).
1901. *Pipistrellus Kuhlii fuscatus* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (43): 34. Publication date: 1 July 1901. Type locality: Kenya: Naivasha [00 46 S 36 21 E] [Goto Description]. Holotype: BMNH 1901.8.9.96: ad ♂, skull and alcoholic. Collected by: Sir Harry Hamilton Johnston; collection date: 19 October 1900. Presented/Donated by: Sir Harry Hamilton Johnston.
1913. *Pipistrellus kuhli fuscatus:* Roberts, Ann. Transv. Mus., 4: 67. - Comments: Alternate spelling for the name used by Thomas, 1901. (Alternate Spelling)
1951. *Pipistrellus (Pipistrellus) kuhlii fuscatus:* Swynnerton and Hayman, J. East Afr. Nat. Hist. Soc., 20 (6-7) (90): 297 (for 1950).
? *Pipistrellus hesperidus hesperidus:* (Name Combination, Current Combination)

GENERAL DISTRIBUTION:
Sub-Saharan Africa with the exception of the extreme southeastern part of the continent.

Pipistrellus hesperidus subtilis (Sundevall, 1846)

*1846. *Vespertilio subtilis* Sundevall, Öfvers. kongl. Sv. Vet.-Akad. Förhandl., 3 (4): 119. Type locality: South Africa: "Interior of Caffraria". - Comments: Collector: J. Wahlberg.
1855. *Vespertilio (Vesperugo) subtilis:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 746. (Name Combination)
1860. *Hypsugo subtilis:* Kolenati, Monographie der Europäischen Chiroptern, 6. (Name Combination)
1917. *Pipistrellus kuhlii subtilis:* G.M. Allen, Bull. Mus. comp. Zool., 83: 94. (Name Combination)
1931. *Pipistrellus subtilis:* Hewitt, A guide to the Vertebrate fauna of the Eastern Cape Province, 23. (Name Combination)

1951. *Eptesicops subtilis:* Roberts, Mammals of South Africa, 83. (Name Combination)
1953. *Pipistrellus (Pipistrellus) kuhli subtilis:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination)
1971. *Pipistrellus [(Pipistrellus)] kuhii subtilis:* Hayman and Hill, Mammals of Africa: Chiroptera, 40. (Name Combination)
1978. *Pipistrellus kuhli subtilis:* Ansell, Mammals of Zambia, 27. (Name Combination)
1993. *subtilus:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 221. (Lapsus)
? *Pipistrellus hesperidus subtilis:* (Name Combination, Current Combination)

GENERAL DISTRIBUTION:
SE Africa.

Pipistrellus inexspectatus Aellen, 1959

*1959. *Pipistrellus inexspectatus* Aellen, Archs Sci. Genève, 12 (2): 226. Type locality: Cameroon: Upper Benoue Valley: Ngaaouyanga [07 59 N 13 36 E] [Goto Description]. Holotype: MHNC ad ♂, alcoholic (skull not removed). Collected by: Villy Aellen and Albert Monard; collection date: 11 July 1947; original number: 954. See Aellen (1959a: 226). (Current Combination)
1966. *P[ipistrellus] inexpectatus:* Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: 52. (Lapsus)
1971. *Pipistrellus [(Pipistrellus)] inexpectatus:* Hayman and Hill, Mammals of Africa: Chiroptera, 41. (Name Combination, Lapsus)
1987. *Nycterikaupius inexpectatus:* Menu, Palaeovert., 17 (3): 109. Publication date: 15 November 1987. (Name Combination, Lapsus)
1987. *Pipistrellus (Pipistrellus) inexspectatus:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 281. (Name Combination)
1993. *Pipistrellus (Hypsugo) inexspectatus:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 220. (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: netopýr kamerunský. English: Aellen's Pipistrelle Bat, Aellen's Pipistrelle, Central Africa Pipistrelle. French: Pipistrelle d'Aellen, Pipistrelle d'Afrique centrale. German: Unerwartete Zwergfledermaus, Unerwartete Pipistrelle.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Fahr, 2008q; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Fahr, 2008q; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Fahr, 2004i; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are poorly known (Fahr, 2008q; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008q) [in IUCN (2009)] reports that it is not known if the species is present in any protected areas. Further field surveys are needed to better understand the distribution, natural history and possible threats to this little known bats species.

GENERAL DISTRIBUTION:
Pipistrellus inexspectatus has been recorded from a few localities in West and Central Africa. It has been reported from Sierra Leone, Ghana, Benin and Nigeria and Cameroon.

There are also uncertain records from east Sudan and Uganda, although the specimens in question are difficult to certainly allocate to *Pipistrellus inexspectatus* (Koopman, 1975). The records of *P. inexspectatus* from the Democratic Republic of the Congo and Kenya are now allocated to *Pipistrellus eisentrauti* (Koopman *et al.*, 1995; Simmons, 2005).

Native: Benin; Burkina Faso (Kangoyé *et al.*, 2012: 6026; 2015a: 621); Cameroon; Ghana; Nigeria; Sierra Leone.
Presence uncertain: Sudan; Uganda.

ECHOLOCATION:
One FM/QCF call from Maroua (Cameroon), reported by Manga Mongombe (2012: 79) had the following parameters: F_{max}: 54.7 kHz, F_{min}: 47.7 kHz, F_{mean}: 51.2 kHz, F_{knee}: 54.7 kHZ, F_{char}: 47.7 kHz, and duration: 0.46 msec.

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Fahr, 2008q; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, 2008q; IUCN, 2009).

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Cameroon, Côte d'Ivoire, Ghana, Kenya, Madagascar, Nigeria, Sierra Leone.

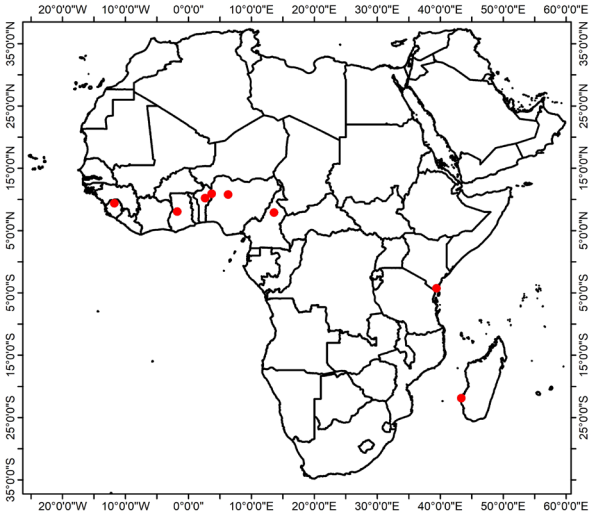


Figure 346. Distribution of *Pipistrellus inexspectatus*

Pipistrellus kuhlii (Kuhl, 1817)

*1817. *Vespertilio Kuhlii* Kuhl, Die Deutschen Fledermäuse, Hanau, 14. Type locality: Italy: Friuli-Venezia Giulia and Trieste. - Comments: Koopman (1993a: 221) mentioned 1817 as year of publication, whereas Meester *et al.* (1986: 51), Harrison and Bates (1991: 85), Corbet and Hill (1992: 137) and Bates and Harrison (1997: 179) mention "1819: Ann. Wetterau Ges. Naturk., 4 (2) 199".

1830. *Vespertilio marginatus* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 74, pl. 29a. Type locality: "Africa": Nile valley or eastern desert of Egypt [Goto Description]. Holotype: SMF 4307: ad ♀, skin and skull. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1822. Don 1882; old catalog II.N.10.a: see Mertens (1925: 21). - Comments: Kock (1969a: 167) mentions "Arabia Petraea (=Sinai) und Nubien" as type locality. The publication date of Cretzschmar's work is sometimes indicated as "1826" (as mentioned on the title page), but also as "1827", "1828", "1830-1831".

1838. *Scotophilus Kuhlii:* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 497. (Name Combination)

1839. *Vesperugo Kuhlii:* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 319. (Name Combination)

1853. *V[esperugo (Vesperugo)] Kuhlii:* Blasius, Arch. Naturgesch. Berlin, 19 (1): 46. (Name Combination)

1855. *Vespertilio (Vesperugo) Kuhlii:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 729. (Name Combination)

1856. *Nannugo Kuhlii:* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (4): 131. (Name Combination)

1857. *S[cotophilus] marginatus:* Tomes, Proc. zool. Soc. Lond., 1857, XXV (cccxxx): 50.

1862. *Vespertilio (Nannugo) Kuhlii:* Koch, Nass. Naturw. Jahrb., 18: 396. (Name Combination)

1862. *Vespertilio (Nannugo) marginatus:* Koch, Nass. Naturw. Jahrb., 18: 397.

1865. *V[espertilio] (Pipistrellus) marginatus:* De Filippi, Note di un viaggio in Persia nel 1862, 343. (Name Combination)

1866. *Vesperugo marginatus:* Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (6 - 10): 546.

1867. *Pipistrella marginata:* Loche, Exploration scientifique de l'Algerie pendant les années 1840, 1841, 1842. Mammifères, Cheiroptères, 77. (Alternate Spelling)

1867. *Pipistrella minuta:* Loche, Exploration scientifique de l'Algerie pendant les années 1840, 1841, 1842. Mammifères, Cheiroptères, 78. Publication date: 1867. Type locality: Algeria: Messad Oasis [34 11 N 03 31 E] [Goto Description]. (Name Combination, Alternate Spelling)

1871. *Pipistrellus marginatus:* Dobson, J. Asiatic Soc. Bengal, 40 (2): 460.

1871. *V[esperugo] Kuhli:* Doderlein, Alcune generalita Intorno la Fauna Sicula de Vertebrati, 31. (Name Combination)

1878. *Vesperugo (Vesperugo) kuhlii:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 230. (Name Combination)
1880. *Vesperugo Kühli:* Dobson, Bull. Soc. zool. France, 5: 235. (Name Combination)
1891. *Vesperugo (Vesperugo) kuhli:* Blanford, The fauna of British India, including Ceylon and Burma. Part II, 315. (Alternate Spelling)
1898. *P[ipistrellus] kuhli:* Thomas, Proc. zool. Soc. Lond., 1897, IV: 927. Publication date: April 1898. (Name Combination)
1899. *Vesperugo (Euvesperugo) kuhli:* Acloque, Faune de France, Mammifères, 36. (Name Combination)
1900. *Pipistrellus kuhlii:* Méhely, Monographia Chiropterorum Hungariae, 261. (Name Combination, Current Combination)
1902. *Pipistrellus deserti* Thomas, Proc. zool. Soc. Lond., 1902, II, I: 4. Publication date: October 1902. Type locality: Libya: Fezzan: Murzuk [25 56 N 13 57 E] [Goto Description]. Holotype: BMNH 1902.11.4.1: ad ♂, skin and skull. Collected by: Joseph Isaac Spadafora Whitaker; collection date: 30 May 1901; original number: 71. - Etymology: From *desèrti*, meaning "of the desert" (see Lanza *et al.*, 2015: 395).
1905. *Vespertilio (Pipistrellus) Kuhli:* Trouessart, Caus. sci. Soc. zool. France, 1 (10): 370/18. (Name Combination)
1909. *Pipistrellus kühli:* Satunin, Mitt. Kauk. Mus., 4: 299. (Name Combination)
1918. *Pipistrellus kuhli kuhli:* Wroughton, J. Bomb. nat. Hist. Soc., 25: 588. (Name Combination)
1936. *P[ipistrellus] k[uhlii] pallidus* Heim de Balsac, Supp. Bull. Biol. Fr. & Belg., 21: 43, 50, 180. Publication date: 1936. Type locality: Algeria: Northern Sahara: A'haggar, to the [ca. 23 30 N 06 00 E]. - Comments: Considered a nomen nudum by Allen (1939a: 94), Rode (1947: 138), Kock (1969a: 167). (Name Combination)
1936. *Pipistrellus kuhlii kuhlii:* Heim de Balsac, Supp. Bull. Biol. Fr. & Belg., 21: 91. (Name Combination)
1937. *[Pipistrellus Kühli] latastei* Laurent, Mammalia, 1: 157, footnote. Type locality: "Africa": Northern Africa [Goto Description]. - Comments: New name for *Pipistrellus kuhlii albolimbatus* Lavauden non Kuster (see Laurent, 1937c: 157 footnote). - Etymology: In honour of Mr. Lataste (see Laurent, 1937c: 157).
1937. *Pipistrellus Kühli Kühli:* Laurent, Mammalia, 1: 157. (Name Combination)
1951. *Pipistrellus kuhlii albolimbatus:* Panouse, Trav. Inst. Sci. Cherifien, 1: 80. (Name Combination)
1953. *Pipistrellus (Pipistrellus) kuhli kuhli:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination)
1953. *Pipistrellus (Pipistrellus) kuhli:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 81. (Name Combination)
1959. *Pipistrellus (Romicia) kuhli:* Anonymus, Koedoe, 3: 58. (Name Combination)
1966. *Pipistrellus (Pipistrellus) kuhli pallidus:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 169. (Name Combination)
1969. *[Pipistrellus kuhli] pallidus:* Aellen and Strinati, Rev. suisse Zool., 76 (16): 427. (Name Combination)
1971. *Pipistrellus [(Pipistrellus)] kuhlii kuhlii:* Hayman and Hill, Mammals of Africa: Chiroptera, 40. (Name Combination)
1971. *Pipistrellus [(Pipistrellus)] kuhlii pallidus:* Hayman and Hill, Mammals of Africa: Chiroptera, 40. (Name Combination)
1971. *Pipistrellus [(Pipistrellus)] kuhlii:* Hayman and Hill, Mammals of Africa: Chiroptera, 40. (Alternate Spelling)
1972. *P[ipistrellus] k[uhli] marginatus:* Gaisler, Madkour and Pelikan, Acta sc. nat. Brno, 6 (8): 32. (Name Combination)
1975. *Pipistrellus kuhli aegyptius:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 400.
1976. *Pipistrellus (Pipistrellus) kuhli palludus:* Anciaux de Faveaux, Bull. Soc. Hist. nat. Afr. Nord, 67 (1-2): 73. (Lapsus)
1978. *Pipistrellus kuhli marginatus:* Madkour, Zool. Anz., 201 (5/6): 387. (Name Combination)
1984. *Pipistrellus (Pipistrellus) kuhli aegyptius:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch..
1985. *Pipistrellus aegyptius:* Qumsiyeh, Spec. Publ. Mus. Texas Tech. Univ., 23: 51.
1985. *Pipistrellus kuhlii marginatus:* Qumsiyeh, Spec. Publ. Mus. Texas Tech. Univ., 23: 47. (Name Combination)

1986. *Pipistrellus kunli:* Chastel, Launay, Le Lay, Bailly-Choumara, Hellal, Valle, Bach-Hamba and Beaucournu, Cah. ORSTOM, sér Ent. méd. et Parasitol., 24 (1): 71. (Lapsus)
1993. *Pipistrellus (Pipistrellus) aegyptius:* Koopman, in: Wilson and Reeder, Mammal species of the World (2nd Edition): Chiroptera, 219.
1994. *P[ipistrellus (Pipistrellus)] k[uhlii] marginatus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 114. (Name Combination)
1997. *Pipistrellus aegyptiacus:* Decher, Z. Säugetierk., 62: 132. (Lapsus)
2008. *Pipistrillus kuhli:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 247. (Name Combination, Lapsus)
2008. *Pipstrillus Kuhli:* Selim, Nahla, and Shelfeh, Tishreen Univ. J. Res. Sci. Stud. - Biol. Sci. Ser., 30 (1): 247. (Name Combination, Lapsus)
? *Nannugo marginatus:*
? *Pipistrellus (Pipistrellus) deserti:*
? *Pipistrellus (Pipistrellus) kuhlii:* (Name Combination)
? *Pipistrellus kuhli:* (Alternate Spelling)
? *Pipistrellus kuhlii pallidus:* (Name Combination)

TAXONOMY:
Koopman (1994: 114) states that the allocation of many populations to subspecies is uncertain. Additionally, sub-Saharan specimens belong to *hesperidus*.

Although most authors have considered *P. deserti* as a separate species (Heim de Balsac, 1934a, 1936, Allen, 1939a, Ellerman and Morrison-Scott, 1951, Kock, 1969a, Kock, 1999b, Hayman and Hill, 1971, Gaisler *et al.*, 1972, Koopman, 1975, 1993a, 1994, Anciaux de Faveaux, 1976b, Hanák and Elgadi, 1984, Qumsiyeh, 1985, Gaisler and Kowalski, 1986, Hill and Harrison, 1987, Le Berre, 1990, Kowalski and Rzebik-Kowalska, 1991, Horácek *et al.*, 2000), others (Corbet, 1978, Aulagnier and Thevenot, 1986, Pavlinov *et al.*, 1995, Benda and Ruedi, 2004, Benda *et al.*, 2004d, perhaps Rode, 1947) doubted the full species status and regarded it as conspecific with *P. kuhlii*, but *P. deserti* and *P. kuhlii* are two separate morphotypes which differ clearly in size (Gaisler *et al.*, 1972, Kowalski and Rzebik-Kowalska, 1991). As these forms do not occur in sympatry (but see Kowalski and Rzebik-Kowalska, 1991), they may perhaps represent two ecogeographic forms of one species. However, this question requires profound revision of the whole *P. kuhlii* complex both on morphologic and genetic bases (see Kock, 2001b). Mayer *et al.* (2007) reported genetic evidence that *P. deserti* are not distinct from *P. kuhlii*, while García-Mudarra *et al.* (2009) found a differentiation in the cytochrome *b*. Benda *et al.* (2014c: 75) indicate that the presence of bats of the *deserti* morphotype within two separate lineages of *P. kuhlii*, the Libyan-Egyptian and Morrocan, suggests two directions of origin of this morphotype, the west-Saharan and east-Saharan, which in turn indicate that the *deserti* morphotype is a local variation (ecomorphotype) of *P. kuhlii*, which does not deserve taxonomic expression even at the subspecific level.
Benda *et al.* (2014a: 419) presented sufficient prove to support the view that significant differences between the two morphotypes are grouped by geographic origin, and that *P. deserti* should be considered a junior synonym of *P. kuhlii*.

The authorship and description date for *Vespertilio kuhlii* has been debated for years. It has been assigned to either Kuhl, Natterer or "Natterer (in Kuhl)". The publication year was mentioned as either 1817 or 1819. This confusing situation has been cleared by Bogdanowicz and Kock (1998), who fixed author and date to Kuhl, 1817.

Similarly, the authorship of *marginatus* has been assigned to various authors: Cretzschmar, 1826-1830, Rüppell, 1826, Wagner, 1840, Bonaparte, 1841, and Kolenati, 1856.

In the synonyms list for this species, we did not make a difference for the author and/or year of publication mentioned by the various publications when dealing with *kuhlii*.

COMMON NAMES:
Afrikaans: Kuhl se vlermuis, Kuhl-vlermuis. Albanian: Pipistrel i Kuhl-it. Arabian: Khaffash. Armenian: Միջերկրածովային փոքրաչղջիկ. Azerbaijani: Küli şəbpərəsi. Basque: Kuhl pipistrelo, Kuhl saguzar. Belarusian: Нетапыр міжземнаморскі, Нетапыр Куля. Bosnian: Kulijev šišmiš. Breton: Pipistrell Kuhl. Bulgarian: Средиземноморско прилепче. Castilian: Murciélago de borde claro. Catalan: Pipistrel·la de vores clares, Rat penat de vores clares. Croatian: Bjelorubi šišmiš. Czech: Netopýr jižní, Netopýr vroubený, Nedopír celouchý, Netopýr červenohlavý. Danish: Kuhls flagermus. Dutch: Kuhls dwergvleermuis, Kuhl's dwergvleermuis.

English: Kuhl's pipistrelle, Kuhl's Pipistrelle Bat, Kuhl's Bat, Great pipistrelle, Flitter Mouse, White stripe bat. Estonian: Vahemere nahkhiir. Finnish: Kapearäpyläpiippa. French: Pipistrelle de Kuhl, Pipistrelle géante, le vespertilion de Kuhl. Frisian: Wytrâne dwerchflearmûs. Galician: Morcego de borde claro, Morcego de beira branca. Georgian: ხმელთაშუაზღვიური ღამორი, კულის. German: Weißrandfledermaus, Weißrand-Pipistrelle, Haarbindigen Dämmerungsfledermaus, Kuhlische Fledermaus. Greek: Λευκονυχτερίδα. Hebrew: Atalfon Leven Shulayim. Hungarian: Fehérszélű törpedenevér, Nycteris i leukogyros. Irish Gaelic: Ialtóg Kuhl. Italian: Pipistrello albolimbato, Pipistrello de Kühli. Latvian: Kūla sikspārnis. Lithuanian: Kulio šikšniukas. Luxembourgish: Wäissbordfliedermaus. Macedonian: Белорабен лилјак [= Beloraben Liljak]. Maltese: Pipistrell ta' Kuhl. Montenegrin: Bijelorubi slijepi mišić. Norwegian: Hvitrandflaggermus. Polish: Karlik średni, Karlik Kuhla. Portuguese: Morcego de Kuhl, Morcego anao de Kuhl. Rhaeto-Romance: Pipistrel da Kuhl. Romanian: Liliacul pitic al lui Kuhl, Liliacul cu dungã albã. Russian: Нетопырь средиземноморский, Средиземноморский нетопырь [= Sredizemnomorskij netopyr], Нетопырь Куля. Serbian: Б[ј]елоруби слепи мишић [= B[j]elorubi slepi mišić]. Scottish Gaelic: Ialtag Kuhl. Slovak: Večernica južná. Slovenian: Belorobi netopir. Swedish: Parkpipistrell, Kuhls fladdermus. Turkish: Beyazşeritli Yarasa. Ukrainian: Нетопир білосмугий. Welsh: Ystlum lleiaf Kuhl.

CONSERVATION STATUS:
Global - The species is widespread and abundant, and populations are increasing in parts of the range. Consequently, it is assessed as Least Concern (LC ver 3.1 (2001)) (Aulagnier *et al.*, 2008b; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Aulagnier *et al.*, 2008b; IUCN, 2009). 2004 - LC ver 3.1 (2001) [assessment included *P. hesperidus*] (Aulagnier, 2004c; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

For *P. deserti*, the assessment history was:
2008 - LC ver 3.1 (2001) (Benda *et al.*, 2008d; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Benda, 2004a; IUCN, 2004). 1996 - LR/lc [assessed as *P. aegyptius*] (Baillie and Groombridge, 1996).

MAJOR THREATS:
No major threats are known. Use of pesticides to eradicate mosquitos (especially in urban areas) may be a threat in places (Aulagnier *et al.*, 2008b; IUCN, 2009).

Sherwin *et al.* (2012: 174) name aerial hawking and its long-distance dispersal to be the most important risk factors related to climatic change. Bilgin *et al.* (2012: 434) indicate that climatic change is already influencing this species as it has been expanding its range northwards over the past 15 years.

CONSERVATION ACTIONS:
Aulagnier *et al.* (2008b) [in IUCN (2009)] report that it is protected by national law in most European range states. It is also protected under international legislation in parts of its range through the Bonn Convention (Eurobats) and Bern Convention, and is included in Annex IV of EU Habitats and Species Directive. It is found in a number of protected areas. No specific conservation actions are known.

GENERAL DISTRIBUTION:
Pipistrellus kuhlii is widespread in North Africa, Europe and Asia. It has a large range extending from Iberia through southern Europe through the Near East and the Caucasus to Kazakhstan, Pakistan, and India (Molur *et al.*, 2002). There is a single record from China (Smith and Xie, 2008). The northern limit of its range in Europe was formerly ca. 45°N, but the species has been expanding northwards. It arrived 1994 in Vienna/Austria (48°N) and was more recently recorded to 50°N in France and 51°N in Ukraine. It has been expanding northwards in Russia for the last half century from 46° N to c.53°N, with the highest record made at almost 57°N (S. Kruskop *pers. comm.*, 2006 in Aulagnier *et al.*, 2008b). It occurs from sea level to 2,000 m.

Native: Afghanistan; Albania; Algeria; Andorra; Angola; Armenia; Austria; Azerbaijan; Bosnia and Herzegovina; Burkina Faso (as *P. deserti*); Bulgaria; Cape Verde Isls (Azzaroli Puccetti and Zava, 1988); Croatia; Cyprus (Benda *et al.*, 2007: 71); Czech Republic (Reiter *et al.*, 2007: 47); Egypt; France [Corsica]; Georgia; Germany; Gibraltar; Greece [Crete]; Holy See [Vatican City State]; Hungary; India; Iran, Islamic Republic of; Iraq; Israel; Italy [Sardegna, Sicilia]; Jordan; Kazakhstan; Kuwait; Lebanon (Horácek *et al.*, 2008: 59); Libyan Arab Jamahiriya; Macedonia, the former Yugoslav Republic of; Malta; Monaco; Montenegro; Morocco (Benda *et al.*, 2004d; 2010a: 158; El Ibrahimi and Rguibi Idrissi, 2015: 362); Oman; Pakistan; Palestinian Territory, Occupied; Portugal; Romania; Russian Federation; San Marino; Saudi Arabia; Serbia; Slovakia; Slovenia; Spain [Baleares, Canary Is.] (Azzaroli Puccetti and Zava, 1988); Sudan (as *P. deserti*); Switzerland; Syrian Arab Republic; Tunisia (Dalhoumi *et al.*, 2014: 53; 2016b: 867); Turkey; Ukraine; United Arab Emirates

(Anonymus, 2008: 38); Western Sahara (Benda *et al.*, 2010a: 161); Yemen.

Presence uncertain: China. Additionally, its presence (as *P. deserti*) was reported as uncertain from Ghana, Kenya, Nigeria, Senegal, and Somalia.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Alagaili *et al.* (2011: 466) describe the timing and molting patterns of *P. kuhlii* specimens from Saudi Arabia. They found that males were molting from the end of April to the end of August, whereas females were molting from the end of May/beginning of June to the end of August. The later molting in females was probably related to the fact that females gave birth between mid-April and mid-May. The molting itself starts at the back of the head and on the lower back and spreads from there over the entire head and back. Ventrally, the molt starts on the neck, around the nipples and along the sides of the body, then making its way to the centre of the chest.

DENTAL FORMULA:
Dorst (1949: 45-46, fig. 1) provides a description of the milk dentition of *P. kuhlii*. He also indicated (p. 47) that the milk teeth show some sort or heterodonty with the premolars being of different shape when compared with the insors and canines, which look more similar to one another. These latter teeth help the young to cling to the mother's nipples.

DETAILED MORPHOLOGY:
Ibraheem and Shelfeh (2008) report on the anatomy and histology of the digestive tract of Syrian *P. kuhlii*.
Selim *et al.* (2008: 247) studied the microscopical structure of the tongue of Egyptian and Syrian *P. kuhlii* specimens and found some differences between them.

SEXUAL DIMORPHISM:
In a year-round study in Tunisia, Dalhoumi *et al.* (2016a: 157) found adult females to be significantly heavier than males.

ECHOLOCATION:
For 31 Greek specimens, Papadatou *et al.* (2008b: 133) report a start frequency of 59.8 ± 14.75 kHz, a terminating frequency of 37.5 ± 1.33 kHz, a peak frequency of 39.7 ± 1.46 kHz, and a bandwidth of 9.4 ± 2.85 kHz. The duration of the call is 6.4 ± 1.38 msec, and the interpulse interval is 124.7 ± 44.55 msec.
Walters *et al.* (2012: suppl.) mention the following numbers for 47 calls of bats from France, Greece, Italy and Switzerland: duration: 5.62 ± 1.43 msec, F_{max}: 53.57 ± 10.08 kHz, F_{min}: 36.87 ± 2.15 kHz, bandwidth: 16.70 ± 9.93 kHz, F_{peak}: 39.77 ± 2.63 kHz.

In Jordan, Benda *et al.* (2010b: 204) reported the following parameters for 76 calls: F_{start}: 51.7 ± 6.2 (41.4 - 65.6) kHz, F_{end}: 39.1 ± 1.1 (41.4 - 65.6) kHz, F_{peak}: 41.1 ± 1.1 (37.2 - 43.2) kHz, duration: 6.4 ± 1.7 (3.4 - 10) msec, interpulse interval: 112.9 ± 38.0 (70.0 - 279.0) msec. For 37 calls from Iran, Benda *et al.* (2012a: 183) report: F_{start}: 48.9 ± 4.5 (43.26 - 60.5) kHz, F_{end}: 41.1 ± 1.6 (38.7 - 44.3) kHz, F_{peak}: 42.2 ± 1.9 (39.1 - 46.8) kHz, duration: 6.1 ± 1.3 (4.0 - 9.0) msec, and interpulse interval: 106.5 ± 38.7 (54.4 - 231.9) msec.

In Israel, the following values were recorded by Hackett *et al.* (2016: 223) for 84 calls: Pulse duration: 4.57 ± 2.05 msec, F_{start}: 51.27 ± 4.54 (40 - 71.2) kHz, F_{end}: 40.58 ± 1.54 (37 - 43.9) kHz, F_{peak}: 41.48 ± 1.53 (37 - 42.8) kHz.

Boonman *et al.* (2013b: 6) determined the detection range to be between 2 and 3.5 m at 20 dB and 4 and 7 m at 0 dB.

Corcoran and Moss (2017: 4560) refer to Amichai *et al.* (2015), who found that *P. kuhlii* solved the jamming problem of extreme acoustic interference from conspecifics not by adjusting call frequency but by emmiting calls of hither intensity, longer duration, and calling more often. This suggests that the bats try to increase the signal-to-noise ratio rather than avoiding spectral overlap.

MOLECULAR BIOLOGY:
DNA - See Mayer *et al.* (2007), García-Mudarra *et al.* (2009).
Karyotype - Both Baker *et al.* (1974) and Iliopoulou-Georgudaki and Giagia (1986) reported $2n = 44$, FN = 50, and BA = 8. However, Baker *et al.* (1974) reported a submetacentric X chromosome and an acrocentric Y chromosome, whereas Iliopoulou-Georgudaki and Giagia (1986) reported metacentric X and Y chromosomes. Rushton (1970: 465) reported $2n = 44$, FN = 50, X = metacentric and Y = acrocentric. Arslan and Zima (2014: 13) indicate that the autosomal set consists of three large and one small metacentric pairs, 15 acrocentric pairs and two dot-like pairs, and both sex chromosomes are medium-sized. According to Capanna and Manfredi Romanini (1971: 474) the autosomal chromosomes consist of 3 metacentric pairs, 1 submetacentric and 17 acrocentrics.

Bray *et al.* (2013: 5) indicate that widspread species - such as *P. kuhlii* - have extensive genetic diversity.

Protein / allozyme - Andriollo *et al.* (2015: 1) examined the COI gene in in European and North African *P. kuhlii* populations and found that all North African nuclear genotypes were grouped in a highly distinct subpopulation when compared with European samples sharing the same mitochondrial barcodes. In their figure 1 (p. 3), they show that the North African populations (including *deserti* have very similar haplotypes with the eastern European populations from the Balkan and Italy, but differ considerably from the western lineage found in France and Spain.

Locatelli *et al.* (2016: 423) determined the complete mitogenome and found it to contain 16,991 base pairs with 37 genes (13 protein-coding genes, 22 tRNA genes, 2 rRNA) and 1 control region.

HABITAT:
In Tunisia, Dalhoumi *et al.* (2018: 1) found this species to forage mainly around water bodies and streetlights. During summer, they also foraged in open Acacia woodlands (*Acacia tortilis raddiana*).

ROOST:
All of the roost found in Libya by Benda *et al.* (2014c: 64) were in ruins, with one exception for a single male in a rock fissure in an overhang.

DIET:
Benda *et al.* (2012a: 448) report that the diet is very variable over the species' distribution range: Diptera, Lepidoptera, Hymenoptera (particularly Formicoidea), Auchenorrhyncha, Coleoptera, and Heteroptera comprised a major part of the diet. For Iran, they found Coleoptera, Heteroptera, and Auchenorrhyncha to be the most important food items.

Also in Libya, Benda *et al.* (2014c: 77) report a very variable diet for *P. kuhlii*, where smaller moths (Lepidoptera) and beetles (Coleoptera) were the most important types of prey. The beetles belonged to the families Scarabaeidae, Carabidae (frequently Harpalini), Staphylinidae, Tenebrionidae, Chrysomelidae. Furthermore, ants (Hymenoptera: Formicoidea) formed a major part of the diet. Additionally, medium-sized brachyceran Diptera (Muscidae, Asilidae) were identified, as well as Neuroptera (Chrysopidae and Hemerobiidae).

PREDATORS:
Reuven (1991: 79) reported on *P. kuhlii* being captured by a Lanner Falcon (*Falco biarmicus* Temminck, 1825) in Israel. Mikula *et al.* (2016: Supplemental data) furthermore mention the same predator from either Botswana, Egypt, Ethiopia, Kenya, Nigeria, Sudan or South Africa. Part of these records might actually be for *P. hesperidus*. This is also the case for their record involving the Peregrine falcon (*Falco peregrinus* Tunstall, 1771).

Souttou *et al.* (2018: 136) found *P. kuhlii* to be a major part of the diet of the Common Kestrel (*Falco tinnunculus* Linnaeus, 1758) in Dergana (Algeria), where it made up to 16.4 % of the birds prey. In a second locality (El Harrach) if made up 0.7 % of the prey (and 0 % in seven other localities).

POPULATION:
Structure and Density - It is a relatively abundant species in the Mediterranean region and Middle East. Populations in South Asia seem to be stable and doing well (Molur *et al.*, 2002). Summer colonies typically number 30-100 individuals. In Iran and the Caucasus, the species' range is increasing, and it is displacing *P. pipistrellus* (M. Sharifi and K. Tsytsulina *pers. comm.*, 2005 in Aulagnier *et al.*, 2008b). The northern border of the species' range is also expanding. It is very numerous in urban areas across much of its range (Aulagnier *et al.*, 2008b; IUCN, 2009).
As *P. deserti*, it was reported to be the most common species in Sahara oases (Benda *et al.*, 2008d; IUCN, 2009).
Trend - 2008 - Unknown (Aulagnier *et al.*, 2008b; IUCN, 2009). *P. kuhlii* populations within the Asia Minor and Levant region are unknown population trend, under predictive climate change scenarios (Bilgin *et al.*, 2012: 433).

LIFESPAN:
Szekely *et al.* (2015: Suppl.) report a maximum longevity of 8 years.

ACTIVITY AND BEHAVIOUR:
In the Negev Desert, Polak *et al.* (2011: 24) found that *P. kuhlii* had a significantly higher flight speed when flying in areas with street lamps, than in in dark areas. They also found that flight height was higher in dark areas than in lighted areas (> 1 m).

Smotherman *et al.* (2016: 537) refer to Barak and Yom-Tov (1991) and Russo and Jones (1999) in describing the song-like structure for *P. kuhlii* as simple syllable type in a basic motif. Singing occurs while flying.

REPRODUCTION AND ONTOGENY:
Deleuil and Labbe (1955b: 238) reported three lactating females from El Hamaïn (Tunisia) on 24 July 1955. From the same country, Dalhoumi *et al.* (2018: 1) reported pregnant females from March to June, lactating females in June, and flying juveniles from June to August.

In Libya, Benda *et al.* (2014c: 71) report on four pregnant females colleced on 16 April, 16 on 20 April, 2 on 8 May, 3 on 22 May, and 1 on 23 May. Lactating females were found on 8, 21, 26 and 27 May. Szekely *et al.* (2015: Suppl.) report that weaning occurs after 60 days.

In the United Arab Emirates, Davis (2007: 8) indicates that females are sexually mature in their first year, and that two young are born.

POSTNATAL DEVELOPMENT:
Sharifi *et al.* (2012: 1235) studied the development of Iranian *P. kuhlii* specimens born in captivity and found that, at birth, young had a mean body mass of 1.04 ± 0.08 g and a forearm length of 11.48 ± 0.45 mm. During the first 23 days of their live, their body mass and forearm lenght increased on average with 0.10 ± 0.10 g/d and 0.64 ± 0.61 mm/d. Wingspan, handwing length and area, armwing length and area, and total wing area increased linearly until the age of the 1st flight (at 33 days), after which growth rates significantly declined. At the age of 60 d, the young had an average weight of 5.47 ± 0.07 g (87.56 % of the adult) and the mean forearm length of 35.97 ± 0.86 mm (89.46 % of the adult length).

PARASITES:
Korine *et al.* (2012: 1435) experimentally infested *P. kuhlii* specimens with the flea *Xenopsylla ramesis*, whose normal host is Sundevall's jird (*Meriones crassus*). They found that both male and female fleas engorged less blood from the bats than from the jird (and less than from *R. aegyptiacus* specimens tested during the same study). They also found that the survival time of the fleas was shorter when fed on *P. kuhlii* blood. Furthermore, fleas feeding from torpid bats were found to engorge more blood than those feeding from normothermic bats.

From Algeria, Bendjeddou *et al.* (2013: 325) reported *Phthiridium biarticulatum* Hermann, 1804 (Diptera: Nycteribiidae), *Cimex pipistrelli* Jenyns, 1839 (Hemiptera: Cimicidae), and *Ischnopsyllus octactenus* (Kolenati, 1856) (Siphonaptera: Ischnopsyllidae).
Bendjeddou *et al.* (2017: 15) mention the following ectoparasites: Siphonaptera: *Nycteridopsylla longiceps* Rothschild, 1908 and *Ischnopsyllus octactenus* (Kolenati, 1856); Heteroptera: *Cimex pipistrelli* Jenyns, 1839 and *Cacodmus vicinus* Horváth, 1934; Arachnida: *Hyalomma dromedarii* Koch, 1844.

Benda *et al.* (2014c: 80) report the following ectoparasites from Libya:
Argasidae: *Argas vespertilionis* (Latreille, 1802),
Macronyssidae: *Steatonyssus periblepharus* Kolenati, 1858,
Spinturnicidae: *Spinturnix acuminata* group,
Cimicidae: *Cimex lectularius* Linnaeus, 1758, *Cacodmus vicinus* Horváth, 1934,
Ischnopsyllidae: *Ischnopsyllus consimilis* (Wahlgren, 1904)

From Jordan, Benda *et al.* (2010b: 285) mention *Argas vespertilionis* (Latreille, 1802) (Argasidae), *Steatonyssus periblepharus* Kolenati, 1858 (Macronyssidae), and *Cacodmus vicinus* Kolenati, 1858 (Cimicidae).

Other parasites that were previously reported from the Middle East include the bat flies: *Nycteribia schmidlii* Schiner, 1853, *N. vexata* Westwood, 1835, *Penicillidia conspicua* Speiser, 1901, and *Basilia daganiae* Theodor and Moscona, 1954; the bat fleas *Ischnopsyllus octactenus* (Kolenati, 1856) (also from Tunisia by Beaucournu and Kock, 1996), *I. consimilis* (Wahlgren, 1904) *Xenopsylla cheopis* (Rothschild, 1903) and *Leptopsylla sengis* (Schoenherr, 1911); and the mite species *Spinturnix acuminatus* (Koch, 1836) and *Steatonyssus periblepharus* Kolenati, 1858.

Benda *et al.* (2012a: 449) report the following ectoparasites from Iran: Spinturnicidae: *Spinturnix* sp., *Meristaspis lateralis* Kolenati, 1857; Macronyssidae: *Steatonyssus periblepharus* Kolenati, 1858; Ischnopsyllidae: *Ischnopsyllus octactenus* (Kolenati, 1856). They also mention the presence of the bat flies *Basilia daganiae* Theodor et Moscona, 1954 in the Levant, *Ischnopsyllus consimilis* (Wahlgren, 1904) in Egypt, Israel and Lebanon, the bed bug *Cimex lectularius* Linnaeus, 1758 in Iraq, and *Cacodmus vicinus* Horváth, 1934 in Cyprus, Syria, Israel, Jordan, and Egypt.

Trypanosoma (Schizotrypanum) vespertilionis Battaglia, 1904 was reported from *P. kuhlii* specimens from the Assiut Governate, Egypt by Fahmy *et al.* (1978: 251).

Duszynski (2002: 16) indicates that Arabian *P. kuhlii* is the type host of *Eimeria chiropteri* Alyousif, 1999, *Eimeria kuhliensis* Alyousif, 1999, and *Eimeria pipistrellus* Alyousif, Al-Dakhil and Al-Shawa, 1999.

Greiman *et al.* (2016: 1006) reported the presence of a Trematode belonging to the genus *Lecithodendrium* Looss, 1896 in *P. kuhlii marginatus* from Egypt.

DIPTERA
Nycteribiidae: *Basilia bathybothyra* from Palestine, Egypt and Cyprus (Haeselbarth *et al.*, 1966: 110).

Ševcík *et al.* (2012: 35) report on the presence of the bat fly *Basilia daganiae* Theodor and Moscona, 1954 on bats from Cyprus. Beaucournu and Noblet (1985: 636) also plot a record for this bat fly in Egypt.

VIRUSES:

Coronaviridae

SARS-CoV - During Febuary 2008 in Ghana, one fecal sample of "*P. deserti*" tested negative for coronavirus (CoV) RNA by Pfefferle *et al.* (2009).

Alphacoronavirus

Kohl and Kurth (2014: 3112) reported this virus from Spain and Italy.

Betacoronavirus

Kohl and Kurth (2014: 3112) reported this virus from Italy.

Paramyxoviridae

Drexler *et al.* (2012a: Suppl. Table S1) indicated that the single specimen of "*P. deserti*" they examined from Ghana did not test positive for *Repirovirus, Henipavirus, Morbillivirus, Rubulavirus* or *Pneumovirus*.

Phenuiviridae

Phlebovirus

de Jong *et al.* (2011: 11), Luis *et al.* (2013: suppl.), and Kohl and Kurth (2014: 3111) report the occurrence of Toscana virus.

Reoviridae

Orthoreovirus

Kohl and Kurth (2014: 3113) reported this virus from Germany and Italy.

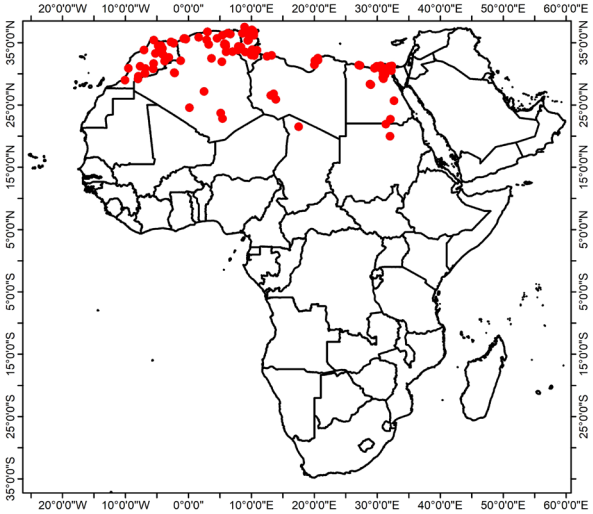


Figure 347. Distribution of *Pipistrellus kuhlii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:

"Africa", Algeria, Canary Islands (Spain), Chad, Egypt, Libya, Madagascar, Morocco, Sudan, Tunisia.

Pipistrellus maderensis (Dobson, 1878)

*1878. *Vesperugo [(Vesperugo)] maderensis* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, p. xxxix, 211, 231, pl. 12, fig. 5. Publication date: June 1878. Type locality: Madeira (Portugal): "Madeira" [32 44 N 15 58 W] [Goto Description]. Holotype: BMNH 1855.8.16.34: ad ♀, skull and alcoholic. Collected by: William S. MacGillivray. - Etymology: The name refers to the island where the type specimen was collected.

1908. *P[ipistrellus] maderensis:* K. Andersen, Ann. Mag. nat. Hist., ser. 8, 1 (5): 435. (Name Combination, Current Combination)

1922. *Pipistrellus maderensis:* Bannerman. - Comments: They Canary Islands: 153. (Name Combination)

1966. *Pipistrellus (Pipistrellus) maderensis:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 171. (Name Combination)

1999. *Pipistrellus madarensis:* Ohlendorf, Nyctalus (N.F.), 7: 193 - 195. (Lapsus)

TAXONOMY:

Pestano *et al.* (2003b: 61) indicate that *P. maderensis* is more closely related to the Canary Island *P. kuhlii* clade than the latter is to *P. kuhlii* from outside the Canaries.

Evin *et al.* (2010: 35) suggest that a Kuhl's pipistrelle-like bat colonized the Canary Islands and differentiated during the middle Pleistocene to give rise to the *maderensis* clade.

COMMON NAMES:

Albanian: Pipistreli i Madeiras. Armenian: Մադեյրական փոքրաչղջիկ. Azerbaijani: Maderiya vəya Kanar şəbpərəsi. Basque: Pipistrelo madeirar. Belarusian: Нетапыр мадэрскі. Bosnian: Madeirski šišmiš. Breton: Pipistrell Madeira. Bulgarian: Мадейрско прилепче. Castilian: Murciélago de Madeira. Catalan: Pipistrel·la de Madeira, Rat penat de Madeira. Croatian: Madeirski mali šišmiš. Czech: Netopýr makaronéský, Netopýr madeirský.

Danish: Madeiraflagermus. Dutch: Madeira dwergvleermuis, Madeiradwergvleermuis. English: Madeiran Pipistrelle Bat, Madeira pipistrelle. Estonian: Madeira nahkhiir. Finnish: Madeiranpiippa. French: Pipistrelle de Madère. Frisian: Madeira dwerchflearmûs. Galician: Morcego de Madeira. Georgian: მადეირული ღამორი German: Madeira-Fledermaus, Madeira-Zwergfledermaus, Madeira-Pipistrelle. Greek: Νυχτερίδας της Μαδέρας. Hungarian: Madeirai törpedenevér. Irish Gaelic: Ialtóg Mhaidéarach. Italian: Pipistrello di Madeira. Latvian: Madeiras sikspārnis. Lithuanian: Madeirinis šikšniukas. Luxembourgish: Madeira-Zwergfliedermaus. Macedonian: Медеирски лилјак. Maltese: Pipistrell ta' Madejra. Montenegrin: Slijepi mišićsa Madeire. Norwegian: Madeiraflaggermus. Polish: Karlik maderski. Portuguese: Morcego da Madeira. Rhaeto-Romance: Pipistrel da Madeira. Romanian: Liliacul pitic din Madeira. Russian: Нетопырь мадейрский. Serbian: Атлантски сл[ij]епи мишић [= Atlantski sl[ij]epi mišić]. Scottish Gaelic: Ialtag Mhaideurach. Slovak: Večernica madeirská. Slovenian: Madeirski mali netopir. Swedish: Madeirapipistrell. Turkish: Maderia Cüce Yarasası. Ukrainian: Нетопир мадейрський. Welsh: Ystlum lleiaf Madeira.

CONSERVATION STATUS:
Global - VU A2c, B1 + 2c ver 2.3 (1994, 2008).

MAJOR THREATS:
Sherwin *et al.* (2012: 174) name the small distribution range, water stress, the aerial hawking feeding style and the long-distance dispersal to be the most important risk factors linked with climatic change.

Jesus *et al.* (2013: 177) indicate that human activities (e.g. large-scale land use change, the use of biocids/pesticides and roost disturbance and destruction) as well as some natural events (e.g. floods and wildfires) form the major threats for this species. Additionally, introduced species such as *Rattus rattus* and *Felis catus* might pose important threats. The latter is also illustrated by Rocha (2015: 17), who reported on a domestic cat, which brought home three bats (of which one was identified as *P. maderensis*) over a period of one year.

Sagot and Chaverri (2015: 1670) mention roost loss or disturbance, and habitat degradation or loss as major threats for this species.

GENERAL DISTRIBUTION:
Madeira Islands (Portugal, where Rainho (2017: 161) reports its presence on six islands); Canary Islands (Spain).

GEOGRAPHIC VARIATION:
When comparing cytochrome *b* sequences from Madeiran and Canary Island specimens, Jesus *et al.* (2013: 119) found that the populations from both island groups represent "sister populations", showing a much higher sequence divergence than that observed within groups.

MOLECULAR BIOLOGY:
DNA - See Pestano *et al.* (2003b), Mayer *et al.* (2007).

POPULATION:
Queiroz *et al.* (2005) [in Jesus *et al.* (2013: "1")] indicate that the population on Madeira consists of about 1,000 individuals. They also indicate that on the Azores the total population is proably less than 300 (but they point out that the identity of these bats is uncertain).

ACTIVITY AND BEHAVIOUR:
Referring to Russo *et al.* (2009), Smotherman *et al.* (2016: 537) indicate that the song-like structure for this species consists of a simple syllable type in a basic motif. Singing occurs while flying.

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:

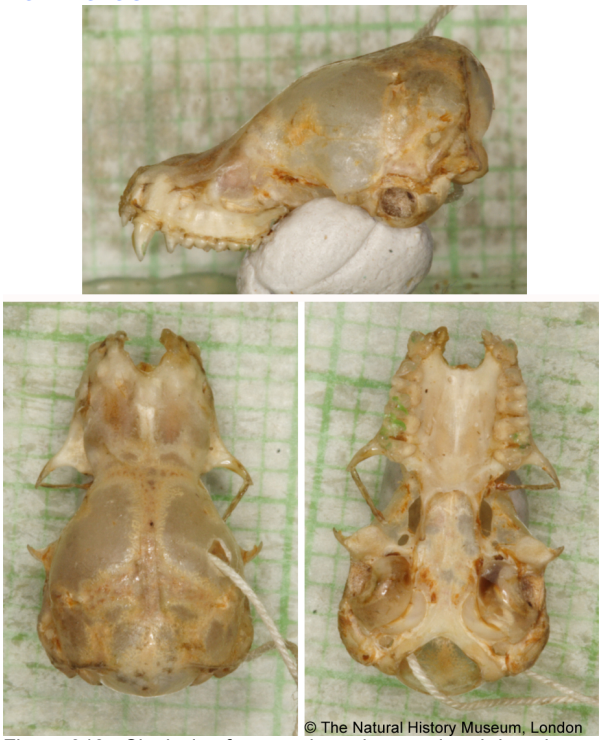


Figure 348. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1955.8.16.34, holotype of *Vesperugo maderensis* Dobson, 1878.

PARASITES:
When describing *Steatonyssus (Steatonyssus) balcellsi*, Estrada-Peña and Sanchez (1988: 305) also mentioned the presence of this mite on *P. maderensis* specimens from El Lagar and Aguamansa, Canary Islands.

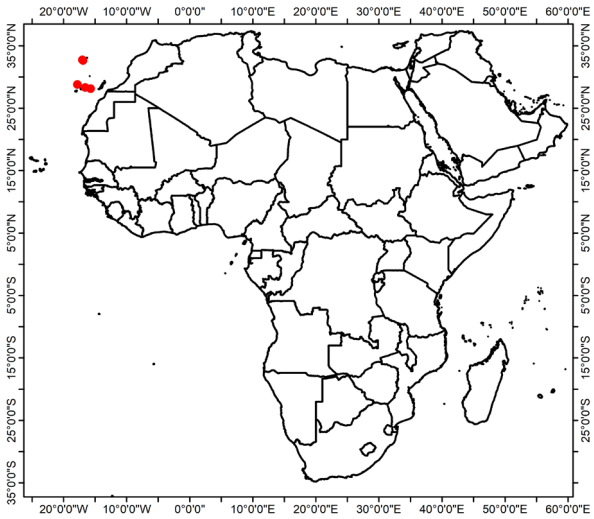


Figure 349. Distribution of *Pipistrellus maderensis*
DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Canary Islands (Spain), Madeira (Portugal).

Pipistrellus nanulus Thomas, 1904

*1904. *Pipistrellus nanulus* Thomas, Ann. Mag. nat. Hist., ser. 7, 14 (81): 198. Publication date: 31 August 1904. Type locality: Cameroon: Efulen [02 46 N 10 42 E] [Goto Description]. Holotype: BMNH 1904.2.8.8: ad ♂, skull and alcoholic. Collected by: George Latimer Bates Esq. (Current Combination)

1966. *Pipistrellus (Pipistrellus) nanulus:* Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: 16. (Name Combination)

1994. *Pipistrellus (Vansonia) nanulus:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 116. (Name Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Chinese: 中非小伏翼. Czech: netopýr efulenský. English: Tiny Pipistrelle Bat, Dwarf Pipistrelle Bat, Tiny Pipistrelle. French: Pipistrelle minuscule. German: Kleine Zwergfledermaus, Kleine Pipistrelle. Spanish (Castillian): Pipistrelo.

CONSERVATION STATUS:
Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Fahr, 2008r; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Fahr, 2008r; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Fahr, 2004h; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
There appear to be no major threats to this species as a whole (Fahr, 2008r; IUCN, 2009).

CONSERVATION ACTIONS:
Fahr (2008r) [in IUCN (2009)] reports that *Pipistrellus nanulus* has been reported from the Mole National Park in Ghana (Grubb *et al.*, 1998). No direct conservation measures are currently needed for this widespread and seemingly adaptable species as a whole.

GENERAL DISTRIBUTION:
Pipistrellus nanulus is widespread in West and Central Africa, with an apparently disjunct population in East Africa. It ranges from Senegal eastwards, through most West African countries to Cameroon, from here it has been recorded from Equatorial Guinea (including the island of Bioko) and Gabon. In the east of the species range it has been recorded from eastern Democratic Republic of the Congo, Uganda and western Kenya (north of Lake Victoria).

Kruskop *et al.* (2016: 64) report two specimens from Ethiopia, which look very similar to *P. nanulus* from other parts of Africa, and although they do not mention any "cf." or "aff." as they do for other species, they hint that the identification need further confirmation.

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Burkina Faso (Kangoyé *et al.*, 2015a: 621);

Cameroon; Central African Republic; Congo (Bates *et al.*, 2013: 329 - 1st authenticated record); Congo (The Democratic Republic of the) (Monadjem *et al.*, 2010d: 572); Côte d'Ivoire; Equatorial Guinea (Bioko); Ethiopia (Kruskop *et al.*, 2016: 64); Gabon; Ghana (Decher and Fahr, 2007: 18); Guinea (Decher *et al.*, 2016: 274); Kenya; Liberia; Nigeria; Senegal; Sierra Leone; Uganda.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Tragus: Monadjem *et al.* (2013c: 204) line drawing of tragi of specimen DNSM 13234 from Mount Nimba, Liberia.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987). *P. nanulus* and *H. c. bellieri* were much longer in total length than any of the *Neoromicia* species examined by Monadjem *et al.* (2013c). The shaft tip has a bifurcated structure with one projection that was slightly more distended than the other baculum shaft in both species was moderately ventrally curved, ending in a fluted base that was broader in *P. nanulus* (0.71 - 0.82 mm) than in *H. c. bellieri* (0.38 - 0.41 mm), a broad projection was clearly visible midway down the ventral surface of the shaft in *P. nanulus* (Monadjem *et al.*, 2013c: 197). Line drawing of dorsal and ventral bacula of specimen DNSM 13230 from Mount Nimba, Liberia are shown in Monadjem *et al.* (2013c: 204).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:

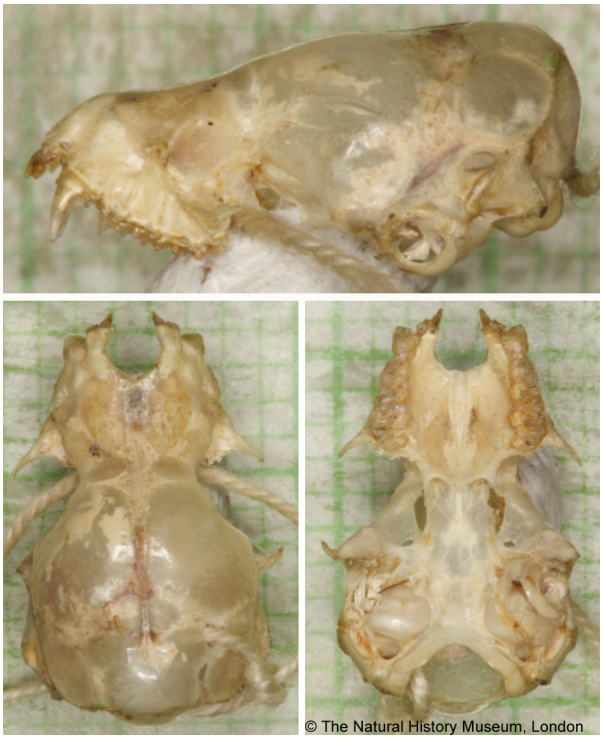


Figure 350. Clockwise from top lateral, ventral and dorsal skull images of BMNH 1904.2.8.8, holotype of *Pipistrellus nanulus* Thomas, 1904.

ECHOLOCATION:
Manga Mongombe (2012: 79) reported a FM/QCF call type for 1 calls from Maroua (Cameroon) and F_{max}: 65.5 kHz, F_{min}: 45.6 kHz, F_{mean}: 51.3 kHz, F_{knee}: 49.2 kHZ, F_{char}: 45.8 kHz, and duration: 2.89 msec.

HABITAT:
The specimens recorded by Monadjem *et al.* (2016y: 371) from the Mount Nimba area were found in lowland forest habitats (420 - 480 m).

POPULATION:
Structure and Density - This species is relatively common (Fahr, 2008r; IUCN, 2009).
Trend - 2008 - Unknown (Fahr, Fahr, 2008r; IUCN, 2009).

VIRUSES:
Coronaviridae - Coronaviruses
SARS-CoV - During Febuary 2008 in Ghana, Pfefferle *et al.* (2009) tested negative one fecal sample for coronavirus (CoV) RNA.

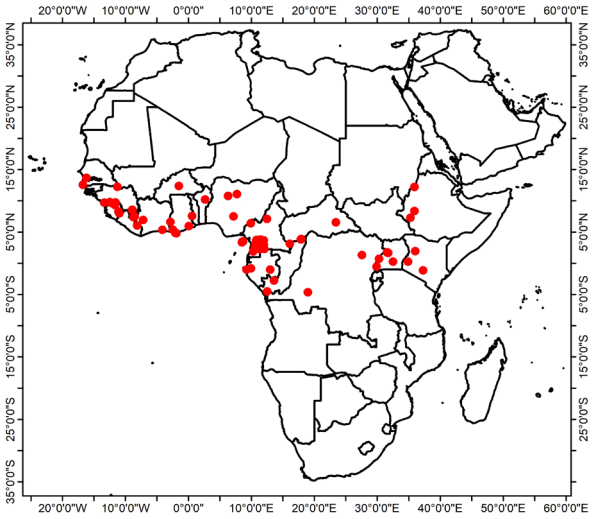


Figure 351. Distribution of *Pipistrellus nanulus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Burkina Faso, Cameroon, Central African Republic, Congo, Congo (Democratic Republic of the), Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Liberia, Mali, Nigeria, Senegal, Sierra Leone, The Gambia, Togo, Uganda.

Pipistrellus permixtus Aellen, 1957

*1957. *Pipistrellus (Pipistrellus) permixtus* Aellen, Rev. suisse Zool., 64 (6): 200. Type locality: Tanzania: Dar-es-Salaam [06 48 S 39 18 E] [Goto Description]. Holotype: MZS 12c: ad ♀, skull and alcoholic. Collected by: Hürstel; collection date: 1905.
1966. *[Pipistrellus] permixtus:* Koopman, The Puku, 4: 159. (Name Combination, Current Combination)
1982. *Pipistrellus permixtus:* Seal and Makey, ISIS Mammalian Taxonomic Director, ???. (Name Combination)

TAXONOMY:
This is a very illusive species. It is only known from the type specimen, which shows more affiliation to the European *P. nathusii* than to any of the African species. Since the type specimen was collected in Dar-es-Salaam, a port, it can not be excluded that this animal was transported by ship from Europe to Africa.

COMMON NAMES:
Czech: netopýr tanganjický. English: Dar-es-Salaam Pipistrelle Bat, Dar-es-salaam Pipistrelle, Tanzania Pipistrelle. French: Pipistrelle de Tanzanie. German: Verwechselte Zwergfledermaus, Verwechselte Pipistrelle.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of recent information on its extent of occurrence, ecological requirements, threats and conservation status (Jacobs *et al.*, 2008v; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs *et al.*, 2008v; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004ac; IUCN, 2004). 1996 - DD (Baillie and Groombridge, 1996).

MAJOR THREATS:
The threats to this species are poorly known. However, it may be confined to dry coastal forest habitat, which is significantly threatened by conversion to agricultural use and extraction of firewood and timber (Jacobs *et al.*, 2008v; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008v) [in IUCN (2009)] report that there appear to be no direct conservation measures in place for this species, and it is not known if the species is present within any protected areas. Additional studies are needed into the distribution, abundance, breeding biology and general ecology of this species. There is a need to conserve remaining areas of dry coastal forest in much of East Africa.

GENERAL DISTRIBUTION:
Pipistrellus permixtus is known only from a single specimen collected close to Dar es Salaam in Tanzania.

Native: Tanzania.

POPULATION:
Structure and Density - No information available on the abundance of this bat (Jacobs *et al.*, 2008v; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008v; IUCN, 2009).

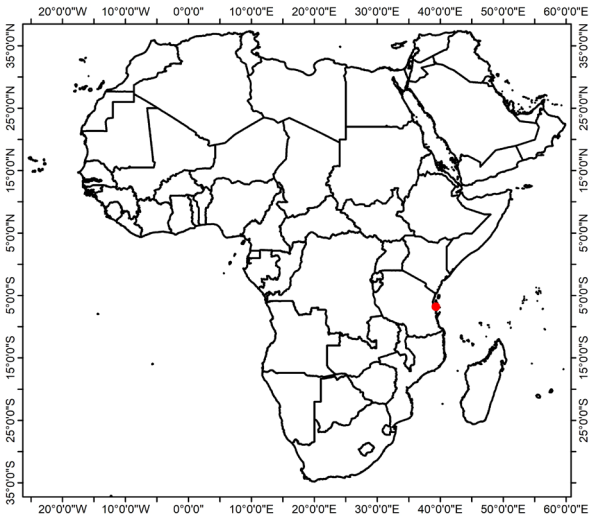


Figure 352. Distribution of *Pipistrellus permixtus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Tanzania.

Pipistrellus pipistrellus (Schreber, 1774)

*1774. *Vespertilio pipistrellus* Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, 1 (7): pl. 54 + 1 (9): 167. Publication date: 1774. Type locality: France: "France". Neotype: BMNH 1997.81: ad ♂. Collection date: October 1996. Designated by Anonymus (2003: 85). Locality of neotype: France: Normandy: Beauvais cathedral.

1839. *V[esperus (Vesperugo)] Pipistrellus:* Keyserling and Blasius, Arch. Naturgesch. Berlin, 5 (1): 321. (Name Combination)
1853. *V[esperugo (Vesperugo)] Pipistrellus:* Blasius, Arch. Naturgesch. Berlin, 19 (1): 36. (Name Combination)
1855. *Vespertilio (Vesperugo) pipistrellus:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 730. (Name Combination)
1856. *Vesperugo (Nannugo) pipistrellus:* Kolenati, Allg. deutsche naturh. Zeitung, N.F., 2 (5): 170. (Name Combination)
1857. *S[cotophilus] pipistrellus:* Tomes, Proc. zool. Soc. Lond., 1857, XXV (cccxxx): 5x. (Name Combination)
1860. *Nannugo pipistrellus:* Kolenati, Monographie der Europäischen Chiroptern, 8. (Name Combination)
1862. *Vesperugo (Vesperugo) pipistrellus:* Römer, Nass. Naturw. Jahrb., 18: ???. (Name Combination)
1863. *Vespertilio (Nannugo) pipistrellus:* Koch, Nass. Naturw. Jahrb., 18: 339. (Name Combination)
1866. *Scotophilus pipistrellus:* H. Allen, Proc. Acad. nat. Sci. Philad., 18: 287. (Name Combination)
1871. *Vesperugo pipistrellus:* Doderlein, Alcune generalita Intorno la Fauna Sicula de Vertebrati, ???. (Name Combination)
1899. *Vesperugo (Euvesperugo) pipistrellus:* Acloque, Faune de France, Mammifères, 36. (Name Combination)
1900. *Pipistrellus pipistrellus:* Méhely, Monographia Chiropterorum Hungariae, 262. (Name Combination, Current Combination)
1928. *Pipistrellus pipistrellus pipistrellus:* Ognev, Mammals of eastern Europe and Northern Asia, 481. (Name Combination)
1959. *Pipistrellus (Pipistrellus) pipistrellus pipistrellus:* Aellen, Rev. suisse Zool., 66 (2): 381. (Name Combination)
1966. *Pipistrellus (Pipistrellus) pipistrellus:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 163. (Name Combination)
1970. *P[ipistrellus] pipistrelli:* Rushton, Ann. Génét. Sél. anim., 2 (4): 465. (Lapsus)

TAXONOMY:
Does not contain *pygmaeus* Leach, 1821. Genetic studies (e.g. Benda *et al.*, 2004b) provided evidence for a North-African lineage, possibly identified as a subspecies. Evin *et al.* (2011: 2096) also show that the shape of the skull of the Moroccon specimens differs from that of specimens from continental Europe and Corsica, and to a lesser extent, from the Middle East. Boston *et al.* (2014: 268) found *P. pipistrellus* to form a monophyletic group, but with a split between *P. pipistrellus* s. stricto and a possible paraphyletic group in Morocco, Algeria, Tunisia, Malta, Sicily, Corsica and Italy. Hulva *et al.* (2004; 2010) called this latter group "*P. pipistrellus* SW" and Puechmaille *et al.* (2012) suggest this group might represent a new species.

COMMON NAMES:
Albanian: Pipistrel i zakonshëm. Arabian: Khaffash. Armenian: Ցգnւկ փnքրաչnչիկ. Azerbaijani: Cı rtdan şə bpə rə. Basque: Pipistrelo arrunt, Saguzar. Belarusian: Нетапыр-карлік. Bosnian: Mali š iš miš, Patuljasti slijepi miš ić. Breton: Pipistrell voutin. Bulgarian: Кафяво прилепче. Castilian: Murciélago comú n, Murciélago enan, Murciélago enano. Catalan: Rat penat comú, Pipistrel·la comuna. Croatian: Patuljasti šišmiš. Czech: Netopýr hvízdavý, Nedopír hvízdavý, Netopýr malý, Letouň zakrpený, Netopýr pisklavý. Danish: Pipistrelflagermus, Dværgflagermus. Dutch: Gewone dwergvleermuis. English: Common Pipistrelle, Common Pipistrelle Bat, 45 kHz pipistrelle, Small house-bat. Estonian: Kääbus-nahkhiir. Finnish: Vaivaislepakko. French: Pipistrelle commune. Frisian: Gewoane dwerchflearmûs. Galician: Morcego común. Georgian: ჯუჯა ღამორი. German: Zwergfledermaus, Kahlschienige Dämmerungsfledermaus. Greek: Ναvovυχτερίδα Hebrew: atalefon eropi, Atalfon Aeropi. Hungarian: Törpe denevér, Közönséges törpedenevér, Nycteris i kini. Irish Gaelic: Ialtóg fheascrach. Italian: Pipistrello nano. Latvian: Pundursikspārnis. Lithuanian: ikšniukas nykštukas. Luxembourgish: Kleng Fliedermaus, Zwergfliedermaus. Macedonian: Мал лилјак, Dzudzest Liljak. Maltese: Pipistrell, Pipistrell Komuni. Montenegrin: Mali slijepi mišić. Norwegian: Tusseflaggermus, Dvergflaggermus. Polish: Karlik malutki. Portuguese: Morcego-anão. Rhaeto-Romance: Pipistrel nanin. Romanian: Liliacul pitic. Russian: Нетопырь-карлик [= Netopyr karlik]. Serbian: Обични сл[ij]епи

мишић [= Obič ni sl[ij]epi miš ić]. Scottish Gaelic: Ialtag fheasgarach. Slovak: Več ernica hvízdavá, Več ernica malá. Slovenian: Mali netopir. Swedish: Sydpipistrell, Pipistrell. Turkish: Cüce Yarasa. Ukrainian: Нетопир карлик, Нетопир малий. Welsh: Ystlum-lleiaf cyffredin.

CONSERVATION STATUS:
Global - The species is widespread and abundant, and there is no evidence of current significant population decline. Consequently, it is assessed as Least Concern (LC ver 3.1 (2001)) (Hutson *et al.*, 2008l; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Hutson *et al.*, 2008l; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Aulagnier and Benda, 2004a; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
In parts of the range there is deliberate persecution as people do not want thousands of bats roosting in their buildings. As a high proportion of colonies are found in buildings, the species may be particularly vulnerable to other anthropogenic factors, such as disturbance, timber treatment and building renovation (Battersby, 2005; Hutson *et al.*, 2008l; IUCN, 2009).

Sherwin *et al.* (2012: 174) indicate that the aerial hawking feeding style and the long-distance dispersal are the most important risk factors related to climatic change.

CONSERVATION ACTIONS:
Hutson *et al.* (2008l) [in IUCN (2009)] report that it is protected under national law in most range states. It is also protected under international law through the Bonn Convention (Eurobats) and Bern Convention in parts of its range where these apply, and is included in Annex IV of the EU Habitats and Species Directive. It occurs in many protected areas. No specific conservation actions are known.
Adoption of bat-friendly practices in the construction and maintenance of buildings is a proposed action.

GENERAL DISTRIBUTION:
Pipistrellus pipistrellus is a widespread western Palaearctic species with a range extending from the British Isles through southern Scandinavia, much of Europe (including all the Mediterranean countries, but with the exception of northern Fennoscandia) to the Volga and Caucasus; and through parts of north-western Africa (mountainous areas of Morocco, Algeria and Tunisia, also in Cyrenaica in Libya) and south-west Asia to central and eastern Asia (China, India, Myanmar). Its detailed distribution, as distinct from that of the recently-differentiated *P. pygmaeus*, is still to be established. It occurs from sea level to 2,000 m.

A dubious record from Taiwan by Kishida (1924) is rejected by Lin *et al.* (2002: 509). A record from Myanmar by Bates and Harrison (1997: 167) is rejected by Bates *et al.*, 2005: 220).

Native: Afghanistan; Albania; Algeria; Andorra; Armenia; Austria; Azerbaijan; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; China; Croatia; Cyprus (Benda *et al.*, 2007: 71); Czech Republic; Denmark; Estonia; Finland; France [Corse]; Georgia; Germany; Gibraltar; Greece [East Aegean Is., Kriti]; Holy Seat [Vatican City State]; Hungary; India (Jammu-Kashmir); Iran, Islamic Republic of; Ireland; Israel; Italy (Sardegna, Sicilia); Jordan (Benda *et al.*, 2010b: 185), Kazakhstan; Latvia; Lebanon (Horácek *et al.*, 2008: 59); Libyan Arab Jamahiriya; Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Yugoslav Republic of; Malta; Moldova (Bondarenko, 2007: 23); Monaco; Montenegro; Morocco (Benda *et al.*, 2010a: 157; El Ibrahimi and Rguibi Idrissi, 2015: 361); Myanmar; Netherlands; Norway; Pakistan; Poland; Portugal; Romania; Russian Federation; San Marino; Serbia; Slovakia; Slovenia; Spain [Baleares]; Sweden; Switzerland; Taiwan, Province of China; Tunisia (Dalhoumi *et al.*, 2016b: 867); Turkey; Ukraine (Tyshchenko *et al.*, 2005: 181); United Kingdom.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

Madej *et al.* (2012: 478) studied the skin structure and hair morphology of different body parts and found a number of areas with thin skin (wing and tail membrane) and other areas with thick skin (head and dorsum, abdomen, footpad). They also found that the density of the hairs was higher on the head than in the dorsal and ventral body parts. These differences might play a role for ectoparasites when choosing their preferred body region.

ECHOLOCATION:
The data for 47 animals from Greece are the following: F_{start}: 78.9 ± 15.79 kHz, F_{end}: 47.5 ± 1.43 kHz, F_{peak}: 48.6 ± 1.46 kHz, bandwidth: 6.5 ± 1.31 kHz, duration 5.7 ± 1.53 msec and interpulse interval: 94.9 ± 29.90 msec (Papadatou *et al.*, 2008b: 132).
Benda *et al.* (2010a: 163) report for 50 Moroccan specimens a starting frequency of 53.3 ± 4.6 (45.6 - 62.7) kHz, a maximum energy frequency of 47.9 ± 2.9 (42.9 - 51.8) kHz, an end frequency of 46.3 ± 3.0 (40.0 - 50.7) kHz, with a duration of 7.4 ± 1.7

(5.2 - 12.4) msec, and an inter-pulse interval of 123.9 ± 46.2 (73.4 - 250.1) msec.
Data presented by Walters *et al.* (2012: suppl.) for 47 calls by bats from France, Switzerland and the UK include: duration: 6.02 ± 2.10 msec, F_{max}: 58.06 ± 10.34 kHz, F_{min}: 44.77 ± 1.92 kHz, bandwidth: 13.29 ± 9.25 kHz, F_{peak}: 45.75 ± 2.03 kHz.

In Jordan, Benda *et al.* (2010b: 204) recorded the following parameters for 70 calls: F_{start}: 69.3 ± 14.8 (53.1 - 110.0) kHz, F_{end}: 48.4 ± 0.9 (46.8 - 50.5) kHz, F_{peak}: 51.2 ± 2.0 (48.2 - 57.9) kHz, duration: 5.7 ± 1.5 (2.8 - 8.0) msec, and Interpulse interval: 81.7 ± 22.2 (49.0 - 169.0) msec. For 54 Iranian calls, Benda *et al.* (2012a: 182) report: F_{start}: 57.1 ± 4.2 (50.2 - 60.8) kHz, F_{end}: 46.6 ± 2.2 (42.6 - 50.8) kHz, F_{peak}: 48.6 ± 2.4 (44.1 - 54.0) kHz, duration: 6.8 ± 1.5 (3.4 - 10.4) msec, and interpulse interval: 100.5 ± 26.5 (62.3 - 162.7) msec.

Götze *et al.* (2013: 61) indicate that frequency shifts ocurring when *P. pipistrellus* specimens are flying together, are not linked with jamming avoidance, but with a switch from search calls to shorter approach calls, which have higher frequencies. The other bats are perceived as moving targets, hence the switch to the approach call.

In Morocco, Disca *et al.* (2014: 226) reported for "*Pipistrellus* cf. *pipistrellus*" a FM-QFC type of call with the following parameters: F_{start}: 75.5 ± 12.8 kHz, F_{end}: 47.7 ± 2.3 kHz, F_{peak}: 50.4 ± 2.4 kHz, $F_{QFC\text{-}peak}$: 49.9 ± 2.5 kHz, bandwidth: 27.8 ± 12.3 kHz, duration: 6.4 ± 1.1 msec.

Molecular Biology:
DNA - See Benda *et al.* (2004b), Hulva *et al.* (2004), Mayer *et al.* (2007), García-Mudarra *et al.* (2009).

Karyotype - Rushton (1970: 465) mentioned a diploid number (2*n*) of 42. Arslan and Zima (2014: 12) report 2*n* = 42-44, FNa = 48-50, FN = 52-54, a medium-sized (sub)metacentric X, and a dot-like acrocentric Y. The autosomal component contains three large metacentric, one small metacentric and 16/17 acrocentric pairs. However, they can not exclude that some of the "aberrant" sets might represent *P. pygmaeus*.

Diet:
Benda *et al.* (2012a: 425 - 427) indicate that in Europe, *P. pipistrellus* mainly feeds on small swarming nematoceran Diptera, followed by Lepidoptera, Heteroptera and Hymenoptera. In the Middle East, the diet seems to be more variable and is dominated by smaller Coleoptera, Formicoidea, Heteroptera, smaller Lepidoptera, Ephemeroptera, Plecoptera, and Blattodea. In Iran, the most important food items are: Nematocera, Hymenoptera (Formicoidea), and Auchenorrhyncha.

Population:
Structure and Density - A widespread and abundant species, one of the most common bats in many parts of its range. Summer maternity colonies generally number 25 - 50 individuals, although colonies of as many as 200 have been recorded. In winter, it tends to occur singly or in small groups, although some very large groups have been recorded (e.g., up to 45,000 in caves in Romania and Slovakia) (Seamark, 2006d). Significant declines have been recorded in some European countries (e.g. Britain), although in Britain at least the trend may now have stabilised (Battersby, 2005). In Serbia, in the urban areas, *P. pipistrellus* has become less common due to displacement by *P. kuhlii* (M. Paunovic *pers. comm.*, 2007 in Hutson *et al.*, 2008l). The same is also reported from the Russian Federation.
Trend - 2008 - Stable (Hutson *et al.*, 2008l; IUCN, 2009).

Activity and Behaviour:
Referring to amongst others Barlow and Jones (1997a,1997b), Smotherman *et al.* (2016: 537) describe the song-like structure for this species as simple syllable type in a basic motif. Singing occurs while flying.

Reproduction and Ontogeny:
Ginther (1967: 580) mentioned that the embryo is more frequently located in the right uterine horn, whereas the Corpus luteum is about 50 % in the left ovary.
At birth, the young weights about 23.7 % of its mother's body mass (1.4 g versus 5.9 g), and its forearm length is about 35.6 % of that of its mother (11.4 versus 32.0 mm) (see Kurta and Kunz, 1987: 83).

Parasites:
In Europe, Genov *et al.* (1992) reported the following Nematodes: *Molinostrongylus vespertilionis* Morosov and Spassky, 1961 (of which *P. pipistrellus* is the type host) and *M. alatus* (Ortlepp, 1932).

Benda *et al.* (2010b: 278) found the following ectoparasites on Jordanian *Pipistrellus pipistrellus*: Ticks: Argasidae: *Argas vespertilionis* (Latreille, 1802); mites (Macronyssidae): *Macronyssus* sp., *Steatonyssus periblepharus* Kolenati, 1858, *Parasteatonyssus hoogstraali* Keegan, 1956; bugs: Cimicidae: *Cacodmus vicinus* Keegan, 1956; bat flies: Nycteribiidae: *Basilia daganiae* Keegan, 1956; and fleas:

Ischnopsyllidae sp. The latter might possibly belong to *Ischnopsyllus octactenus* (Kolenati, 1856), *I. dolosus* Dampf, 1912 or *I. consimilis* (Wahlgren, 1904) which were previously reported from *P. pipistrellus* from Turkey and Lebanon.

From Iran, Benda *et al.* (2012a: 428) reported the following ectoparasites: Ticks: Argasidae: *Argas vespertilionis* (Latreille, 1802), Ixodidae: *Dermacentor marginatus* (Sulzer, 1776), *Ixodes redikorzevi* Olenev, 1927; mites: Macronyssidae: *Steatonyssus* sp., Trombiculidae: *Schoutedenichia chilmirica* Kudrâšova, 1975; fleas: Ischnopsyllidae: *Ischnopsyllus octactenus* (Kolenati, 1856), Pulicidae: *Xenopsylla nuttalli* Ioff, 1930. From Azerbaijan, they mention another bat flea: *Ischnopsyllus dolosus* Dampf, 1912.

From Algeria, Bendjeddou *et al.* (2013: 325) reported the following parasites: *Cimex pipistrelli* Jenyns, 1839 (Hemiptera: Cimicidae) and *Ischnopsyllus octactenus* (Kolenati, 1856) (Siphonaptera: Ischnopsyllidae). Bendjeddou *et al.* (2017: 15) mentioned the following Heteroptera: *Cimex pipistrelli* Jenyns, 1839, *Cimex lectularius* Linnaeus, 1758 and *Cacodmus vicinus* Horváth, 1934.

Beaucournu and Noblet (1985: 636) refer to Hurka (1982) in plotting a record of *Basalia mediterranea* Hurka, 1970, parasiting on *P. pipistrellus*.

VIRUSES:

Adenoviridae

Mastadenovirus

Reported from Germany by Kohl and Kurth (2014: 3111).

Bornaviridae

An unclassified genus belonging to this family was reported by Kohl and Kurth (2014: 3111) from France.

Coronaviridae

None of five Kenyan bats tested by Tao *et al.* (2017: Suppl.) tested positive for CoV.

Betacoronavirus

This virus was reported from the Netherlands by Kohl and Kurth (2014: 3112).

Herpesviridae

Betaherpesvirus and *Gammaherpesvirus*

These viruses were reported by Kohl and Kurth (2014: 3113) from Germany.

Orthomyxoviridae

Despite sampling and testing of 44 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

Paramyxoviridae

An unassigned virus was reported from Germany by Kohl and Kurth (2014: 3113).

Reoviridae

Orthoreovirus

Kohl and Kurth (2014: 3113) reported this virus from Germany.

Rhabdoviridae

"Various European bat lyssaviridae" were reported from various European countries by Kohl and Kurth (2014: 3114).

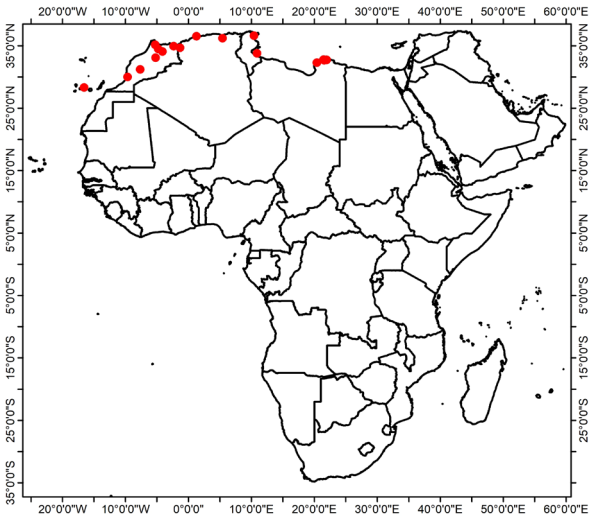


Figure 353. Distribution of *Pipistrellus pipistrellus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:

"Africa", Algeria, Canary Islands (Spain), Egypt, France, Libya, Morocco, Tunisia.

Pipistrellus pygmaeus (Leach, 1825)

*1825. *Vespertilio Pygmæus* Leach, Zool. Journ., 1: 560. Type locality: United Kingdom: Chew valley. - Comments: Type locality: The original type locality was "England, Devonshire, near forest of Dartmoor, Spitchweek". The Neotype was collected in NE Somerset, Bath, Chew valley.

1999. *Pipistrellus pygmaeus:* Jones and Barratt, Bull. Zool. Nomencl., 56 (3): 182. Publication date: September 1999. (Name Combination, Current Spelling)

TAXONOMY:
One of the most outspoken examples of cryptic species is formed by the "*Pipistrellus pipistrellus / pygmaeus*" species complex. Originally, both taxa were considered to represent one single species, but with the growing use of bat detectors, it became clear that two forms were present. In a first stage, these were called the "45 kHz phonic type" and the "55 kHz phonic type". Jones and van Parijs (1993) and Barratt *et al.* (1995) proved that two separate species were involved: *Pipistrellus pygmaeus* and *Pipistrellus pipistrellus*.

Based on López-Baucells *et al.* (2012), Disca *et al.* (2014: 211) include *P. pygmaeus* as a member of the Moroccan bat fauna, but they indicate that more prove (e.g. photos, detailed descriptions, echolocation data, …) would be welcome.

Herdina *et al.* (2014: 157) indicate that *P. pipistrellus* and *P. pygmaeus* specimens can be discriminated by measuring the projected length, height, and width of the baculum. Other morphological discrimination traits commonly used are "wing vein" pattern and shape and color of the penis, but these have not been validated on sets of genetically identified specimens.

COMMON NAMES:
Albanian: Pipistrel xhuxh. Armenian: Գաջաճ փոքրաչղջիկ. Azerbaijani: Kiçik şəbpərə. Basque: Pipistrelo mediterraneo. Belarusian: Нетапыр-пігмей. Bosnian: Patuljasti šišmiš. Breton: Pipistrell gorr. Bulgarian: Малко кафяво прилепче. Castilian: Murciélago pigmeo, Murciélago de Cabrera. Catalan: Pipistrel·la nana. Croatian: Močvarni patuljasti šišmiš. Czech: Netopýr nejmenší, Nedopír kařelný. Danish: Dværgflagermus. Dutch: Kleine dwergvleermuis. English: Midge Bat, Soprano Pipistrelle, Pygmy pipistrelle bat, 55 kHz pipistrelle, Mediterranean Lesser pipistrelle. Estonian: Pügmee-nahkhiir. Finnish: Kääpiölepakko. French: Pipistrelle soprane, Pipistrelle pygmée, le vespertilion pygmée. Frisian: Lytse dwerchflearmûs. Galician: Morcego anano. Georgian: პაწია ღამორი. German: Mückenfledermaus. Greek: Μικρονυχτερίδα. Hungarian: Szoprán törpedenevér. Irish Gaelic: Ialtóg shopránach. Italian: Pipistrello soprano, Pipistrello pigmeo, Pipistrello soprano. Latvian: Pigmejsikspārnis. Lithuanian: Šikšniukas mažylis. Luxembourgish: Méckefliedermaus. Macedonian: Џуџест лилјак, Kafeav Dzudzest Liljak. Maltese: Pipistrell Żgħir. Montenegrin: Patuljasti slijepi mišić. Norwegian: Dvergflaggermus. Polish: Karlik drobny. Portuguese: Morcego-pigmeu. Rhaeto-Romance: Pipistrel pigmeic, Pipistrel muschin. Romanian: Liliacul pigmeu. Russian: Нетопырь малый (пигмей), Малый нетопырь [=Malyj Neopyr]. Serbian: Патуљасти сл[ij]епи мишић [= Patuljasti sl[ij]epi mišić]. Scottish Gaelic: Ialtag shopranach. Slovak: Večernica Leachova. Slovenian: Drobni netopir. Liliacul-pitic mediteranean. Swedish: Dvärgpipistrell, Dvärgfladdermus. Turkish: Akdeniz Cüce Yarasası. Ukrainian: Нетопир пігмей. Welsh: Ystlum-lleiaf soprano.

GENERAL DISTRIBUTION:
Great Britain, Ireland, Germany, Switzerland, Czech Republic, Slovakia, Denmark, Sweden, Estonia, Latvia, Belarus, Portugal, Spain, Greece, Cyprus, Slovenia, Croatia, Albania, Serbia, Bosnia-Herzogovina, Montenegro, Romania, Bulgaria, Moldova, Georgia [Turkey, Belgium, Holland], Azerbaijan; Morocco; Iran; possibly Lebanon.

López-Baucells *et al.* (2012: 43) reported this species from the northern African Spanish enclave Ceuta, which is the first report of this species on the African continent.

VIRUSES:
Coronaviridae
Alphacoronavirus
Kohl and Kurth (2014: 3112) report this virus from German bats.

Orthomyxoviridae
Despite sampling and testing of 132 individuals of this species, no evidence of influenza A-like viruses (*Orthomyxoviridae*) were obtained (Fereidouni *et al.*, 2015).

Pipistrellus raceyi Bates, Ratrimomanarivo, Harrison and Goodman, 2006

*2006. *Pipistrellus raceyi* Bates, Ratrimomanarivo, Harrison and Goodman, Acta Chiropt., 8 (2): 301. Type locality: Madagascar: Fianarantsoa province: Kianjavato [21 22.84 S 44 40.49 E, 75 m] [Goto Description]. Holotype: FMNH 185567: ad ♂, skull and alcoholic. Collected by: Fania H. Ratrimomanarivo and E. Rakotonandrasana; collection date: 22 May 2005; original number: RHF 1281. - Etymology: In honour of Prof. Paul A. Racey, Regius professor of natural history, University of Aberdeen, UK, in recognition of his longstanding commitment to the study and conservation of bats worldwide and in particular to his on-

going programme of capacity building and bat research in Madagascar (see Bates *et al.*, 2006: 305). (Current Combination)

TAXONOMY:
See Bates *et al.* (2006).

COMMON NAMES:
English: Racey's Pipistrelle Bat. French: Pipistrelle de Racey. German: Raceys Zwergfledermaus, Raceys Pipistrelle.

CONSERVATION STATUS:
Global - This species is listed as Data Deficient (DD ver 3.1 (2001)) because although preliminary evidence suggests that it is widely distributed in lowland areas of parts of eastern and western Madagascar and it exists in a range of vegetation types, there are insufficient data on its habitat requirements and major threats (Jenkins *et al.*, 2008j; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jenkins *et al.*, 2008j; IUCN, 2009).

MAJOR THREATS:
No major threats are documented, but forest degradation may conceivably reduce availability of suitable foraging and roosting habitat in the west where this species presumably roosts in trees and appears to be associated with forest habitats (Jenkins *et al.*, 2008j; IUCN, 2009).

CONSERVATION ACTIONS:
Jenkins *et al.* (2008j) [in IUCN (2009)] report that even though this species roosts synanthropically in the east and may therefore be expected to be relatively common given the abundance of suitable roosting sites, it is only known from four locations across Madagascar despite the large survey effort on Malagasy bats in recent years. Of the four known localities, all receive some form of active forest management and it is expected that deforestation at these sites has been and will be less than for non-protected forest. Further studies of this species are needed to investigate why it appears to be forest-dependent in the west but not in the east of its range.

GENERAL DISTRIBUTION:
Pipistrellus raceyi is an endemic species to Madagascar that is currently known from four localities (Bates *et al.*, 2006), two in the west (Mikea forest and Kirindy CFPF) and two in the east (Kianjavato and Tampolo forests), all below 80 m elevation (from 16 - 70 m asl.).

Native: Madagascar (Bates *et al.*, 2006).

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
See Bates *et al.* (2006).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
See Bates *et al.* (2006).

DETAILED MORPHOLOGY:
Baculum - Unknown
For a description of the crania, teeth, ears and tragus see Bates *et al.* (2006).

MOLECULAR BIOLOGY:
DNA, Karyotype, Protein / allozyme - Unknown.

HABITAT:
See Bates *et al.* (2006).

ROOST:
Synanthropic structures and vegetation for the typical roosting sites for this species on Madagascar according to Wilkinson *et al.* (2012: 160).

DIET:
Rakotondramanana *et al.* (2015: 77) reported the following volume percentages of food items: Coleoptera: 27.8 ± 20.00; Hymenoptera: 12.5 ± 17.15; Lepidoptera: 26.1 ± 23.05; Trichoptera: 1.9 ± 4.80; Isoptera: 30.0 ± 40.71; Homoptera: 1.5 ± 3.31; Arachnida: 0.1 ± 0.24. Expressed as frequency percentages, the values are: Coleoptera: 78.9 ± 29.48; Hymenoptera: 47.8 ± 41.81; Lepidoptera: 65.6 ± 44.35; Trichoptera: 10.0 ± 23.01; Isoptera: 37.8 ± 48.94; Homoptera: 12.2 ± 27.56; Arachnida: 1.7 ± 4.71. Based on the faeces of three animals, Rasoanoro *et al.* (2015: 64) found the following volume percentages: Aranea: 6.8 ± 1.47, Coleoptera: 32.5 ± 1.36, Diptera: 28.9 ± 4.15, Homoptera: 11.7 ± 2.18, Hymenoptera: 3.9 ± 2.20, and Lepidoptera: 16.3 ± 1.95.

POPULATION:
Structure and density - This recently described species is currently known only from 15 specimens (Bates *et al.*, 2006); however, with further survey work, it may be shown to more common (Jenkins *et al.*, 2008j; IUCN, 2009).
Trend - 2008 - Unknown (Jenkins *et al.*, 2008j; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
See Bates *et al.* (2006).

VIRUSES:
Paramyxoviridae
Wilkinson *et al.* (2012: 160) tested 1 individuals from the Madagascar using RT-PCR specific for *Respirovirus*/*Morbillivirus*/*Henipahvirus* (RMH) and *Paramyxovirinae* (PMV) and found 0 positive results for viral nucleic acids.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Madagascar.

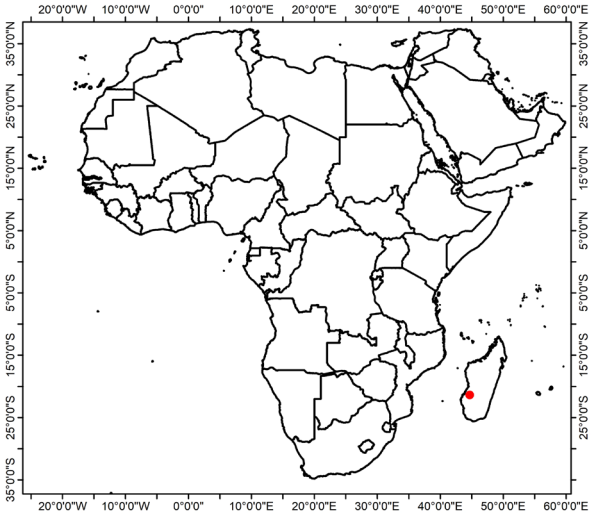


Figure 354. Distribution of *Pipistrellus raceyi*

Pipistrellus rueppellii (Fischer, 1829)

1826. *Vespertilio temminckii* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 17: pl. 6. Type locality: Sudan: Northern province: Dongola [19 10 N 30 27 E] [Goto Description]. Lectotype: SMF 4308: ad ♂, skin only. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1824. Old catalog: II.N.11.b: see Mertens (1925: 22). - Comments: Preoccupied by *temmincki* Horsfield, 1824 (a *Scotophilus*): see Allen (1939a: 95), Meester *et al.* (1986: 51), Simmons (2005). The publication date of Cretzschmar's work is sometimes indicated as "1826" (as mentioned on the title page), but also as "1827", "1828", "1830-1831".

*1829. *Vespertilio Rüppelii* J.B. Fischer, Synopsis Mamm, 109. Publication date: 1829. Type locality: Sudan: Northern province: Dongola [19 10 N 30 27 E]. - Comments: Mertens (1925: 22) mentions that the specimen designated as lectotype for *temminckii* is also the lectotype for *rüppellii*. - Etymology: The type (*Vespertilio temminckii*) was described in Rüppell's (1827) *Atlas zu der Reise im Nordlichen Afrika* and renamed by Fischer (1829) after Rüppell (*V. rüppellii*) (see Taylor, 2005).

1838. *Scotophilus Temminckii:* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 497.

1855. *V[espertilio] rüppelli:* Giebel, Die Säugethiere, 945. (Name Combination)

1855. *Vespertilio (Vesperugo) Rüppellii:* Wagner, in: Schreber, Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen, Suppl. 5: 745. (Name Combination)

1860. *Panugo rüppelii:* Kolenati, Monographie der Europäischen Chiroptern, 10. (Name Combination, Alternate Spelling)

1868. *Vespertilio (Alobus) Temminckii:* Peters, Monatsb. k. preuss. Akad. Wiss. Berlin, 707 (for 1867).

1877. *V[esperugo] Temminckii:* Heuglin, Reise in Nordost Afrika, 2: 32.

1877. *Vesperugo Rüppellii:* Heuglin, Reise in Nordost Afrika, 2: 32. (Name Combination)

1878. *Vesperugo (Vesperugo) temminckii:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 233.

1880. *Vesperugo temminckii:* Dobson, Report on accessions to our knowledge of the chiroptera during the past two years (1878 - 1880), 186.

1891. *Vesperugo temmincki:* Noack, Jb. Hamb. Wiss. Anst., 9: 140.

1901. *Pipistrellus Temminckii:* Thomas, Ann. Mag. nat. Hist., ser. 7, 8 (46): 274.

1902. *Pipistrellus rueppelli:* Anderson and de Winton, Zoology of Egypt: Mammalia, 127. (Name Combination)

1917. *Scotozous rüppelii:* J.A. Allen, Bull. Am. Mus. Nat. Hist., 37 (18): 409. (Name Combination)

1918. *Pipistrellus rüppelii:* Hollister, Bull. U.S. natl. Mus., 99: 93. (Alternate Spelling)

1919. *P[ipistrellus] rüppelli:* Thomas, J. Bomb. nat. Hist. Soc., 26: 747. (Alternate Spelling)

1920. *Pipistrellus rüppelli:* Schwarz, Fledermäuse aus West- und Zentralafrika, ???. (Alternate Spelling)

1925. *Pipistrellus rüppellii:* Mertens, Senckenb. biol., 7 (1/2): 22. (Alternate Spelling)

1925. *V[espertilio] Rüppellii:* Mertens, Senckenb. biol., 7 (1/2): 22. (Name Combination)

1928. *Scotozous rüppellii:* Gyldenstolpe, Ark. Zool. Stockholm, 20A (4): 71. (Alternate Spelling)
1935. *Scotozous trüppellii:* Monard, Arq. Mus. Bocage, 6: 31. - Comments: Lapsus (see Kock, 1969a: 174; Meester *et al.*, 1986: 51). (Lapsus)
1938. *[Scotozous] rüppeli:* Frechkop, Exploration du Parc National Albert, 52. (Lapsus, Alternate Spelling)
1953. *Pipistrellus (Scotozous) rueppelli:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination)
1956. *Pipistrellus ruppelli:* Harrison, Proc. zool. Soc. Lond., 127: ???. (Alternate Spelling)
1957. *[Pipistrellus] rueppeli:* Aellen, Rev. suisse Zool., 64 (6): 204. (Lapsus)
1962. *Scotozous rüppelli:* Wassif, Proc. zool. Soc. Lond., 811. (Alternate Spelling)
1964. *Scotozous temmincki:* Lehmann, in: Niethammer, Alexander Koenigs Reisen am Nil, 72.
1969. *Vespertilio temmincki:* Kock, Abh. Senckenberg. naturforsch. Ges., 521: 174. (Alternate Spelling)
1980. *Pipistrellus rueppellii:* Swanepoel, Smithers and Rautenbach, Ann. Transv. Mus., 32 (7): 171. (Name Combination, Current Combination)
1981. *Pipistrellus (Pipistrellus) rueppellii:* Hill and Harrison, Bull. Br. Mus. (nat. Hist.) Zool., 52 (7): 281. (Name Combination)
1983. *Pipistrellus (Scotozous) rueppellii:* Smithers, Mammals Southern African subreg, 97. (Name Combination)
1985. *Pipistrellus ruepellii:* Rautenbach, Fenton and Braack, Koedoe, 28: 74. (Lapsus)
1986. *Pipistrellus (Vansonia) rueppellii:* Meester, Rautenbach, Dippenaar and Baker, Transv. Mus. Monogr., 5: 50. (Name Combination)
1990. *Pipistrellus ruppellii:* Yom-Tov, Cohen and Wollberg, Mammalia, 54 (2): 281. (Name Combination)
1995. *P[ipistrellus (?Hypsugo)] rueppelli:* Pavlinov, Borissenko, Kruskop and Jahonton, Arch. Zool. Mus., Moscow State Univ., 133: 107. (Name Combination)
1995. *P[ipistrellus (Pipistrellus)] ruepelli:* Nowak, Walker's Bats of the World, 94. (Lapsus)
1996. *Eptesicus rueppellii:* Kityo and Kerbis, J. East Afr. Nat. Hist., 85: 53. (Name Combination)
? *Pipistrellus rueppellii vernayi:* (Name Combination)
? *Scotozous rueppellii:* (Name Combination)
? *Vesperugo hesperida:*

TAXONOMY:



Figure 355. *Pipistrellus rueppellii* (ECJS-126/2009) caught in the Okanango, Botswana.

Renaming of *V. temminckii* Cretzschmar, 1826 (see Allen, 1939a: 95). Mentioned in the subgenus *Vansonia* by Koopman (1994: 116). Mentioned in the subgenus *Hypsugo* inc. sedis by Pavlinov *et al.* (1995: 107).

Meester *et al.* (1986) state that Ellerman *et al.* (1953: 79) do not recognize *Vansonia*, and instead place *Pipistrellus rueppellii* in the subgenus *Scotozous*, as do later authors (Rosevear, 1965; Hayman and Hill, 1971: 41; Smithers, 1983). Corbet and Hill (1980: 68), however, retain *Scotozous* as a full genus for the Indian *S. dormeri* Dobson, 1875, and both J.E. Hill (in litt.) and K.F. Koopman (in litt.) agree that it is incorrect to use this name for *rueppellii*. *Vansonia* is therefore the prior subgeneric name for this species. Benda *et al.* (2014c: 81; 2016: 322) place *rueppellii* in the genus *Vansonia*.

Helbig *et al.* (2010: 168) suggest that *rueppellii* needs to be transferred to a genus that needs to be newly created or resurrected from the current synonymy. Also Koubínová *et al.* (2013: 8) found evidence in the cyt *b* gene to support the transfer of *rueppellii* to a distinct genus, but they indicate that further investigations on material from the type countries of *P. rueppellii* [=Sudan] and the type locality of *P. vernayi* (the type species of *Vansonia* [Maun, Ngamiland, Botswana] are needed to confirm the relationship with *Vansonia*.

The original name was spelled as *Rüppelii*, so the present spelling should probably be *rueppelii*. However, this spelling was only found one single time in all of the literature data: as a misspelling in Koopman (1975). There are a number of earlier authors which use *rueppelli* (e.g. Anderson and de

Winton, 1902). Older literature data are: Wagner (1855) as *Vespertilio (Vesperugo) rüppelli*, Kolenati (1860) as *Panugo rüppelii*, and Heuglin (1877) as *Vesperugo rüppellii*. So the earliest record we were able to find was Wagner (1855), who already used the double "ll" (and double "ii"), but still used "ü", as did Heuglin (1877). Only Kolenati (1860) used a single "l". So if we consider Wagner to be the first reviewer, the name should be spelled as "*rueppellii*" with double "ll" and double "ii" and with "ue" since diacritics are no longer allowed in scientific names.

COMMON NAMES:
Afrikaans: Rüppell se vlermuis, Rüppell-vlermuis. Arabian: Khaffash. Chinese: 吕氏伏翼. Czech: netopýr Rüppellův, netopýr dvoubarvý. Dutch: Rüppells dwergvleermuis. English: Rüppell's Bat, Ruppell's Pipistrelle, Rüppel's Pipistrelle Bat, Rüppel's Pipistrelle. French: Pipistrelle de Rueppel, Pipistrelle de Rüppell. German: Rüppells Zwergfledermaus, Rüppells Pipistrelle, Dongola-Dämmerungsfledermaus. Hebrew: Atalfon Rippel. Italian: Pipistrèllo di Rüppell.

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Butler and Greenwood (1965) found in the early Pleistocene at Olduvai material which they refered to as "cf *Pipistrellus* (*Scotozous*) *rueppelli* (Fischer)" (see Butler, 1978).

CONSERVATION STATUS:
Global - A widespread species with no known major threats, hence is assessed as Least Concern (LC ver 3.1 (2001)) (Jacobs *et al.*, 2008a; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008a; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004ag; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016q). 2004 - considered a vagrant not assessed, only one locality in SA (Augrabies Falls) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:
Use of pesticides against locusts is a threat (Jacobs *et al.*, 2008a; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008a) [in IUCN (2009)] report that no specific measures are known. A study on the impacts of pesticides is required, especially ways in which the impact might be minimised.

GENERAL DISTRIBUTION:
Pipistrellus rueppellii has been recorded throughout Africa, with scattered records from southwest Asia. North African records include a disjunct distribution being recorded from a small part of eastern Morocco into western Algeria, Tunisia, a single record from eastern Libya (on the border with Egypt; Benda *et al.*, 2004a) and then in a broad strip in Egypt including all of the Nile River valley and delta and extending to the Red Sea (but not in the south) and the westernmost part of the Sinai. West African records are from the Senegal coast and the Senegal/Mauritania border. The largest contiguous range consists of a strip stretching from northern Sudan down to northern Zimbabwe, which at its widest point ranges from western Zambia to western Mozambique. Occurs up to 1,100 m in Morocco.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 477,914 km^2.

Bates *et al.* (2013: 339) reject the occurrence of *P. rueppellii* in the Republic of Congo as Malbrant and Maclatchy (1949) only suggested that it 'likely' occurs in that country.

Native: Algeria; Angola (Crawford-Cabral, 1989; Monadjem *et al.*, 2010d: 572); Benin; Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 572); Burkina Faso; Burundi; Cameroon; Central African Republic (Benda *et al.*, 2004a: 91); Chad; Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 572); Egypt (Sinai); Equatorial Guinea; Ethiopia; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Iraq; Israel; Kenya; Liberia; Libyan Arab Jamahiriya (Benda *et al.*, 2004a: 91); Malawi (Ansell and Dowsett, 1988: 40; Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 572); Mali; Mauritania (Padial and Ibáñez, 2005: 240); Morocco (Benda *et al.*, 2004d; 2010a; El Ibrahimi and Rguibi Idrissi, 2015: 362); Mozambique; Namibia (Monadjem *et al.*, 2010d: 572); Nigeria (Benda *et al.*, 2004a: 91); Rwanda; Senegal; Sierra Leone; Somalia; South Africa (Monadjem *et al.*, 2010d: 572); Sudan; Tanzania (including Unguja [O'Brien, 2011: 290]); Togo; Tunisia; Uganda (Kityo and Kerbis, 1996: 62); Yemen; Zambia (Monadjem *et al.*, 2010d: 572); Zimbabwe (Monadjem *et al.*, 2010d: 572).

Presence uncertain: Kuwait.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

ECHOLOCATION:
See Jacobs (1996), Taylor (1999b) and Taylor *et al.* (2005).

Disca *et al.* (2014: 226) indicate that the type of call is FM-QFC. They also provide two different sets of parameters: A - long) F_{start}: 93.0 ± 8.9 kHz, F_{end}: 51.7 ± 0.7 kHz, F_{peak}: 53.6 ± 1.3 kHz, bandwidth: 41.3 ± 8.6 kHz, duration: 6.1 ± 1.2 msec; B - short) F_{start}: 68.2 ± 6.1 kHz, F_{end}: 52.8 ± 1.7 kHz, F_{peak}: 55.8 ± 2.0 kHz, bandwidth: 15.4 ± 6.7 kHz, duration: 2.4 ± 0.5 msec. The "B" type has not been reported from *Pipistrellus* before, and the peak frequencies of both type differ from those observed in Kenya (37.3 ± 0.8 kHz) and Zimbabwe (45 kHz).

84 calls from Israeli bats were reported by Hackett *et al.* (2016: 223): F_{start}: 62.24 ± 3.75 (55.5 - 72.0) kHz, F_{end}: 51.94 ± 0.88 (50.0 - 54.7) kHz, F_{peak}: 52.19 ± 0.97 (50.0 - 55.0) kHz, pulse duration: 4.22 ± 0.39 msec.

MOLECULAR BIOLOGY:
DNA - See Mayer *et al.* (2007).
Karyotype - Rautenbach *et al.* (1993) reported 2*n* = 36, FN = 54, BA = 20, a submetacentric X chromosome, and an acrocentric Y chromosome, for specimens from South Africa.
Protein / allozyme. - Based on the analysis of eight mitochondrial and nuclear genes, Koubínová (2013: 7) found that *P. rueppellii* was basal to the whole *Pipistrellus* / *Nyctalus* clade, and possibly might be placed in a genus of its own.

HABITAT:
In southern Africa, this species occurs primarily in Savanna (82 %) and Afromontane (11 %) habitats (Cooper-Bohannon *et al.*, 2016: Table S2).

DIET:
Benda *et al.* (2014c: 86) analyzed the content of the digestive tract of the single specimen they captured and found it contained 50 % by the volume of brachyceran Diptera, 30% of Lepidoptera and 20% of nematoceran Diptera.

PREDATORS:
Mikula *et al.* (2016: Supplemental data) mention the Bat hawk (*Macheiramphus alcinus* Bonaparte, 1850) as diurnal avian predator.

POPULATION:
Structure and Density - Unknown, because it is primarily known only from mist net captures (Jacobs *et al.*, 2008a; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008a; IUCN, 2009).

PARASITES:
SIPHONAPTERA:
Ischnopsyllidae: (*Ischnopsyllus emminus* Jordan and Rothschild, 1921 was reported from Malawi by Beaucournu and Kock (1996).

IXOIDIDA:
Hornok *et al.* (2017b: 3) collected a larva of *Argas vespertilionis* (Latreille, 1796) from a *P.* cf. *rueppellii* from South Horr, Kenya. Hornok *et al.* (2019: 2) probably refer to the same bat and tick and mentioned that the tick itself was infected by *Rickettsia* sp. Bacteria.

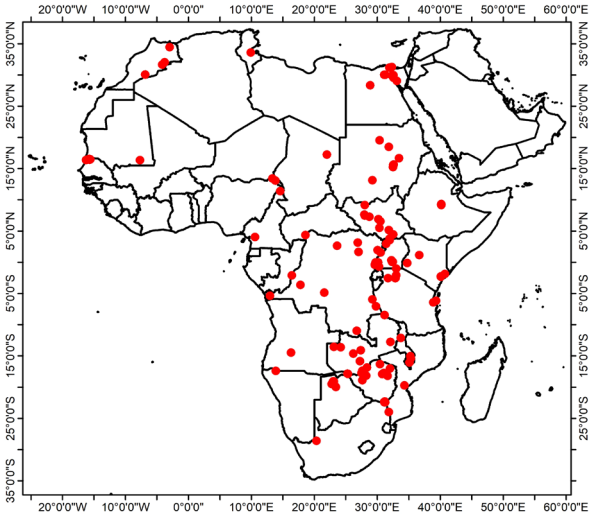


Figure 356. Distribution of *Pipistrellus rueppellii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Angola, Botswana, Cameroon, Central African Republic, Chad, Congo (Democratic Republic of the), Egypt, Ethiopia, Kenya, Malawi, Mauritania, Morocco, Mozambique, Namibia, Nigeria, Senegal, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

Pipistrellus rueppellii fuscipes Thomas, 1913

*1913. *Pipistrellus fuscipes* Thomas, Ann. Mag. nat. Hist., ser. 8, 11 (63): 315. Publication date: 1 March 1913. Type locality: Uganda: Entebbe, 60 mi (90 km) W [00 04 N 32 20 E, 3 700 ft] [Goto Description]. Holotype: BMNH 1906.7.1.5: ad ♂, skin and cranium only (no mandibula). Collected by: R.E. Dent and The Ruwenzori Expedition; collection date: 29 November 1905; original number: 1. See Thomas (1913b: 315).

1939. *Pipistrellus rüppellii fuscipes:* G.M. Allen, Bull. Mus. comp. Zool., 83: 96. (Name Combination)
1951. *Pipistrellus (Scotozous) ruppellii fuscipes:* Swynnerton and Hayman, J. East Afr. Nat. Hist. Soc., 20 (6-7) (90): 293 (for 1950). (Name Combination)
1960. *Pipistrellus ruppelli fuscipes:* Harrison, J. East Afr. Nat. Hist. Soc., 23 (7)(104): 294. Publication date: December 1860. (Name Combination, Alternate Spelling)
1966. *Pipistrellus (Scotozous) rüppelli fuscipes:* Hayman, Misonne and Verheyen, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., (8) 154: 55. (Name Combination)
1975. *P[ipistrellus] r[ueppelli] fuscipes:* Koopman, Bull. Am. Mus. Nat. Hist., 154 (4): 404. (Name Combination)
1984. *Pipistrellus (Scotozous) rueppelli fuscipes:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch.. (Name Combination)
1994. *P[ipistrellus (Vansonia)] r[ueppelli] fuscipes:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 116. (Name Combination)
? *Pipistrellus (Vansonia) rueppellii fuscipes:* (Name Combination)
? *Pipistrellus rueppellii fuscipes:* (Name Combination, Current Combination)

GENERAL DISTRIBUTION:
Ethiopia to northern Angola.

Pipistrellus rueppellii pulcher (Dobson, 1875)

*1875. *Vesperugo pulcher* Dobson, Proc. zool. Soc. Lond., 1875, III: 471. Publication date: October 1875. Type locality: Tanzania: Zanzibar [ca. 06 10 S 39 12 E] [Goto Description]. Holotype: BMNH 1868.12.22.3: ad ♂, alcoholic (skull not removed). Presented/Donated by: Dr. Kirk.
1878. *Vesperugo (Vesperugo) pulcher:* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, 233. (Name Combination)
1902. *P[ipistrellus] pulcher:* Anderson and de Winton, Zoology of Egypt: Mammalia, 129. (Name Combination)
1910. *Pipistrellus pulcher:* Thomas and Wroughton, Trans. Linn. Soc. Lond., 19 (5) (63): 489. (Name Combination)
1984. *Pipistrellus (Scotozous) rueppelli pulcher:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch.. (Name Combination)
1994. *P[ipistrellus (Vansonia)] r[ueppelli] pulcher:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 116. (Name Combination)
? *Pipistrellus rueppellii pulcher:* (Name Combination, Current Combination)

GENERAL DISTRIBUTION:
Northeastern Tanzania and Zanzibar.

Pipistrellus rueppellii rueppellii (J. B. Fischer, 1829)

1827. *Vespertilio temminckii* Cretzschmar, in: Rüppell, Atlas Reise Nördlichen Afrika, Zoologie Säugethiere, 1: 17: pl. 6. Type locality: Sudan: Northern province: Dongola [19 10 N 30 27 E]. Lectotype: SMF 4308: ad ♂, skin only. Collected by: Wilhem Peter Edward Simon Rüppell; collection date: 1824. Old catalog: II.N.11.b: see Mertens (1925: 22). - Comments: Preoccupied by *temmincki* Horsfield, 1824 (a *Scotophilus*): see Allen (1939a: 95), Meester *et al.* (1986: 51), Simmons (2005). The publication date of Cretzschmar's work is sometimes indicated as "1826" (as mentioned on the title page), but also as "1827", "1828", "1830-1831".
*1829. *Vespertilio ruppellii* J.B. Fischer, Synopsis Mamm, 109. Publication date: 1829. Type locality: Sudan: Northern province: Dongola [19 10 N 30 27 E].
1866. *Vesperugo hypoleucus* Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 546. Publication date: 1866. Type locality: Sudan: between Kéréri, Halfaye & Surerát on the Nile: Sennaar, near Khartoum, [ca. 15 35 N 33 38 E] [Goto Description].

Holotype: NMW 24574: ad, skin and skull. Collection date: August 1853. - Comments: Meester *et al.* (1986: 51) assigned it to Fitzinger only.

1866. *Vesperugo sennaariensis* Heuglin and Fitzinger, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 546. Publication date: 1866. Type locality: Sudan: Khartoum [15 40 N 32 35 E, 380 m] [Goto Description]. - Comments: Nomen nudum (see Allen, 1939a: 95; Meester *et al.*, 1986: 51).

1877. *Vesperugo senarensis* Heuglin, Reise in Nordost Afrika, 2: 32. Publication date: 1877 [Goto Description]. - Comments: Nomen nudum (see Allen, 1939a: 95; Meester *et al.*, 1986: 51).

1939. *Pipistrellus rüppellii rüppellii:* G.M. Allen, Bull. Mus. comp. Zool., 83: 95. (Name Combination)

1955. *Pipistrellus ruppelli ruppelli:* Sanborn and Hoogstraal, J. Egypt. Publ. Health Ass., 30 (4): xxx.

1958. *Pipistrellus (Scotozous) rueppelli rueppeli:* Anciaux de Faveaux, Bull. IFAN, (A) 20 (1): 273. (Name Combination, Alternate Spelling)

1962. *Pipistrellus ruppelii ruppelii:* Heyneman and Macy, J. Egypt. Publ. Health Ass., 37 (4): 123. (Alternate Spelling)

1964. *Scotozous r[üppelli] rüppelli:* Niethammer, Alexander Koenigs Reisen am Nil, 72. (Name Combination)

1966. *Pipistrellus (Scotozous) rüppelli rüppelli:* Ellerman and Morrison-Scott, Checklist of Palaearctic and Indian Mammals 1758 to 1946. (Second Edition), 172. (Name Combination)

1974. *Pipistrellus rueppelli rueppelli:* Largen, Kock and Yalden, Mon. Zool. ital., (N.S.) 16 (Suppl. 5): 222, 245.

1978. *Pipistrellus rüppelli rüppelli:* Madkour, Zool. Anz., 201 (5/6): 387. (Alternate Spelling)

1983. *P[ipistrellus (Vansonia)] r[ueppellii] rueppellii:* Smithers, Mammals Southern African subreg, 97. (Name Combination)

1984. *Pipistrellus rueppellii rueppellii:* Rautenbach, Schlitter and Braack, Koedoe, 27: ???. (Name Combination, Current Combination)

1988. *Pipistrellus (Pipistrellus) rueppellii rueppellii:* Ansell and Dowsett, Mammals of Malawi, 39. (Name Combination)

1994. *P[ipistrellus (Vansonia)] r[ueppelli] rueppelli:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 116. (Alternate Spelling)

MAJOR THREATS:
Sherwin *et al.* (2012: 174) consider water stress and the aerial hawking feeding style to be risk factors related with climatic change.

GENERAL DISTRIBUTION:
Egypt to Nigeria and Central Sudan.

Pipistrellus rueppellii senegalensis Dorst, 1960

*1960. *Pipistrellus Rüppelli senegalensis* Dorst, Bull. Mus. natn. Hist. nat., Paris, sér. 2, 31: 473 (for 1959). Type locality: Senegal: Richard Toll [16 48 N 15 42 W] [Goto Description]. Holotype: MNHN ZM-MO-1960-81: ad ♀, skull and alcoholic. Collected by: Francis Roux; collection date: September 1958.

1965. *Pipistrellus (Scotozous) rueppelli senegalensis:* Rosevear, Bats of West Africa, 272. (Name Combination)

1972. *P[ipistrellus] ruepelli senegalensis:* Adam and Hubert, Mammalia, 36 (1): 59. (Lapsus)

1972. *Pipistrellus rueppeli senegalensis:* Adam and Hubert, Mammalia, 36 (1): 64. (Name Combination)

1972. *Pipistrellus rueppelli senegalis:* Adam and Hubert, Mammalia, 36 (1): 59. (Lapsus)

1982. *Pipistrellus ruppelli senegalensis:* Verschuren, Mém. IFAN, 92: 307. (Alternate Spelling)

1994. *P[ipistrellus (Vansonia)] r[ueppelli] senegalensis:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 116. (Name Combination)

1998. *P[ipistrellus (Pipistrellus)] r[ueppellii] senegalensis:* Grubb, Jones, Davies, Edberg, Starin and Hill, Mammals of Ghana, Sierra Leone and The Gambia, 84.

? *Pipistrellus rueppellii senegalensis:* (Current Combination, Current Spelling)

GENERAL DISTRIBUTION:
Algeria to Senegal.

Pipistrellus rueppellii vernayi Roberts, 1932

*1932. *Pipistrellus vernayi* Roberts, Ann. Transv. Mus., 15 (1): 16. Publication date: 1 October 1932. Type locality: Botswana: Ngamiland: Maun [19 59 S 23 25 E] [Goto Description]. Holotype: TM 6546: ad ♂. Collected by: The Vernay-Lang Kalahari Expedition 1930; collection date: 29 May 1930; original number: 648.
1933. *Pipistrellus leucomelas* Monard, Bull. Soc. Neuchât. Sci. nat., 57: 47 (for 1932?). Publication date: 1933. Type locality: Angola: South-Central Angola: Vila da Ponte [14 25 S 16 15 E].
1939. *Pipistrellus rüppellii vernayi:* G.M. Allen, Bull. Mus. comp. Zool., 83: 96. (Name Combination, Current Combination)
1946. *[Vansonia] vernayi:* Roberts, Ann. Transv. Mus., 20 (4): 304. (Name Combination)
1951. *Vansonia vernayi:* Roberts, Mammals of South Africa, 82. (Name Combination)
1953. *Pipistrellus (Scotozous) rueppelli vernayi:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination)
1978. *Pipistrellus rueppelli vernayi:* Ansell, Mammals of Zambia, 24. (Name Combination)
1983. *P[ipistrellus (Scotozous)] r[ueppellii] vernayi:* Smithers, Mammals Southern African subreg, 97. (Name Combination)
1984. *Pipistrellus (Scotozous) rueppelli leucomelas:* Anciaux de Faveaux, Ann. Kon. Mus. Mid. Afr., Zool. Wetensch., 244: 49.
1986. *Pipistrellus (Vansonia) rueppellii vernayi:* Meester, Rautenbach, Dippenaar and Baker, Transv. Mus. Monogr., 5: 51. (Name Combination)
1994. *P[ipistrellus (Vansonia)] r[ueppelli] leucomelas:* Koopman, in: Niethammer, Schliemann and Starck, Handbook of Zoology, volume II (Mammalia) Chiroptera, (60) 116.
? *Pipistrellus (Vansonia) rueppellii leucomelas:*
? *Pipistrellus rueppellii leucomelas:*
? *Pipistrellus rueppellii vernayi:* (Current Spelling)

TAXONOMY:
If *vernayi* and *leucomelas* indeed represent the same form, then it might become important to check the actual publication date of *leucomelas*. This name was published in the 1932 issue of the "Bulletin de la Société Neuchâteloise de Sciences Naturelles", but the issue seemed to have appeared in 1933. Otherwise, this name might have priority over *Pipistrellus vernayi* which was published on 1 October 1932.

At present, we synonymize both names and consider *vernayi* to be the oldest name.

Kock (1969a: 174) points out that *leucomelas* might be a homonym of *Vespertilio leucomela* Cretzschmar, 1830.

GENERAL DISTRIBUTION:
Malawi to Transvaal and Southern Angola.

Pipistrellus rusticus (Tomes, 1861)

*1861. *Scotophilus rusticus* Tomes, Proc. zool. Soc. Lond., 1861, I: 31, 35. Publication date: May 1861. Type locality: Namibia: Ovamboland: Olifants Vlei [18 00 S 17 30 E] [Goto Description]. Lectotype: BMNH 1907.1.1.419: ad ♀, skin and skull. Collected by: 1 Anderson; original number: 176a. Paralectotype: BMNH 1907.1.1.420: ad, skin and skull. Collected by: 1 Anderson; collection date: November 1899; original number: 176b. - Etymology: Lanza *et al.* (2015: 441) mention "The masculine Latin adjective *rùsticus* actually means "rural, country" i. e. farmland-loving. Tomes (1861b: 35) apparently used this adjective erroneously instead of the masculine Latin adjective *robiginosus* "rusty", referring to the fur dorsal colour of the species: 'On the upper surface it is dark brown at the roots, with the terminal half light cinnamon-brown […].' ".
1913. *Pipistrellus rusticus:* Roberts, Ann. Transv. Mus., 4: 67. (Name Combination, Current Combination)

1923. *Pipistrellus marrensis* Thomas and Hinton, Proc. zool. Soc. Lond., 1923, II: 249. Publication date: 6 July 1923. Type locality: Sudan: foothills S Jebel Marra: Darfur [12 54 N 24 21 E, 4 000 ft] [Goto Description]. Holotype: BMNH 1923.1.1.15: ad ♂. Collected by: Captain/Rear-Admiral Hubert Lynes and Willoughby P. Lowe; collection date: 3 April 1924; original number: 633.
1934. *Eptesicops rusticus:* Shortridge, Mammals of South West Africa, 60. (Name Combination)
1953. *Pipistrellus (Pipistrellus) rusticus:* Ellerman, Morrison-Scott and Hayman, Southern African mammals 1758 to 1951, 78. (Name Combination)
1959. *Pipistrellus (Eptesicops) rusticus:* Anonymus, Koedoe, 3: 58. (Name Combination)
1968. *Pipistrellus (Pipistrellus) rusticus rusticus:* Smithers, A check list and atlas of the mammals of Botswana (Africa), ???. (Name Combination)
1971. *Pipistrellus [(Pipistrellus)] rusticus marrensis:* Hayman and Hill, Mammals of Africa: Chiroptera, 40. (Name Combination)
1975. *P[ipistrellus] r[usticus] rusticus:* Wilson, Mus. Mem., Salisbury, 5: 141. (Name Combination)
? *Pipistrellus rusticus marrensis:* (Name Combination)
? *Pipistrellus rusticus phasma:* (Name Combination)
? *Pipistrellus rusticus rusticus:* (Name Combination)

TAXONOMY:



Figure 357. A male *Pipistrellus rusticus* (TM 48130) caught at Makalali-GR, Limpopo, South Africa.

See Simmons (2005).

COMMON NAMES:

Afrikaans: Roeskleurvlermuis. Chinese: 锈色伏翼. Czech: netopýr damarský. English: Rusty Bat, Rusty Pipistrelle Bat, Rusty Pipistrelle. French: Pipistrelle rustique, Pipistrelle rouille. German: Rostfarbene Zwergfledermaus, Rostfarbene Pipistrelle. Italian: Pipistrèllo rugginóso.

ETYMOLOGY OF COMMON NAME:

The colloquial name refers to the rusty colour of their fur (Taylor, 2005).

CONSERVATION STATUS:

Global - Listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008am; IUCN, 2009).

Assessment History -

2008 - LC ver 3.1 (2001) (Jacobs *et al.*, 2008am; IUCN, 2009). 2004 - LC ver 3.1 (2001) (Jacobs *et al.*, 2004ao; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - LC ver 3.1 (2001) (Monadjem *et al.*, 2016r). 2004 - NT ver 3.1 (2001) (Friedmann and Daly, 2004). 1986 - Indeterminate (Smithers, 1986).

MAJOR THREATS:

There appear to be no major threats to this species as a whole (Jacobs *et al.*, 2008am; IUCN, 2009).

CONSERVATION ACTIONS:

Jacobs *et al.* (2008am) [in IUCN (2009)] report that this species has been recorded from Mole National Park in Ghana (Grubb *et al.*, 1998). No direct conservation measures are currently needed for this species as a whole.

GENERAL DISTRIBUTION:

Pipistrellus rusticus has been widely, but patchily, recorded throughout much of sub-Saharan Africa. It is distributed from Senegal and The Gambia in the west, with easternmost records from Ethiopia close to the Somalia border area. It is found as far south as northern South Africa (where its distribution is mostly affected by precipitation seasonality; Babiker Salata (2012: 49)) and central Namibia. Other than records from southern Chad and northern Central African Republic, the species has not been recorded in Central Africa.

For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 842,481 km^2.

Fahr (2007a: 105) assigns the Liberian *rusticus* specimens tentatively to *hesperidus*.

Native: Angola (Taylor *et al.*, 2018b: 60); Botswana (Archer, 1977; Monadjem *et al.*, 2010d: 572); Burkina Faso (Kangoyé *et al.*, 2015a: 621); Central African Republic (Kock *et al.*, 2002: 87); Chad; Ethiopia; Gambia (Kock *et al.*, 2002: 87); Ghana; Kenya; Malawi (Ansell and Dowsett, 1988: 40; Happold *et al.*, 1988; Monadjem *et al.*, 2010d: 572); Mozambique; Namibia (Monadjem *et al.*, 2010d: 572); Nigeria; Senegal; South Africa (Monadjem *et al.*, 2010d: 572); Sudan (Kock *et al.*, 2002: 87); Tanzania (Kock *et al.*, 2002: 87); Uganda; Zambia (Ansell, 1969; Ansell, 1973; Monadjem *et al.*, 2010d: 572); Zimbabwe (Monadjem *et al.*, 2010d: 572).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987) and Kearney *et al.* (2002).

ECHOLOCATION:
In Waterberg, South Africa, Taylor *et al.* (2013b: 17) recorded the following parameters for 1 call: F_{max}: 62.1 kHz, F_{min}: 55.3 kHz, F_{knee}: 57.6 kHz, F_{char}: 55.4 kHz, duration: 3.1 msec. 19 calls recorded at Mapungubwe National Park (RSA) by Parker and Bernard (2018: 57) had the following features: F_{char}: 55.20 ± 0.92 kHz, F_{max}: 64.41 ± 3.75 kHz, F_{min}: 54.00 ± 1.05 kHz, F_{knee}: 57.68 ± 1.34 kHz, duration: 4.70 ± 1.59 msec, and 6.11 ± 3.12 calls/sec.

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Both Rautenbach *et al.* (1993) and Kearney *et al.* (2002) reported 2*n* = 42, FN = 50, BA = 10, and an acrocentric Y chromosome, for specimens from South Africa. However, while Rautenbach *et al.* (1993) reported a submetacentric X chromosome, Kearney *et al.* (2002) reported a metacentric X chromosome. GTG banding identified that *P. hesperidus* and *P. rusticus* share the same Robertsonian fusion of chromosomes 11/12 (Kearney *et al.*, 2002).
Protein / allozyme - Unknown.

HABITAT:
In southern Africa, *P. rusticus* occurs in Savanna habitats (84 %; Cooper-Bohannon *et al.*, 2016: Table S2).

POPULATION:
Structure and Density - This species is locally common (Jacobs *et al.*, 2008am; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008am; IUCN, 2009).

REPRODUCTION AND ONTOGENY:
P. rusticus displays a clear disassociation between male and female gamete production (van der Merwe and Mostert, 2005: 45). Spermatogenesis occurs during summer, and by late autumn the testes have regressed and the caudae epididymidis are full of stored spermatozoa (van der Merwe and Rautenbach, 1990). Mating is initiated in autumn, and spermatozoa from these inseminations are stored throughout the winter in the uteri of females (van der Merwe and Rautenbach, 1990; van der Merwe, 1994). Ovulation occurs late in winter to early spring and the released ova are fertilized by the spermatozoa stored within the female (van der Merwe and Mostert, 2005: 45).

van der Merwe and Rautenbach (1990: 538) found that 1 to 5 embryos might be present, but a maximum of two become implanted. The other embryos (up to morula stage) are resorbed (p. 540).

P. rusticus are seasonally monoestrous breeders and normally give birth to twins during the middle of November (van der Merwe and Rautenbach, 1990: 539; van der Merwe, 1994). However, occasional singletons have been recorded by van der Merwe and Rautenbach (1990). The uterus is bicornuate and a single foetus is carried in each of the uterine horns (van der Merwe and Rautenbach, 1990). *P. rusticus* is unique, in that although implantation is superficial, the amnion is formed by means of cavitation (van der Merwe, 1994). According to van der Merwe and Rautenbach (1990), embryonic development seems to be retarded just after implantation.
van der Merwe and Mostert (2005) investigated the reproductive pattern of female *P. rusticus* in South Africa by means of a histological examination of the ovarian follicles as well as early embryonic development. Female *P. rusticus* are seasonal monestrous breeders, initiating copulation in mid-autumn (April), storing sperm until the time of ovulation in late winter (August), and giving birth to twins in late spring (November). The period April until mid-August was characterized by sperm storage and increased follicular development. During mid-August the females ovulate and excess sperm were discarded. Females released between three and five ova, while a maximum of two embryos implanted successfully. Only a single embryo implanted per uterine horn. Embryo movement through the Fallopian tubes appeared to be a rapid process. Redundant embryos were resorbed before implantation. The period from the end of August until mid-November was marked by Pregnancy. Females invariably carried twins (one foetus in each uterine horn). Large-scale follicle

atresion, and very low levels of follicle development, chatacterized the period end of August until March. High incidences of polyovular follicles were recorded for all months of the year. No obvious form of reproductive asymmetry was recorded in *P. rusticus* (van der Merwe and Mostert, 2005).

Monadjem *et al.* (2010d) [in Weier *et al.* (2018: Suppl.)] mentioned births taking place in November.

MATING:
For Northern Transvaal (RSA), van der Merwe and Rautenbach (1990: 538) indicate that copulation was initiated during April, and ovluation and fertilization takes place in the second half of August.

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Botswana, Burkina Faso, Cameroon, Central African Republic, Egypt, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mozambique, Namibia, Niger, Nigeria, Senegal, Somalia, South Africa, South Sudan, Sudan, The Gambia, Uganda, Zambia, Zimbabwe.

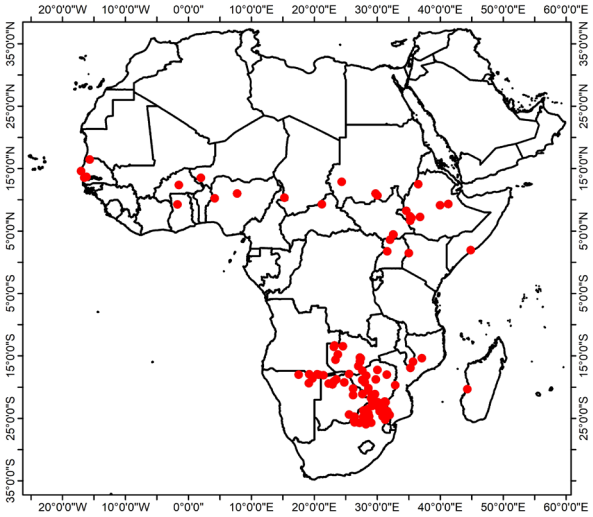


Figure 358. Distribution of *Pipistrellus rusticus*

Pipistrellus sp. aff. ***kuhlii*** Kuhl, 1817

*2001. *Pipistrellus cf kuhlii* Volleth, Bronner, Göpfert, Heller, von Helversen and Yong, Chromosome Res., 9 (1): 26. (Current Combination)

TAXONOMY:
Volleth *et al.* (2001: 25) report a *Pipistrellus kuhlii*-like species from Madagascar, which they separated from the European *Pipistrellus* based on a different diploid chromosome number. This form might possibly be conspecific with *Pipistrellus hesperidus* Temminck, 1840, since Bates *et al.* (2006: 299) mention *P. hesperidus* from Madagascar.

Pipistrellus "incertae-sedis"

1858. *Nannugo Kolenatii* Müller, Lotos (Prag), 8: 75, figs 1 - 4. Type locality: Egypt: "Egypt" [Goto Description].
1862. *Vespertilio (Nannugo) Kolenatii:* Koch, Nass. Naturw. Jahrb., 18: 397.
2013. *Pipistrellus cf. hesperidus:* Koubínová *et al.*, Front. Zool., 10: 1-48. - Comments: Koubínová *et al.* (2013: 7) found found differences in dipoloid chromosome number and/or in chromosome morphology between the populations from Senegal and other regions in Africa. (Name Combination)

TAXONOMY:
Müller (1858: 75) called *Nannugo Kolenati* one of the smallest Nord African bat species. Its German name "Die weissgesäumte Buschfledermaus" indicates that a white edge on the wing membrane was present.
Koch (1862: 397) considers this form a relative of *Nannugo marginatus*, which in turn is a synonym of *P. kuhlii*. Except for these two publications, no other references to this form were found.
The description does not enable us to assign this name to either *Pipistrellus kuhlii* Kuhl, 1817 or *Pipistrellus deserti* Thomas, 1902. In the latter case this name might be a senior synonym, provided *aegyptius* Fischer, 1829 is to be ignored. However, this name clearly does qualify for the status of "*nomen oblitum*", and should, therefore, probably be ignored.

Genus ***Plecotus*** E. Geoffroy St.-Hilaire, 1818

1816. *Macrotus* Leach, Cat. Mamm. Birds B.M, p 5. - Comments: Type species: *Macrotus europaeus* Leach, 1816 [= *Vespertilio auritus* Linnaeus, 1758]. Preoccupied by *Macropus* Gray, 1842, *Nomen nudum* by Pavlinov *et al.* (1995: 103).. - Etymology: From the Greek "*μακρός*", meaning large and "*ούς*" or "*ώτός*", meaning ear, referring to very large ears (see Palmer, 1904: 395).

*1818. *Plecotus* E. Geoffroy Saint-Hilaire, Description des Mammifères qui se trouve en Egypte, 2: 112, pl. 2, No 3. Publication date: 1818. - Comments: Type species: *Vespertilio auritus* Linnaeus, 1758. - Etymology: From the Greek "*pleko*" meaning folded or twisted and "*otis*" meaning ear (see Jones, 1977a: 3; Álvarez-Castañeda and Álvarez Solórzano, 1996: 43). Gardner (2005: 184) considers this to be masculine (*Plec* = twisted + *ot* = ear(ed) + *us* (Latin second declension ending)). (Current Combination)

1829. *Plecautus:* F. Cuvier. - Comments: Lapsus: see Cabrera (1914). (Lapsus)

? *Plecotus sp.:*

TAXONOMY:
A key to the genus was published by Jones (1977a: 1). Mediterranean and Atlantic islands forms reviewed by Juste *et al.* (2004a).

Benda *et al.* (2006) indicated that Benda *et al.* (2004c) and Spitzenberger *et al.* (2006) performed combined genetic and morphological analyses of Mediterranean plecotine bats with very similar results but with a slightly different interpretation. The difference is in the taxonomic evalutation of the *kolombatovici* clade of the *austriacus* group (in the sense of Juste *et al.* (2004a). This clade consists of a mosaic of morphotypes with a relatively very shallow genetic divergence. Benda *et al.* (2004c) coidentified this group with one species *P. teneriffae*, containg three to four more or less distinct forms living in allopatry (*teneriffae*, *kolombatovici*, *gaisleri*, and a possible fourth form in the Maghreb, but preliminary included into *gaisleri*). Spitzenberger *et al.* (2006) distinguished two species in the clade, the monotypic *P. teneriffae* and *P. kolombatovici* with three forms, *kolombatovici*, *gaisleri*, and the unnamed Maghrebian form. A third possible interpretation, considering three species within the clade (which well confirm with the morphological evidence) was recently suggested by Mayer *et al.* (2007). Since all three analyses used almost the same types of character sets, their interpretations are alternatives arising from almost identical results. Thus, contrary to Benda *et al.* (2006) who suggest to follow the 'intermediate' designation *P.* (*teneriffae*) *gaisleri* for the populations of the Maghreb and Cyrenaica, the IUCN evaluated *P. kolombatovici* including these North African populations.

Known species of the genus *Plecotus*: *alpinus* Kiefer and Veith, 2002 – France, Liechtenstein, Switzerland, Austria, Croatia, Greece (Simmons, 2005: 482); *auritus* (Linnaeus, 1758) – Norway, Ireland and Spain to Sakhalin Isl (Russia), Korea, Japan, northern China, Nepal, India (Simmons, 2005: 482); *austriacus* (J. Fischer, 1829) – England and Spain to Mongolia and western China (Simmons, 2005: 482); ***balensis*** Kruskop and Lavrenchenko, 2000; ***christii*** Gray, 1838; *kolombatovici* Dulic, 1980 – Croatia and nearby islands in the Adriatic Sea (Simmons, 2005: 483); ***gaisleri*** Benda, Kiefer, Hanak and Veith, 2004; *sardus* Mucedda, Kiefer, Pidinchedda and Veith, 2002; *taivanus* Yoshiyuki, 1991 – Taiwan (Simmons, 2005: 483); ***teneriffae*** Barrett-Hamilton, 1907.

COMMON NAMES:
Czech: praví ušani (ušanové, srostlouchové, pletušanové, vrásničové. English: Long-eared bats, Old World Big-eared Bats, Big-eared Bats, Old World Long-eared Bats. French: Oreillards, Chauves-souris à grandes oreilles. German: Langohrfledermäuse, Langohren.

GENERAL DISTRIBUTION:
Dorst and de Naurois (1966: 292) report on *Plecotus austriacus* specimens collected on the Cape Verdian islands of Maio and Santiago.

Plecotus balensis Kruskop & Lavrenchenko, 2000

*2000. *Plecotus balensis* Kruskop and Lavrenchenko, Myotis, 38: 6, figs 1, 5, 6, 7. Publication date: December 2000. Type locality: Ethiopia: Southern Ethiopia, Bale Mountains National Park: Harenna Forest [06 45 N 39 44 E, 2 760 m] [Goto Description]. Holotype: ZMMU S-164904: ad ♂, skin and skull. Collected by: Sergey V. Kruskop; collection date: 29 December 1995. - Etymology: In reference to the Bale mountains, the area from where

the type specimen originated (see Kruskop and Lavrenchenko, 2000: 8). (Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Czech: ušan habešský. English: Bale Big-eared Bat, Bale Long-eared Bat, Ethiopian Big-eared Bat, Ethiopian Long-eared Bat. French: Oreillard d'Ethiopie. German: Bale-Langohr.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status. The species has only been recently described, and there remains very little information on the distribution of the species. While it is currently known from fewer than five locations, it seems plausible that the species ranges more widely than this and does not therefore qualify for Vulnerable B2ab(iii) (Lavrenchenko *et al.*, 2008; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Lavrenchenko *et al.*, 2008; IUCN, 2009). 2004 - VU D2 ver 3.1 (2001) (Lavrenchenko *et al.*, 2004a; IUCN, 2004).

MAJOR THREATS:
This species is threatened by the rapid destruction of montane forest, presumably through extraction of timber and firewood, and the conversion of land to agricultural use (Lavrenchenko *et al.*, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Lavrenchenko *et al.* (2008) [in IUCN (2009)] report that this species has been recorded within the Bale Mountains National Park. Additional management of the area is needed to prevent further deforestation of the Harenna Forest. There is a need for further field surveys to better determine the range of this species.

GENERAL DISTRIBUTION:
Plecotus balensis is endemic to the Ethiopian highlands were it is currently known only with certainty from the upper belts of the Harenna Forest in the Bale Mountains National Park and from Abune Yosef (Kruskop and Lavrenchenko, 2000; Juste *et al.*, 2004a; Benda *et al.*, 2004c). There is an early record from "Shoa" (= Shewa), which probably came from the uplands north or northwest of Addis Ababa (Kruskop and Lavrenchenko, 2000). It is possible that the species occurs in similar areas of montane forest, but it has not been recorded during surveys in either the Beletta Forest or the Sheko Forest (Kruskop and Lavrenchenko, 2000). The species is found at elevations of 2,500 to 3,000 m asl.

There are a number of poorly documented museum specimens that may have come from additional sites within Ethiopia, or possibly from adjacent Eritrea (although this may refer to a specimen of *Plecotus christii*) (Kruskop and Lavrenchenko, 2000).

Benda *et al.* (2011b: 44) tentatively assign *Plecotus* specimens from Yemen to this taxon as *Plecotus* cf. *balensis*.

Native: Ethiopia (Kruskop and Lavrenchenko, 2000; Juste *et al.*, 2004a; Benda *et al.*, 2004c).
Presence uncertain: Eritrea (Kruskop and Lavrenchenko, 2000).

DETAILED MORPHOLOGY:
Baculum - See Kruskop and Lavrenchenko (2000), Benda *et al.* (2004c).

MOLECULAR BIOLOGY:
DNA - See Benda *et al.* (2004c), Juste *et al.* (2004c).
Karyotype - Unknown.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - Kruskop and Lavrenchenko (2000) mention that this bat appears to be relatively common within its limited distribution.
Trend - 2008 - Unknown (Lavrenchenko *et al.*, 2008; IUCN, 2009).

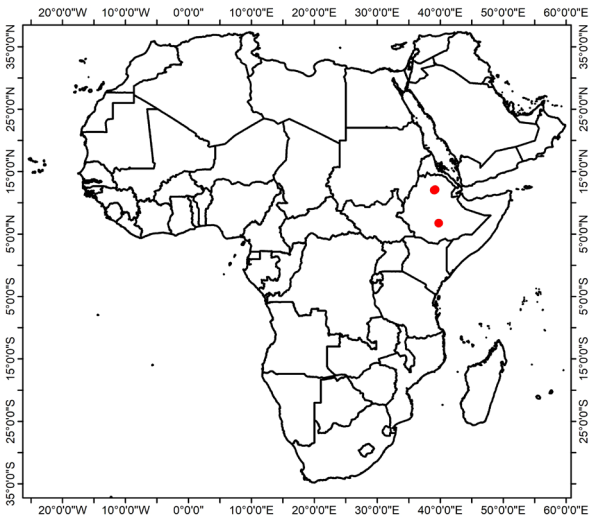


Figure 359. Distribution of *Plecotus balensis*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Ethiopia.

Plecotus christii Gray, 1838

1829. *Vespertilio auritus ß aegyptius* J.B. Fischer, Synopsis Mamm, 117. Publication date: 1829. - Comments: Junior homonym of *Vespertilio pipistrellus var aegyptius*: see Qumsiyeh (1985: 65). Allen (1939a: 96) mentioned this form to be based on the description by E. Geoffroy, 1818: Description de l'Egypte, 2: 119.

*1838. *Plecotus christii* Gray, Mag. Zool. Bot., Edinburgh, 2 (12): 495. Publication date: 1 February 1838. Type locality: Egypt: southern Egypt: Nile valley between Qena and Aswan. Lectotype: BMNH 1866.a: skin only. Collected by: Major (Dr.) Turnbell Christie. Presented/Donated by: ?: Collector Unknown. Skin in poor condition. Sometimes also mentioned as "BMNH GMC M66a". - Comments: Type locality originally North Africa, but restricted by Qumsiyeh (1985: 65, 67) to southern Egypt, Nile valley between Qena and Aswan. Between 16° 10' N, 32° 43' E and 24° 05' N, 32° 53' E: see Benda *et al.* (2008f: 70). - Etymology: In honour of Dr. Turnbull Christie, the collector of the type specimen (see Gray, 1838: 495).

1866. *Plecotus æthiopicus* Heuglin, in: Fitzinger and Heuglin, Sber. k. Akad. Wiss. Wien, math. naturw. Kl., 54 (1) 10: 546. Publication date: 1866. Type locality: Sudan: Bahr-el-Abiad [ca. 14 00 N 33 00 E]. - Comments: Nomen nudum. Mentioned by Allen (1939a: 96) as a synonym of *Plecotus auritus aegyptiacus* Geoffroy.

1878. *Plecotus ægyptiacus* Dobson, Catalogue of the Chiroptera of the collection of the British Museum, p. 178. Publication date: June 1878. Type locality: Egypt. Topotype: MCZ 32976: ♂, alcoholic (skull not removed). Collected by: Dr. John Anderson. Presented/Donated by: ?: Collector Unknown. - Comments: Allen (1939a: 96) mentioned "I. Geoffroy, Mag. de Zool., 2: cl. 1, p. 2 of description of pl. 2-3, 1832, who repeats characters given by E. Geoffroy, in Description de l'Egypte, 2: 119, 1818. Egypt". Kock (1969a: 179) also mentions "I. Geoffr.", buf refers to Fitzinger (in Heuglin and Fitzinger, 1866: 545) as first reference, who reported it from Egypt, Abyssinia and Shoa. Pavlinov *et al.* (1995) mentioned Dobson, 1878 as author.

1911. *Plecotus christiei:* Thomas, Proc. zool. Soc. Lond., 1911, I: 160. - Comments: Unjustified emendation (Benda *et al.*, 2006). (Emendation)

1964. *Plecotus austriacus christiei:* - Comments: Unjustified emendation (see Thomas, 1911; Benda *et al.*, 2006). (Name Combination, Lapsus)

2002. *Plecotus cristiei:* Kiefer and Veith, Myotis, 39: 12. (Lapsus)

2008. *Plecotus christii petraeus* Benda, in: Benda, Dietz, Andreas, Hotový, Lucan, Maltby, Meakin, Truscott and Vallo, Acta Soc. Zool. Bohem., 72: 1, 71, fig. 68. Type locality: Egypt: Sinai: Janub Sina Governate: Wadi Feiran: western edge of Feiran Oasis [28 43 N 33 37 E, 595 m]. Holotype: NMP 90496: ad ♂, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Josef Hotový and Radek K. Lucan; collection date: 8 September 2005; original number: pb2858. See Benda in Mlíkovský *et al.* (2011: 138). Paratype: BMNH 1903.12.8.5: ad ♀, skull and alcoholic. Collected by: Dr. John Anderson. Tor [= El Tur], Sinai [Egypt]. Paratype: NMP 90497: sad ♀, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Josef Hotový and Radek K. Lucan; collection date: 9 September 2005; original number: pb2859. El Milga, Sinai, Egypt. See Benda in Mlíkovský *et al.* (2011: 138). Paratype: NMP 90499: ad ♂, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Josef Hotový and Radek K. Lucan; collection date: 10 September 2005; original number: pb2861. Feiran, Sinai, Egypt. See Benda in Mlíkovský *et al.* (2011: 138). Paratype: NMP 90518: ad ♀, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Josef Hotový and Radek K. Lucan; collection date: 10 September 2005; original number: pb2880. El Tur, Hammam Musa, Sinai, Egypt. See Benda in Mlíkovský *et al.* (2011: 138). Paratype: NMP 90519: ad ♂, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Josef Hotový and Radek K. Lucan; collection date: 10 September 2005; original number: pb2881. El Tur, Hammam Musa, Sinai, Egypt. See Benda in Mlíkovský *et al.* (2011: 138). Paratype: NMP 90523: ad ♂, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Josef Hotový and Radek K. Lucan; collection date: 15 September 2005; original number: pb2885. Ain Hudra, Sinai, Egypt. See Benda in Mlíkovský *et al.* (2011: 138). Paratype: NMP 90533: ad ♀, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Josef Hotový and Radek K. Lucan; collection date: 18

September 2005; original number: pb2895. Ain Sudr, Sinai. See Benda in Mlíkovský *et al.* (2011: 138). Paratype: TAU M.7160: ad ♂, skin and skull. Collection date: 01 December 1977. Hashiba [= Umm Khisheib], Sinai [Egypt]. See Benda *et al.* (2008f: 71).

? *Plecotus auritus aegyptiacus:*

? *Plecotus austriacus christei:* (Lapsus)

? *Plecotus austriacus christii:* (Name Combination)

TAXONOMY:
Generally considered to be a subspecies of *austriacus*, but see Benda *et al.* (2004c: 23), who raised it to species rank.

Since *Plecotus austriacus* is a strictly European species (Juste *et al.*, 2004a; Mayer *et al.*, 2007). Therefore, this species is removed from the list of African species. All of the African records of *P. austriacus* in fact belong to *P. christii*, *P.* (*teneriffae*) *gaisleri* or to *P. balensis*.

COMMON NAMES:
Arabian: Khaffash. Czech: ušan egyptský. Dutch: Egyptische grootoorvleermuis. English: Christie's Long-eared Bat. French: Oreillard d'Egypte. German: Christis Graues Langohr. Hebrew: Oznan.

CONSERVATION STATUS:
Global - Probably a small population, suitable habitat might be fragmented, but needs more research to be properly assessed (Aulagnier and Benda, 2008; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Aulagnier and Benda, 2008; IUCN, 2009). 2006 - DD ver 3.1 (2001) (Aulagnier and Benda, 2004b; IUCN, 2006). 2004 - DD ver 3.1 (2001) [assessed as *Plecotus christiei*] (Aulagnier and Benda, 2004b; IUCN, 2004).

MAJOR THREATS:
Affected by human disturbance (Aulagnier and Benda, 2008; IUCN, 2009).

CONSERVATION ACTIONS:
Aulagnier and Benda (2008) [in IUCN (2009)] report that no conservation measures are in place. Further research on population is needed in order to make an assessment.

GENERAL DISTRIBUTION:
Plecotus christii is known only from a few localities in NE Africa, including eastern Libya (S. Aulagnier *pers. comm.*, 2007 in Aulagnier and Benda, 2008 [in IUCN, 2009]), Egypt including Sinai and Sudan. Benda *et al.* (2004c: 26) restricted its confirmed distribution to the north-eastern African desert region, Mayer *et al.* (2007) suggested its occurrence also in the Jordan desert.

A specimen from Eritrea may belong to this species or to *P. balensis* (Kruskop and Lavrenchenko, 2000).

Native: Egypt [Sinai] (Horácek *et al.*, 2000: 135); Libyan Arab Jamahiriya (Horácek *et al.*, 2000: 135); Sudan (Horácek *et al.*, 2000: 135).
Presence uncertain: Eritrea.

DETAILED MORPHOLOGY:
Baculum - See Benda *et al.* (2004c).

ECHOLOCATION:
In Jordan, Benda *et al.* (2010b: 204) recorded the following parameters for 42 calls: Start frequency: 44.2 ± 2.8 (34.5 - 49.0) kHz, End frequency: 25.0 ± 1.0 (22.6 - 26.7) kHz, Peak frequency: 30.5 ± 1.7 (28.6 - 34.2) kHz, Pulse duration: 2.3 ± 0.5 (1.4 - 3.5) msec, and Inter-pulse duration: 57.6 ± 18.9 (18.0 - 89.0) msec.

Hackett *et al.* (2016: 223) reported on 25 calls from Israel: Pulse duration: 3.05 ± 0.98 msec, F_{start}: 37.22 ± 3.43 kHz, F_{end}: 23.85 ± 2.45 kHz, F_{peak}: 28.47 ± 2.74 kHz.

MOLECULAR BIOLOGY:
DNA - See Benda *et al.* (2004c), Juste *et al.* (2004c), Spitzenberger *et al.* (2006, Mayer *et al.* (2007).
Karyotype - Unknown.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - Probably very small population, only scattered and isolated records (Aulagnier and Benda, 2008; IUCN, 2009).
Trend - 2008 - Unknown (Aulagnier and Benda, 2008; IUCN, 2009).

ACTIVITY AND BEHAVIOUR:
Korine *et al.* (2015: 5) indicate that the activity of *P. christii* could be underestimated because of the whispering nature of their echolocation calls.

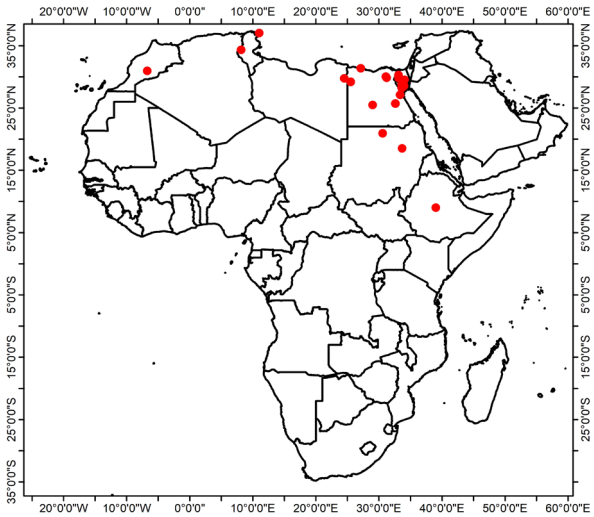


Figure 360. Distribution of *Plecotus christii*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Egypt, Ethiopia, Libya, Morocco, Sudan, Tunisia.

Plecotus gaisleri Benda, Kiefer, Hanak & Veith, 2004

*2004. *Plecotus teneriffae gaisleri* Benda, Kiefer, Hanák and Veith, Folia Zool., 53 (Monogr. 1): 28. Type locality: Libya: Cyrenaica: Al Jabal Al Akhdar district: 8 km SW Massah,: Wadi al Kuf (Jabal Akhdar Mts) [32 42 N 21 35 E, ca. 330 m] [Goto Description]. Holotype: NMP 49911: ad ♀, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002. Paratypes: 4 MM + 2 FF; see Benda *et al.* (2004c: 29). Paratype: NMP 49905: ad ♂, skull and alcoholic. Collected by: Michal Andreas, Petr Benda, Vladimir Hanák, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2153. See Benda *et al.* (2004c: 29), Benda in Mlíkovský *et al.* (2011: 137). Paratype: NMP 49906: ad ♂, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2154. See Benda *et al.* (2004c: 29), Benda in Mlíkovský *et al.* (2011: 137). Paratype: NMP 49907: ad ♂, skull and alcoholic. Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2155. See Benda *et al.* (2004c: 29), Benda in Mlíkovský *et al.* (2011: 137). Paratype: NMP 49908: ad ♂, alcoholic (skull not removed). Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2156. See Benda *et al.* (2004c: 29), Benda in Mlíkovský *et al.* (2011: 137). Paratype: NMP 49909: ad ♀, alcoholic (skull not removed). Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2157. See Benda *et al.* (2004c: 29), Benda in Mlíkovský *et al.* (2011: 137). Paratype: NMP 49910: ad ♀, alcoholic (skull not removed). Collected by: Petr Benda, Vladimir Hanák, Michal Andreas, Antonin Reiter and Marcel Uhrin; collection date: 20 May 2002; original number: pb2158. See Benda *et al.* (2004c: 29), Benda in Mlíkovský *et al.* (2011: 137). - Comments: Considered a valid species by Mayer *et al.* (2007: Additional file 1) based on mitochondrial DNA analyses. - Etymology: In honour of professor Jiri Gaisler (Brno, Czech Republic) who significantly contributed to the knowledge of the North Afrian bat fauna (see Benda *et al.*, 2004c: 29).

2006. *P. kolombatovici gaisleri:* Spitzenberger, Strelkov, Winkler and Haring, Zool. Scr., 35 (3): 221. (Name Combination)

? *Plecotus gaisleri:* (Name Combination, Current Combination)

TAXONOMY:
See under *Plecotus* above. Formerly considered as *P. auritus* or *P. austriacus*, for details see Benda *et al.* (2004c). Spitzenberger *et al.* (2006) include it in *P. kolombatovici*.
See Mayer *et al.* (2007) and Mayer *et al.* (2007: Additional material).

COMMON NAMES:
Czech: ušan berberský. Dutch: Gaislers grootoorvleermuis. English: Gaisler's Long-eared Bat. French: Oreillard du Gaisler. German: Gaislers Langohrfledermaus. Italian: Orecchione di Gaisler.

CONSERVATION STATUS:
Global - VU (Baillie and Groombridge, 1996); DD ver 3.1 (2001) (IUCN, 2004; Juste *et al.*, 2004a) as *P. teneriffae*.

GENERAL DISTRIBUTION:
Northern Cyrenaica (Libya); north-west Africa [Maghreb: Morocco (Benda *et al.*, 2010a: 158; El Ibrahimi and Rguibi Idrissi, 2015: 364 [as "*Plecotus teneriffae = (P. austriacus, P. gaisleri)*"]), Algeria, Tunisia (Dalhoumi *et al.*, 2014: 53; 2016b: 867); Pantelleria island (Italy) and Malta.

ECHOLOCATION:
Benda *et al.* (2010a: 163) are the first to provide echolocation data for this species, based on 58 Moroccan specimens. They report a F_{start}: 41.7 ± 1.7 (37.2 - 44.5) kHz, F_{max}: 31.9 ± 2.0 (28.3 - 37.0) kHz, F_{end}: 21.7 ± 2.3 (16.1 - 26.5), with a duration of 1.4 ± 0.3 (0.9 - 1.9) ms, and an inter-pulse interval of 40.9 ± 23.5 (12.9 - 95.7) ms.

Also from Morocco, Disca *et al.* (2014: 226) report the following: call type FM multi H, F_{start}: 51.4 ± 1.1 kHz, F_{end}: 22.0 ± 0.7 kHz, $F_{max\ all\ harmonics}$: 29.7 ± 1.0 kHz, bandwidth: 29.3 ± 1.0 kHz, duration: 2.6 ± 0.2 msec.

ROOST:
Benda *et al.* (2014c: 103) found a roost (probably the remainder of a maternity colony) in deep holes and crevices of the ceiling of an ancient ruin covered by carob trees. Further specimens were also recovered from ruins, indicating that *P. gaisleri* is probably a petrophilous species, which seems to select its roosts solely in underground spaces rather open to daylight and in rock fissures

DIET:
Benda *et al.* (2014c: 108) examined eight sample sets of the diet and found large amounts of moths (Lepidoptera), most with wingspans between 30 and 35 mm. From other areas in Libya, orthopterans (Ensifera) or cockroaches (Blattoidea) formed the major part of the diet.

REPRODUCTION AND ONTOGENY:
Two pregnant females, both with one foetus, were collected in the central part of Wadi Al Kuf (Libya) on 19 May, whereas lactating females were found between 9 May and 4 August (Benda *et al.*, 2014c: 105).

PARASITES:
Benda *et al.* (2014c: 109) reported one egg with praelarvae of a mite belonging to the superorder Acariformes.

From Algeria, Bendjeddou *et al.* (2017: 15) reported the following ectoparasites: Nycteribiidae: *Nycteribia (Nycteribia) latreillii* (Leach, 1817) and Arachnida: *Spinturnix myoti* (Kolenati, 1856) and *Argas vespertilionis* (Latreille, 1802).

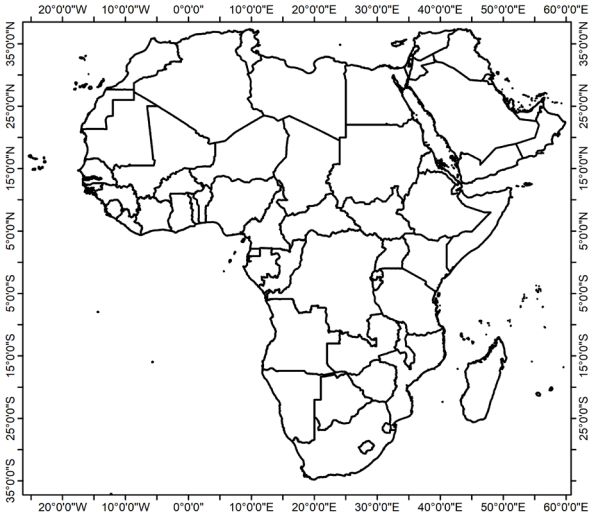


Figure 361. Distribution of *Plecotus gaisleri*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Morocco.

Plecotus teneriffae Barrett-Hamilton, 1907

*1907. *Plecotus teneriffae* Barrett-Hamilton, Ann. Mag. nat. Hist., ser. 7, 20 (120): 520. Publication date: 1 December 1907. Type locality: Canary Islands (Spain): Tenerife island: Orotava [28 23 N 16 31 W] [Goto Description]. Holotype: BMNH 1887.4.18.1: skin only. Collected by: Ramon Gomez; collection date: 3 April 1887. See Benda *et al.* (2004c: 39). - Comments: Barrett-Hamilton (1907: 520) mentions that the type specimen has no skull. - Etymology: Refering to the island where the type specimen was collected. (Current Combination)

? *Plecotus austriacus:*

TAXONOMY:
Synonymized with *P. austriacus* by Corbet (1978); but see Ibañez and Fernández (1985b). Genetic studies clearly show that *teneriffae* is more closely related with *kolombatovici*, while Pestano *et al.*

(2003a: 306) suggested the North African to be the closest relative.

COMMON NAMES:
Albanian: Lakuriq nate veshgjatë i Teneriffae-ve. Armenian: Կանարյան կամ Տենեռիֆյան ականջեղ. Azerbaijani: Kanar palazqulağı. Basque: Belarrihandi kanariar. Belarusian: Вушан канарскі. Bosnian: Kanarski dugouhi šišmiš. Breton: Skouarnegell Tenerife. Bulgarian: Канарски дългоух прилеп. Castilian: Orejudo canario, Murciélago orejudo canario. Catalan: Orellut canari, Rat penat orellut canari. Croatian: Kanarski dugoušan. Czech: Netopýr kanárský, Ušan kanárský. Danish: Kanarielangøre. Dutch: Canarische grootoorvleermuis. English: Canary Long-eared Bat, Canary big-eared bat. Estonian: Kanaari suurkõrv. Finnish: Kanariankorvayökkö. French: Oreillard de Ténérife. Frisian: Kanaryske grutearflearmûs. Galician: Orelludo canario. Georgian: კანარიული ყურა. German: Kanaren-Langohr, Kanaren-Langohrfledermaus. Greek: Ωτονυχτερίδα της Τενερίφης. Hungarian: Kanári-szigeteki hosszúfülű-denevér. Irish Gaelic: Ialtóg fhadchluasach Chanárach. Italian: Orecchione di Tenerife. Latvian: Tenerifes garausis. Lithuanian: Kanarinis ausylis. Luxembourgish: Kanaren-Laangouer. Macedonian: Тенерифов ушест лилјак. Maltese: Farfett il-Lejl Widnejħ Twal tal-GŻejjer Kanarji. Montenegrin: Kanarski slijepi miš. Norwegian: Kanarilangøre. Polish: Gacek kanaryjski. Portuguese: Morcego-orelhudo-canarino. Rhaeto-Romance: Ureglia gronda da Teneriffa. Romanian: Liliacul urecheat din Tenerife. Russian: Ушан канарский. Serbian: Канарски сиви дугоушан. Serbian Latin: Kanarski sivi dugoušan. Scottish Gaelic: Ialtag fhad-chluasach Chanaireach. Slovak: Ucháčkanársky. Slovenian: Kanarski uhatež. Swedish: Kanarielångöra. Turkish: Kanaryarlar Uzunkulaklı Yarasası. Ukrainian: Вухань канарський. Welsh: Ystlum hirglust yr Ynysoedd Dedwydd.

CONSERVATION STATUS:
Global - VU (Baillie and Groombridge, 1996); DD ver 3.1 (2001) (IUCN, 2004; Juste *et al.*, 2004a).

MAJOR THREATS:
Sagot and Chaverri (2015: 1670) mention roost loss or disturbance, and habitat degradation or loss as major threats for this species.

GENERAL DISTRIBUTION:
(Tenerife, La Palma, El Hiero) Canary Isls (Spain) (Benda *et al.*, 2004c: 28).

DETAILED MORPHOLOGY:
Baculum - See Ibañez and Fernández (1985b), Benda *et al.* (2004c).

MOLECULAR BIOLOGY:
DNA - See Pestano *et al.* (2003a), Benda *et al.* (2004c), Juste *et al.* (2004a), Spitzenberger *et al.* (2006), Mayer *et al.* (2007).
Karyotype - Unknown.
Protein / allozyme - Unknown.

PARASITES:
Estrada-Peña and Sanchez (1988: 309) described the mite *Steatonyssus (Steatonyssus) teidae* from a *P. teneriffae* specimen from La Caldera, Tenerife, Canary Islands.

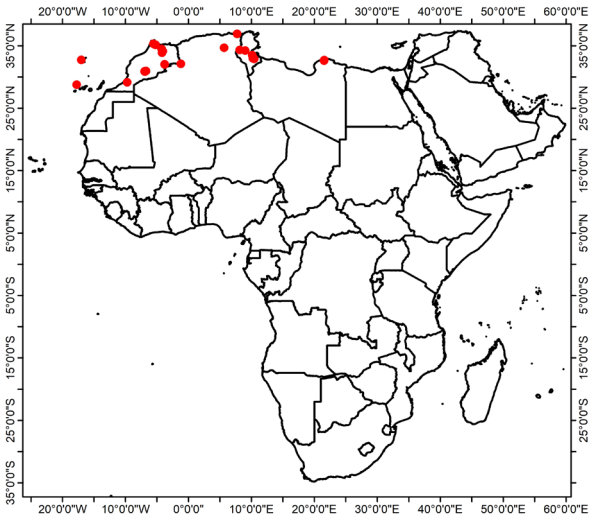


Figure 362. Distribution of *Plecotus teneriffae*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Algeria, Canary Islands (Spain), Libya, Madeira (Portugal), Malta, Morocco, Tunisia.

Genus ***Scotoecus*** Thomas, 1901

*1901. *Scotœcus* Thomas, Ann. Mag. nat. Hist., ser. 7, 7 (39): 263. Publication date: 1 March 1901 [Goto Description]. - Comments: Type species: *Scotophilus albofuscus* Thomas, 1890. - Etymology: From the Greek "*σκόοτος*", meaning darkness and "*όικέω*", meaning to dwell (see Palmer, 1904: 627).
1917. *Scotæcus:* Thomas, Ann. Mag. nat. Hist., ser. 8, 19 (111): 280. (Lapsus)
? *Scotoecus:* (Current Spelling)

TAXONOMY:
Scotoecus has been treated as a subgenus of *Nycticeius* (Ellerman *et al.*, 1953; Hayman and Hill, 1971), but more often as a full genus (Allen, 1939a; Rosevear, 1965; Kock, 1969a; Hill, 1974b; Koopman, 1975, 1978; Corbet and Hill, 1980; Swanepoel *et al.*, 1980; Honacki *et al.*, 1982). Of the two (Honacki *et al.*, 1982) or three (Corbet and Hill, 1980) recognized African species only *albofuscus* occurs in Southern Africa, having been recorded from a single locality in Mozambique.

Bronner *et al.* (2003) report the light-winged lesser house bat (*Scotoecus albofuscus*) in South Africa. This represents a significant extension in the known ranges of both species and testifies to the need for more intensive field surveys targeting poorly known taxa. Cotterill (2001d) also recorded *Scotoecus albigula* and *S. hindei* from Zinave, Mozambique, based on the re-identification of two museum specimens originally assigned to *Scotophilus viridis*. Compared with the light-winged *albofuscus*, species identification of the dark-winged taxa of *Scotoecus* (*albigula, hindei, hirundo, falabae*) is more complicated. Indeed, Koopman (1993a) included all these taxa in *S. hirundo*. A study of cranial variation involving a small sample of Malawian specimens (Taylor and van der Merwe (1998) revealed that *hindei, hirundo* and *albigula* are distinguishable on morphometric grounds, with *albigula* and *hindei* apparently having larger canines and cheekteeth (as well as larger skulls) than *hirundo*, while *albigula* and *hindei* differ from each other in skull proportions. However, we provisionally retain these within *S. hirundo*, pending a broader study of the dark-winged forms including a larger sample of specimens from across the range.

Known species of the genus *Scotoecus*: ***albigula*** Thomas, 1909; ***albofuscus*** (Thomas, 1890); ***hindei*** Thomas, 1901; ***hirundo*** (de Winton, 1899); ***†olduvensis*** Gunnell, Butler, Greenwood and Simmons, 2015; *pallidus* (Dobson, 1876) – Pakistan, northern India (Simmons, 2005: 465).

COMMON NAMES:
Czech: vlaštovčí netopýři. English: Lesser House Bats, House Bats. French: Scotoèques, Chauves-souris des maisons. German: Kleine Hausfledermäuse. Italian: Scotoèchi.

GENERAL DISTRIBUTION:
Monadjem *et al.*, 2010d could not distinguish between *S. hindei* and *S. albigula* therefore they were combined for the distribution being recorded from Angola; Congo (Democratic Republic of the); Malawi; Mozambique; Zambia.

GENERAL DESCRIPTION OF EXTERNAL MORPHOLOGY:
Patterson and Webala (2012: 43) indicate that male *Scotoecus* can easily be distinguished from any other Vespertlionid by th large size of its penis.

VIRUSES:
Coronaviridae
None of the 24 *Scotoecus* specimens tested by Tao *et al.* (2017: Suppl.) in Kenya were positive for CoV.

Alphacoronavirus
Tong *et al.* (2009) identified coronavirus RNA from the fecal material of *Scotoecus* spp.

†***Scotoecus olduvensis*** Gunnell, Butler, Greenwood and Simmons, 2015

*2015. *Scotoecus olduvensis* Gunnell, Butler, Greenwood and Simmons, Am. Mus. Novit., 3846: 1, 10, figs 6B, 7. Publication date: 16 December 2015. Type locality: Tanzania: Arusha province: Olduvai Gorge: Bed I, FLK NI, Layer 3. [Goto Description]. - Etymology: Named for Olduvai Gorge, Tanzania (Gunnell *et al.*, 2015a: 10).

SIMILAR SPECIES:
The teeth of *S. olduvensis* are on average 12 % larger than those of its congeners (Gunnell *et al.*, 2015a: 10)..

PALAEONTOLOGICAL OR ARCHAEOLOGICAL RECORDS:
Timeframe: Pleistocene.

Scotoecus albigula Thomas, 1909

*1909. *Scotœcus albigula* Thomas, Ann. Mag. nat. Hist., ser. 8, 4 (24): 544. Publication date: 1 December 1909. Type locality: Kenya: Mount Elgon: Kirui [04 43 S 39 13 E, 6 000 ft] [Goto Description]. Holotype: BMNH ad ♂. Collected by: Robin Kemp; collection date: 5 September 1909; original number: 200. Formerly Rudd Collection. - Comments: Type locality coordinates mentioned as 00 50 N 34 40 E by Thorn *et al.* (2009: 58). - Etymology:

From the feminine Latin adjective *àlba*, meaning "white" and the feminine Latin substantive *gùla*, meaning "throat", referring to the colour of the throat fur (see Lanza *et al.*, 2015: 460).

2010. *Scotoecus hindei/albigula:* Monadjem, Taylor, Cotterill and Schoeman, Bats of Southern and Central Africa. A biogeographic and taxonomic synthesis. Wits University Press, Johannesburg, 510.

? *Nycticeius (Scotoecus) hirundo albigula:* (Name Combination)

? *Scotoecus albigula:* (Current Combination, Current Spelling)

? *Scotoecus hindei albigula:* (Name Combination)

? *Scotoecus hirundo albigula:* (Name Combination)

TAXONOMY:
Considered a subspecies of *hindei* by Hill (1974b: 182), and Thorn and Kerbis Peterhans (2009: 58). Included in *hirundo* by Koopman (1993a: 226), but considered a valid species by Ansell and Dowsett (1988: 44), Simmons (2005).

COMMON NAMES:
Czech: netopýr bělohrdlý. English: White-throated Lesser House Bat, White-bellied Lesser House Bat. French: Scotoèque à gorge blanche. German: Weisskehl-Hausfledermaus. Italian: Scotoèco golabiànca.

CONSERVATION STATUS:
Global - *Scotoecus albigula* was included in *Scotoecus hirundo* by Jacobs *et al.* (2008af) in IUCN (2009) for the global assessment. Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008af; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as part of *Scotoecus hirundo*] (Jacobs *et al.*, 2008af; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs and Cotterill, 2004c; IUCN, 2004).

MAJOR THREATS:
While the threats to this species are not well known, it is presumed not to have any major threats in view of the species wide distribution in habitats that are not rapidly declining throughout much of its recorded range (Jacobs *et al.*, 2008af; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008af) [in IUCN (2009)] report that further studies are needed into the natural history and possible threats to this poorly known species.

GENERAL DISTRIBUTION:
Native: Angola; Kenya; Malawi; Mozambique (Monadjem *et al.*, 2010c: 384 as *S. hindei/albigula*); Somalia; Uganda; Zambia.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

ECHOLOCATION:
See Taylor *et al.* (2005).

POPULATION:
Structure and Density - It is very rarely recorded, and there is little information is available on the population abundance or size of this species (Jacobs *et al.*, 2008af; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008af; IUCN, 2009).

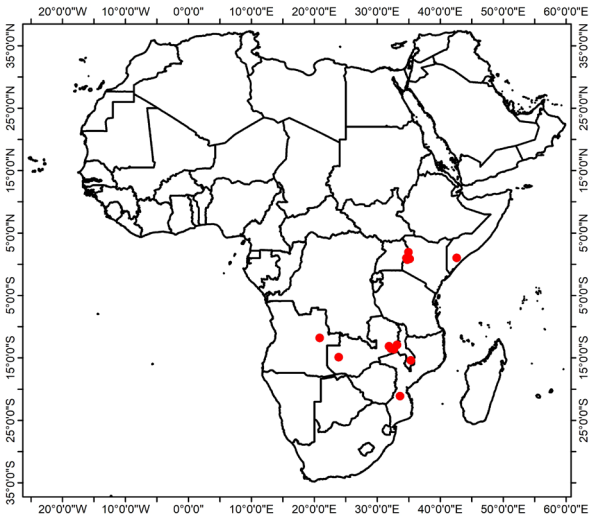


Figure 363. Distribution of *Scotoecus albigula*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Angola, Kenya, Malawi, Mozambique, Somalia, Tanzania, Uganda, Zambia.

Scotoecus albofuscus (Thomas, 1890)

*1890. *Scotophilus albofuscus* Thomas, Ann. Mus. civ. Stor. nat. Genova, ser. 2a, (O.S. 29) 9: 84. Publication date: 3 February 1890. Type locality: The Gambia: Bathurst [=Banjul] [13

28 N 16 39 W] [Goto Description]. Holotype: BMNH 1889.12.12.2: ad ♂, alcoholic (skull not removed). Collected by: Dr. Percy Rendall.

1917. *Scotoecus woodi* Thomas, Ann. Mag. nat. Hist., ser. 8, 19 (111): 280. Publication date: 1 March 1917. Type locality: Malawi: Shiré valley: Chiromo [16 32 S 35 09 E, 200 ft] [Goto Description]. Holotype: BMNH 1917.2.1.1: ad ♂. Collected by: Rodney Carrington Wood Esq. Collection date: 2 October 1916; original number: 173. Presented/Donated by: Rodney Carrington Wood Esq.

? *Scotoecus albofuscus albofuscus:* (Name Combination)

? *Scotoecus albofuscus woodi:* (Name Combination)

? *Scotoecus albofuscus:* (Name Combination, Current Combination)

TAXONOMY:
See Simmons (2005).

COMMON NAMES:
Afrikaans: Thomas se vlermuis, Thomas-vlermuis. Chinese: 淡翼宽吻蝠. Czech: netopýr gambiánský. English: Thomas' House Bat, Light-winged Lesser House Bat, Thomas's Lesser House Bat. French: Scotoèque à ailes pâles, Scotophile du crépuscule, Chauve-souris de Thomas. German: Weißflügel-Hausfledermaus. Portuguese: Morcego pequeno das casas.

CONSERVATION STATUS:
Global - Listed as Data Deficient (DD ver 3.1 (2001)) in view of the absence of sufficient information on its extent of occurrence, natural history, threats and conservation status (Jacobs, 2008l; IUCN, 2009).

Assessment History -
2008 - DD ver 3.1 (2001) (Jacobs, 2008l; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs, 2004h; IUCN, 2004). 1996 - LR/nt (Baillie and Groombridge, 1996).

Regional -
South Africa: 2016 - NT D2 ver 3.1 (2001) (Richards *et al.*, 2016f). 2004 - VU D2 ver 3.1 (2001) (Friedmann and Daly, 2004).

MAJOR THREATS:
The threats to this species are not known (Jacobs, 2008l; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs (2008l) [in IUCN (2009)] reports that there appear to be no direct conservation measures in place. It has been recorded from Zinave National Park on the Save River in Mozambique, and presumably is present in additional protected areas. Further studies are needed into the distribution, natural history and possible threats to this widespread but seemingly very poorly known species.

GENERAL DISTRIBUTION:
Scotoecus albofuscus has been widely, but patchily recorded over much of West Africa and East Africa, with some records from Central Africa. It ranges from The Gambia and Senegal in the west, through West Africa to eastern Nigeria, it is then distributed from northern Uganda and southern Kenya, through Tanzania, southeastern Democratic Republic of the Congo, southern Malawi, Mozambique and southeastern South Africa. The range is poorly known and the species might be more widespread.

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Burkina Faso (Kangoyé *et al.*, 2012: 6026; 2015a: 626); Congo (The Democratic Republic of the) (Hayman *et al.*, 1966; Monadjem *et al.*, 2010d: 573); Côte d'Ivoire; Gambia; Ghana; Kenya; Malawi (Happold and Happold, 1997b: 819; Cotterill, 2001d; Monadjem *et al.*, 2010d: 573); Mozambique (Cotterill, 2001d; Monadjem *et al.*, 2010d: 573); Nigeria; Senegal; Sierra Leone; South Africa (Kearney and Taylor, 1997: 53; Monadjem *et al.*, 2010d: 573); Sudan; Tanzania; Uganda (Kityo and Kerbis, 1996: 62); Zambia (Monadjem *et al.*, 2010d: 573).

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

POPULATION:
Structure and Density - Little information is available on the population abundance or size of this species (Jacobs, 2008l; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs, 2008l; IUCN, 2009).

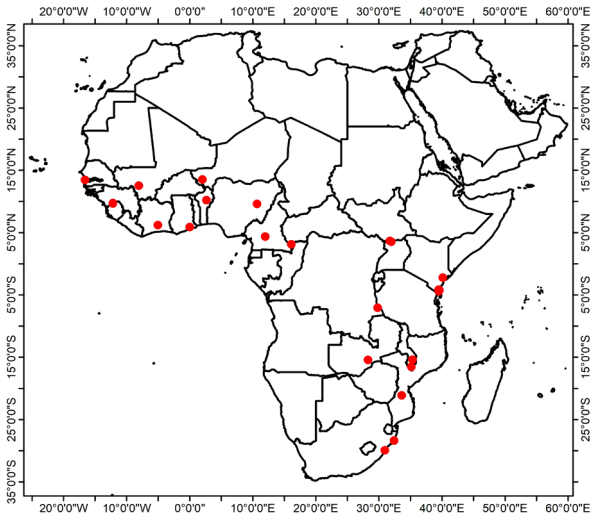


Figure 364. Distribution of *Scotoecus albofuscus*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Benin, Cameroon, Central African Republic, Congo (Democratic Republic of the), Côte d'Ivoire, Ghana, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Sierra Leone, South Africa, Tanzania, The Gambia, Uganda, Zambia.

Scotoecus hindei Thomas, 1901

*1901. *Scotœcus Hindei* Thomas, Ann. Mag. nat. Hist., ser. 7, 7 (39): 264. Publication date: 1 March 1901. Type locality: Kenya: Kitui [01 22 S 38 01 E, 3 500 ft] [Goto Description]. Holotype: BMNH 1901.2.5.1: ♂. Collected by: Dr. Sidney Langford Hinde; collection date: 26 November 1900; original number: 63. - Etymology: In honour of Sidney Langford Hinde (1863 - 1931), English Medical Officer of the Interior in the former British East Africa, Captain in the Congo Free State Forces, Provincial Commissioner in Kenya, naturalist and collector of the type specimen (see Allen, 1939a: 98; Lanza *et al.*, 2015: 466).

1915. *Scotoecus falabæ* Thomas, Ann. Mag. nat. Hist., ser. 8, 16 (95): 447. Publication date: 1 November 1915. Type locality: Nigeria: Northern Nigeria, Bauchi plateau: Kabwir [09 24 N 09 34 E, 2 500 ft] [Goto Description]. Holotype: BMNH 1915.10.8.1: sad ♀. Collected by: Dr. J.C. Fox; collection date: 28 July 1915; original number: 70. Presented/Donated by: Dr. J.C. Fox.

2010. *Scotoecus hindei/albigula:* Monadjem, Taylor, Cotterill, and Schoeman, Bats of Southern and Central Africa. A biogeographic and taxonomic synthesis. Wits University Press, Johannesburg, 510. (Name Combination)

? *Scotoecus hindei falabae:* (Name Combination)

? *Scotoecus hindei hindei:* (Name Combination)

? *Scotoecus hindei:* (Current Combination, Current Spelling)

? *Scotoecus hirundo hindei:* (Name Combination)

TAXONOMY:



Figure 365. *Scotoecus hindei* (ECJS-36/2008), from Lafupa camp, Zambia.

Included in *hirundo* by Kock (1969a: 192), Koopman (1993a: 226), but considered a valid species by Ansell and Dowsett (1988: 44), Simmons (2005).

COMMON NAMES:
Czech: netopýr Hindeův. English: Hinde's Lesser House Bat. French: Scotoèque de Hinde. German: Hindes Hausfledermaus. Italian: Scotoèco di Hìnde.

CONSERVATION STATUS:
Global - *Scotoecus hindei* was included in *Scotoecus hirundo* by Jacobs *et al.* (2008af) in IUCN (2009) for assessment. Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008af; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [assessed as part of *Scotoecus hirundo*] (Jacobs *et al.*, 2008af; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs *et al.*, 2004q; IUCN, 2004).

MAJOR THREATS:
While the threats to this species are not well known, it is presumed not to have any major threats in view of the species wide distribution in habitats that are not rapidly declining throughout much of its recorded range (Jacobs *et al.*, 2008af; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008af) [in IUCN (2009)] report that further studies are needed into the natural history and possible threats to this poorly known species.

GENERAL DISTRIBUTION:
Native: Cameroon; Congo, Democratic Republic of the; Ethiopia (Lavrenchenko *et al.*, 2004b: 141); Kenya; Malawi; Mozambique (Monadjem *et al.*, 2010c: 384 as *S. hindei/albigula*); Nigeria; Somalia; Sudan; Tanzania; Zambia.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

ECHOLOCATION:
See Taylor *et al.* (2005).

MOLECULAR BIOLOGY:
DNA - Unknown.
Karyotype - Nagorsen *et al.* (1976) reported 2*n* = 30, FN = 50, BA = 22, a subtelocentric X chromosome and a submetacentric Y chromosome.
Protein / allozyme - Unknown.

POPULATION:
Structure and Density - It is very rarely recorded, and there is little information available on the population abundance or size of this species (Jacobs *et al.*, 2008af; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008af; IUCN, 2009).

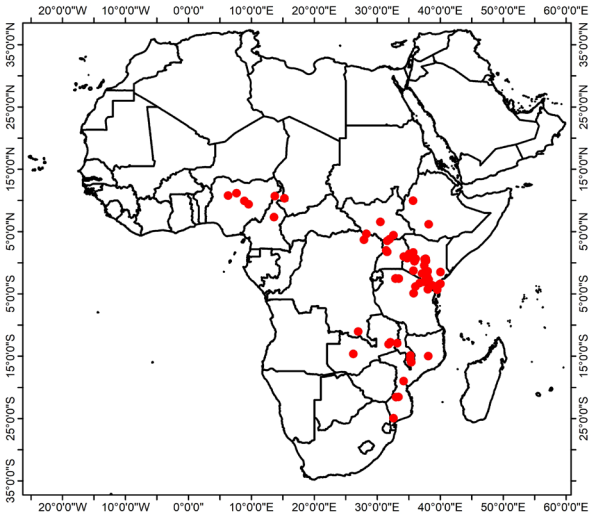


Figure 366. Distribution of *Scotoecus hindei*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
Cameroon, Congo (Democratic Republic of the), Ethiopia, Kenya, Malawi, Mozambique, Nigeria, South Sudan, Tanzania, Uganda, Zambia.

Scotoecus hirundo (de Winton, 1899)

*1899. *Scotophilus hirundo* de Winton, Ann. Mag. nat. Hist., ser. 7, 4 (23): 355. Publication date: 1 November 1899. Type locality: Ghana: Gambaga [10 32 N 00 26 W] [Goto Description]. Holotype: BMNH 1899.6.15.8:. - Etymology: From the feminine Latin noun, in apposition, *hirùndo*, meaning "swallow", referring to the species' appearance (see Lanza *et al.*, 2015: 471).

1923. *Scotoecus artinii* de Beaux, Atti Soc. ital. Sci. nat., 62: 98. Publication date: July 1923. Type locality: Kenya: Northern Guaso Nyiro: Archer's Post [00 39 N 37 41 E, 2 000 ft] [Goto Description]. Holotype: [Unknown] ♀, skin and skull. Collected by: L. Franchetti and L. Tonker; collection date: 26 December 1919; original number: N1443. 2 paratypes: see De Beaux (1923: 98). - Etymology: In honour of prof. E. Artini, director of the Museo Civico di Storia Naturale di Milano (see De Beaux, 1923: 98).

2013. *Scotoecus cf. hirundo:* Koubínová *et al.*, Front. Zool., 10: 1-48. - Comments: Koubínová *et al.* (2013: 7) showed that the karyotype from Senegal (2n=30, FN=50, aFN=46) had a reduced number of arms than reported previously from the Ivory Coast (2n=30, FN=54, Fna=50 Volleth *et al.* (2006)), and suggested that this may represent a distinct species. Further investigations are needed to compare other related species of *Scotecus*, as both the cytogenetics only compared the specimens from Sengal with that of Ivory Coast. (Name Combination)

? *Scotoecus hirundo artinii:* (Name Combination)

? *Scotoecus hirundo:* (Name Combination, Current Combination)

TAXONOMY:
Koopman (1993a: 226) included *hindei*; see Hayman and Hill (1971: 36) and Robbins (1980: 84); but see also Hill (1974b).

COMMON NAMES:
Chinese: 暗翼宽吻蝠. Czech: netopýr vlaštovčí. English: Dark-winged Lesser House Bat, Swallow Lesser House Bat. French: Scotoèque hirundine, Scotophile à ailes noires. German: Schwarzflügel-Hausfledermaus. Italian: Scotoèco róndine.

CONSERVATION STATUS:
Global - Although this species is known mainly from isolated records from a large area, it is listed as Least Concern (LC ver 3.1 (2001)) in view of its wide distribution, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (Jacobs *et al.*, 2008af; IUCN, 2009).

Assessment History -
2008 - LC ver 3.1 (2001) [includes *S. albigula* and *S. hindei*] (Jacobs *et al.*, 2008af; IUCN, 2009). 2004 - DD ver 3.1 (2001) (Jacobs, 2004g; IUCN, 2004). 1996 - LR/lc (Baillie and Groombridge, 1996).

MAJOR THREATS:
While the threats to this species are not well known, it is presumed not to have any major threats in view of the species wide distribution in habitats that are not rapidly declining throughout much of its recorded range (Jacobs *et al.*, 2008af; IUCN, 2009).

CONSERVATION ACTIONS:
Jacobs *et al.* (2008af) [in IUCN (2009)] report that further studies are needed into the natural history and possible threats to this poorly known species.

GENERAL DISTRIBUTION:
For southern Africa, Cooper-Bohannon *et al.* (2016: Table S2) calculated a potential distribution area of 555,102 km^2.

Native: Benin (Capo-Chichi *et al.*, 2004: 163); Burkina Faso (Kangoyé *et al.*, 2012: 6026; 2015a: 626); Cameroon; Côte d'Ivoire (Volleth *et al.*, 2006); Ethiopia; Ghana; Guinea-Bissau (: 59); Senegal; Tanzania; Uganda (Kityo and Kerbis, 1996: 63).

GENERAL DESCRIPTION OF CRANIAL AND DENTAL MORPHOLOGY:
Scott *et al.* (2012: 2943) report that the mandibular symphysis is completely fused in this species.

DETAILED MORPHOLOGY:
Baculum - Hill and Harrison (1987).

ECHOLOCATION:
Two FM/QCF calls from Maroua (Cameroon) were reported by Manga Mongombe (2012: 79) having the following parameters: F_{max}: 58.4 (57.2 - 59.6) kHz, F_{min}: 54.5 (54.2 - 54.8) kHz, F_{mean}: 56.6 (55.9 - 57.2) kHz, F_{knee}: 58.2 (57.2 - 59.2) kHZ, F_{char}: 54.7 (54.5 - 54.8) kHz, and duration: 0.87 (0.82 - 0.91) msec.

MOLECULAR BIOLOGY:
DNA - See Hoofer and Van Den Bussche (2003) from Tanzania.

Karyotype - Volleth *et al.* (2006) reported 2*n* = 30, FN = 50, BA = 22, and a subtelocentric X chromosome for a female from Ivory Coast.

Koubínová *et al.* (2013: 3) report the following karyotype for 1 ♂ from Senegal: 2*n* = 30, Fna = 46, FN = 50, X = metacentric, and Y = dot-like (probably acrocentric). They also found that the Senegalese specimen differed for 1.6 % in its *rag2* gene when compared with a specimen from Tanzania, which is more than in other non-cryptic species. As such they assign their specimen to *S.* cf. *hirundo*.

Protein / allozyme - Unknown.

HABITAT:
In southern Africa, this species inhabits Savanna habitats (84 %; Cooper-Bohannon *et al.*, 2016: Table S2).

POPULATION:
Structure and Density - It is very rarely recorded, and there is little information is available on the population abundance or size of this species (Jacobs *et al.*, 2008af; IUCN, 2009).
Trend - 2008 - Unknown (Jacobs *et al.*, 2008af; IUCN, 2009).

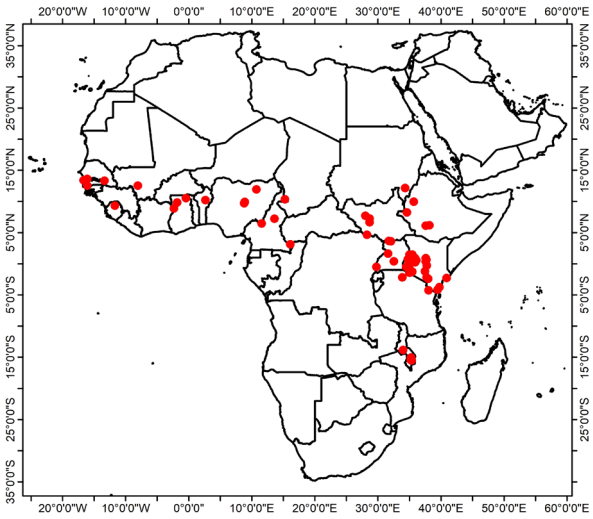


Figure 367. Distribution of *Scotoecus hirundo*

DISTRIBUTION BASED ON VOUCHER SPECIMENS:
"Africa", Benin, Cameroon, Central African Republic, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mali, Nigeria, Senegal, Sierra Leone, South Sudan, Sudan, Tanzania, The Gambia, Uganda.

Acknowledgements

The editors wish to thank all the contributors, and especially the (former) curators and collection managers of the museums which were ever so helpful to provide information concerning the specimens in their holdings:
Amatola Museum - Dr. Lloyd Wingate;
American Museum of Natural History, New York - Dr. Nancy Simmons;
California Academy of Sciences, San Francisco - Karen Cebra;
Carnegie Museum, Pittsburgh - Suzanne B. McLaren;
Centro de Zoologia, Lisbon - J. Crawford Cabral;
David C.D. Happold Collection, Canberra - Dr. David Happold, Dr. Meri Happold;
Ditsong National Museum of Natural History, Pretoria – Dr. Teresa Kearney curator 2002 - present, Onica Mukuwana collection manager 2014 – 2017;
Durban Natural Science Museum - Dr. Peter Taylor was curator 1989-2010, followed by Dr. Leigh Richards;
Field Museum of Natural History, Chicago - Dr. Steve M. Goodman, Dr. Bruce D. Patterson, Dr. Bill Stanley;
Harrison Institute, Sevenoaks- Dr. David Harrison, Dr. Paul Bates and Malcolm Pearch;
Hungarian Natural History Museum, Budapest - Dr. Andres Demeter, Dr. Gabor Csorba;
Iziko South African Museum - Ms Denise Hamerton;
Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels - Dr. Xavier Misonne, Dr. George Lenglet;
Macgregor Museum, Kimberley - Ms Beryl Wilson-Aitchison;
Museum of Comparative Zoology, Harvard - Mrs. Maria E. Rutzmoser;
Muséum d'Histoire Naturelle de Genève - Dr. Louis de Roguin;
Museum National D'Histoire Naturelle, Paris - Dr. Michel Tranier, Dr. J. Cuisin;
Museo ed Instituto Zoologia, Torino - Dr. Oresta Elter;
Museo Civico di Storia Naturale, Milan - Dr. Luigi Cagnolaro;
Michigan State University, Mammal Collection, East Lansing - Mrs. Laura Abraczinskas;
Midwastern State University, Wichita Falls - Frederick B. Stangl;
Museo Zoologico de '"la Specola", Florence - Paolo Agnelli;
National Museum, Bloemfontein - Dr. Nico Avenant, Ms Wanda Kaiser;
National Museum, Bulawayo - Mr Woody Cotterill was curator 1992-2004;
National Museum of Namibia, Windhoek – Seth Eiseb;
Natural History Museum, London - Dr Paula Jenkins, Ms Daphne Hills and Ms Louise Tomsett;
Northern Arizona University, Flagstaff - Tad Theimer;
Naturhistorisches Museum Bern - Paul Schmid;
Naturhistorisches Museum, Vienna - Dr. Frederike Spitzenberger;
Naturhistoriska Riksmuseet Stockholm - Olav Grönwall;
Nationaal Natuurhistorisch Museum, Leiden - Dr. Chris Smeenk;
Oklahoma State University, Stillwater - Anthony A. Echelle;
Royal Museum of Central Africa, Tervuren - Wim Wendelen;
Royal Ontario Museum, Toronto - Dr. Judith Eger, Dr. Burton Lim;
Senckenberg Museum, Frankfurt - Dr. Dieter Kock, Dr. Gerhard Storch, Ms. Katrin Krohmann;
Staatliches Museum für Naturkunde, Stuttgart - Dr. Fritz Dieterlen, Dr. Doris Möricke;
Staatliches Museum fur Tierkunde, Dresden - Dr. Alfred Feiler;
University of Colorado Museum of Natural History, Boulder - Emily M. Braker;
University of Kansas Museum of Natural History, Lawrence - Dr. Robert M. Timm;
Université de Rennes - Dr. Patrick Barrière;
United States National Museum, Washington - Dr. Michael D. Carleton;
Western New Mexico University - Bruce J. Hayward;
Western New Mexico University - Fred Sibley;
Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn - Dr. Rainer Hutterer, Dr. Jan Decher;
Zoologisch Museum, Universiteit Amsterdam - Dr. Peter Van Bree, Dr. Wim Bergmans;
Zoological Museum Moscow University - Dr. Alex Borissenko, Dr. Sergey V. Kruskop;
Zoologisk Museum Universitet, Copenhagen - Dr. Hans Baagoe;
Zoologsiches Museum der Universität, Zürich - Dr. C. Claude.

The editors are also indebted to the late Dr. Dieter Kock, Dr. Karl F. Koopman and John Edwards Hill for their stimulating discussions over the years.

Wilderness Safaries for support for fieldwork in their areas of operation, which allowed images to be captured of some of the species in this report.

Simon Mickleburgh and Lisa Rogers and the Trustees of the Rufford Foundation for financial support allowing for the development of this tool and its spin off projects.

Glossary

The following abbreviations have been used:

a.	adjective
Art.,	Arts. Article, Articles of the Code
e.g.	for example (Latin: *exempli gratia*)
DD	Data Deficient
EN	Endangered
EX	Extinct
EW	Extinct in the wild
CR	Critically Endangered
ICZN	International Commission of Zoological Nomencleature
i.e.	that is (Latin: *id est*)
LC	Least Concern
n.	noun
neut.	Neuter
NE	Not Evaluated
NT	Near Threatened
pl.	plural
q.v.	
RE	Regionally Extinct
sing.	Singular
v.	verb
VU	Vulnerable

The glossary follows the definitions from:
International Commission on Zoological Nomenclature. (1999). *International Code of Zoological Nomenclature.* 4th edition. The International Trust for Zoological Nomenclature, London.
IUCN. (2001). *IUCN Red List Categories and Criteria: Version 3.1.* IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp.
IUCN. (2003). *Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0.* IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 26 pp.

lapsus calami (*sing.* and *pl.*), *n.* A Latin term meaning "slip (or slips) of the pen", i.e. an error (or errors) made by an author in writing a text, such as a misspelling of a name; contrasted with copyist's or printer's errors [Art. 32.5.1].

***nomen dubium* (*pl. nomina dubia*)** *n.* A Latin term meaning "a name of unknown or doubtful application."

***nomen novum* (*pl. nomina nova*)** *n.* A Latin term equivalent to new replacement name.

***nomen nudum* (*pl. nomina nuda*)** *n.* A Latin term referring to a name that, if published before 1931, fails to conform to Article 12; or, if published after 1930, fails to conform to Article 13. A *nomen nudum* is not an available name, and therefore the same name may be made available later for the same or a different concept; in such a case it would take authorship and date [Arts. 50, 21] from that act of establishment, not from any earlier publication as a *nomen nudum*.

***nomen oblitum* (*pl. nomina oblita*)** *n.* A Latin term (meaning forgotten name) applied after 1 January 2000 to a name, unused since 1899, which as a result of an action taken under Article 23.9.2 does not take precedence over a younger synonym or homonym in prevailing usage; the younger name which takes precedence over the *nomen oblitum* may be called a *nomen protectum (q.v.)*. The term *nomen oblitum* was also applied to a disused senior synonym rejected between 6 November 1961 and 1 January 1973 under Article 23b of the Code editions then in force (see Article 23.12.2). *Nomina oblita* remain available names; see Articles 23.9 and 23.12 for conditions controlling their use as valid names.

nomen protectum *n.* A Latin term (meaning protected name) applied to a name which has been given precedence over its unused senior synonym or senior homonym relegated to the status of *nomen oblitum* (*q.v.*, and see Article 23.9.2).

***Sensu lato* (*s. lat.* or *s.l.*)** A Latin term meaning "in the wide sense". Contrast with *sensu stricto (s. str.)*.

***Sensu stricto* (*s. str.* or *s.s.*)** A Latin term meaning "in the strict sense". Often used in conjunction with a name when referring to the nominal taxon in the narrow sense of its subordinate nominotypical taxon (contrast with *sensu lato (s. lat.)*.

sensu A Latin term meaning "in the sense of". Often used to refer to the usage of a name by a (cited) author in a sense different from that of the original author or some other previous author. See also auctorum.

***species inquirenda* (*pl. species inquirendae*)** *n.* A Latin term meaning a species of doubtful identity needing further investigation.

allotype *n.* See under type.

Articles *n.* The mandatory provisions of the ICZN

available name A scientific name applied to an animal taxon that is not excluded under Article 1.3 and that conforms to the provisions of Articles 10 to 20.

Code *n.* (1) An abbreviation of the title International Code of Zoological Nomenclature

conserved name A name otherwise unavailable or invalid that the Commission, by the use of its plenary power, has enabled to be used as a valid name by removal of the known obstacles to such use (see conserve).

cotype *n.* See under type.

Critically Endangered (CR) A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk in the wild.

Data Deficient (DD) A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Date of publication *n.* Of a work (and of a contained name and nomenclatural act): the date on which copies of the work become available by purchase or free distribution. If the actual date is not known, the date to be adopted is regulated by the provisions of Article 21.2-7.

description *n.* A statement in words of taxonomic characters of a specimen or a taxon [Arts. 12,13].

original description The description of a nominal taxon when it is established.

Endangered (EN) A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

extant *a.* (1) Of a taxon: having living representatives. (2) Of specimen: still in existence.

Extinct (EX) *a.* Of a taxon: having no living representatives. IUCN - A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual) throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form (IUCN 2001).

Extinct in the Wild (EW) *a.* A taxon is extinct in the Wild when it is known only to survive in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to a taxons' life cycle and life form.

homonym *n.* (1) In the family group: each of two or more available names having the same spelling, or differing only in suffix, and denoting different nominal taxa. (2) In the genus group: each of two or more names having the same spelling, and denoting different nominal taxa. (3) In the species group: each of two or more available specific or subspecific names having the same spelling, or spellings, or spellings deemed under Article 58 to be the same, and established for different nominal taxa, and either originally (primary homonymy) or subsequently (secondary homonymy) combined with the same generic name [Art. 53.3].

homonymy *n.* (1) The relationship between homonyms. (2) The state of being homonymous.

junior homonym Of two homonyms: the latter established, or in the case of simultaneous establishment to one not given precedence under Article 24.

Least Concern (LC) A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

monotypy *n.* The situation arising (1) when an author establishes a nominal genus or subgenus for what he or she considers to be a single taxonomic species and denotes that species by an available name (the nominal species so named is the type-species by monotypy) [Art. 68.3]; or (2) when an author bases a nominal species-group taxon on a single specimen but does not explicitly designates it as holotype (holotype by monotypy; see Article 73.1.2).

multiple original spelling See under spelling.

Near Threatened (NT) A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

new replacement name (*nomen novum*) A name established expressly to replace an already established name. A nominal taxon denoted by a new replacement name (*nomen novum*) has the same name-bearing type as the nominal taxon denoted by the replaced name [Arts. 67.8, 72.7]. See emendation, substitute name.

Not Evaluated (NE) A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

primary homonym Each of two or more identical specific or subspecific names established for different nominal taxa and originally combined with the same generic name [Art. 57.2]. For variant spellings deemed to be identical see Article 58.

Regionally Extinct (RE) Category for a taxon when there is no reasonable doubt that the last individual potentially capable of reproduction within the region has died or has disappeared from the wild in the region, or when, if it is a former visiting taxon, the last individual has died or disappeared in the wild from the region. The setting of any time limit for listing under RE is left to the discretion of the regional Red List authority, but should not normally pre-date 1500 AD.

rejected name (1) A name which, under the provisions of the Code, cannot be used as a valid name and which is set aside in favour of another name. (2) A name which, as a matter of taxonomic judgment, is either treated as a junior subjective synonym (*q.v.*) of a name used as valid or is believed not to be applicable to the taxon under consideration.

senior homonym Of two homonyms: the first established, or in the case of simultaneous establishment the one given precedence under Article 24.

species (*sing.* and *pl.*) *n.* (1) The rank next below the genus group; the basic rank of zoological classification. (2) A taxon at the rank of species.

species group *n.* In the zoological classification, the lowest-ranking group of taxa the names of which are regulated by the Code. The species group includes all taxa at the ranks of species and subspecies [Art. 45.1].

specimen *n.* An example of an animal, or a fossil or work of an animal, or of a part of these. See Article 72.5 for the kinds of specimen eligible to be name-bearing types of nominal species-group nominal taxa.

spelling

subsequent monotypy The situation arising when a nominal genus or subgenus was established before 1931 without any included nominal species, and when only a single taxonomic species denoted by an available name was first subsequently referred to it [Art. 69.3].

suppression, *n.* (suppress, *v.*) A ruling by the Commission, using its plenary power, (1) that a work is to be deemed, for nomenclature purposes, as unpublished, or that names and acts in it are not available; or (2) that an available name is never to be used as valid because (a) it is available only for the purpose of homonymy ("partial suppression") or (b) it is not available for the purposes of priority and homonymy ("total suppression"; but a totally suppressed species-group name may still denote the type species of a nominal genus or subgenus [Art. 81.2.1]); or (3) that an available name is only to be used as valid under stated conditions (e.g. when not considered a synonym of a particular later name) ("conditional suppression").

synonym *n.* Each of two or more names of the same rank used to denote the same taxonomic taxon.

junior synonym Of two synonyms: the later established, or in the case of simultaneous establishment that not given precedence under Article 24. See also Article 23.9.

objective synonym Each of two or more synonyms that denote nominal taxa with the same name-bearing type, or (in the cases of family-group and genus-group taxa) that denote nominal taxa with name-bearing types whose own names are themselves objectively synonymous.

senior synonym Of two synonyms: the earlier established, or in the case of simultaneous establishment that given precedence under Article 24. See also Article 23.9.

subjective synonym Each of two or more names whose synonymy is only a matter of individual opinion. i.e. it is not objective. See also Article 61.3.1.

synonymy *n.* (1) The relationship between synonyms. (2) A list of synonyms.

syntype *n.* See under type.

taxon, (*pl.* taxa) *n.* A taxonomic unit, whether named or not: i.e. a population, or group of populations of organisms which are usually inferred to be phylogenetically related and which have characters in common which differentiate (*q.v.*) the unit (*e.g.* a geographic population, a genus, a family, an order) from other such units. A taxon encompasses all included taxa of lower rank (*q.v.*) and individual organisms. The Code fully regulates the names of taxa only between and including the ranks of superfamily and subspecies. (2) A species or infraspecific entity whose extinction risk is being assessed.

taxonomic information

taxonomy, *n.* (taxonomic, *a.*) The theory and practice of classifying organisms. See taxonomic information, taxonomic taxon.

topotype See under type.

type *n.* A term used alone, or forming part of a compound term, to denote a particular kind of specimen or taxon.

allotype A term, not regulated by the Code, for a designated specimen of opposite sex to the holotype [Recommendation 72A].

cotype A term not recognized by the Code, formerly used for either syntype or paratype, but that should not now be used in zoological nomenclature [Recommendation 73E].

genotype A term not recognized by the Code, formerly used for type species, but that should not now be used in zoological nomenclature [Recommendation 67A].

holotype The single specimen designated or otherwise fixed as the name-bearing type of a nominal species or subspecies when the nominal taxon is established.

lectotype A syntype designated as the single name-bearing type specimen subsequent to the establishment of a nominal species or subspecies [Art. 74].

name-bearing type The type genus, type species, holotype, lectotype, series of syntypes (which together constitute the name-bearing type) or neotype that provides the objective standard of reference whereby the application of the name of a nominal taxon can be determined.

neotype The single specimen designated as the name-bearing of a nominal species or subspecies when there is a need to define the nominal taxon objectively and no name-bearing type is believed to be extant. If stability and universality are threatened, because an existing name-bearing type is either taxonomically inadequate or not in accord with the prevailing usage of a name, the Commission may use its plenary power to set aside that type and designate a neotype.

paralectotype Each specimen of a former syntype series remaining after the designation of a lectotype [Art. 721.3, Recommendation 74F].

paratype Each specimen of a type series other than the holotype [Recommendation 73D].

syntype Each specimen of a type series (*q.v.*) from which neither a holotype nor lectotype has been designated [Arts. 72.1.2, 73.2, 74]. The syntypes collectively constitute the name-bearing type.

topotype, *n.* (topotypic, *a.*) A term, not regulated by the Code, for a specimen originating from the type locality of the species or subspecies to which it is thought to belong, whether or not the specimen is part of the type series.

type genus *n.* The nominal genus that is the name-bearing type of a nominal family-group taxon.

type host *n.* The host species with which the name-bearing type of a nominal species or subspecies was associated [Recommendation 76A.1].

type locality *n.* The geographical place of capture, collection, or observation of the name-bearing type of a nominal species or subspecies [Art. 76.1, Recommendation 76A].

type series *n.* The series of specimens, defined in Articles 72.4 and 73.2, on which the original author bases a new nominal species-group taxon. In the absence of a holotype designation, any such specimen is eligible for subsequent designation as the name-bearing type (lectotype); pending lectotype designation, all the specimens of the type series are syntypes and collectively they constitute the name-bearing type. Excluded from the type series are any specimens that the original author expressly excludes or refers to as distinct variants, or doubtfully includes in the taxon.

type species *n.* The nominal species that is the name-bearing type of a nominal genus or subgenus.

type specimen A term used in previous editions of the Code for a holotype, lectotype or neotype, or for any syntype; also used generally for any specimen of the type series (*q.v.*).

Vagrant A taxon that is currently found only occasionally within the boundaries of a region.

Visitor (also, visiting taxon) A taxon that does not reproduce within a region but regularly occurs within its boundaries either now or during some period of the last century. Regions have several options on how to decide the boundaries between visitors and vagrants, e.g., using a preset percentage of the global population found in the region or predictability of occurrence.

Vulnerable (VU) A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

References

Abayomi, T. A., D. A. Ofusori, O. A. Ayoka, S. A. Odukoya, E. O. Omotoso, F. O. Amegor, S. A. Ajayi, G. B. Ojo and O. P. Oluwayinka (2009). A comparative histological study of the tongue of rat (*Rattus norvegicus*), bat (*Eidolon helvum*) and pangolin (*Manis tricuspis*). *International Journal of Morphology*, **27 (4):** 1111 - 1119.

Abe, H., N. Ishii, T. Ito, Y. Kaneko, K. Maeda, S. Miura and M. Yoneda (2005). *A guide to the mammals of Japan.* Tokai university Press, Kanagawa, Japan.

Abedi-Lartey, M., D. K. N. Dechmann, M. Wikelski, A. K. Scharf and J. Fahr (2016). Long-distance seed dispersal by straw-coloured fruit bats varies by season and landscape. *Global Ecology and Conservation*, **7:** 12 - 24. doi: 10.1016/j.gecco.2016.03.005.

Abobarin, A. O. (1974). *The masticatory apparatus of the fruit bat Eidolon helvum (Kerr).* Ile-Ife: 1 - 31.

Abumandour, M. M. A. (2014). Morphological comparison of the filiform papillae of New Zealand White Rabbits (*Oryctolagus cuniculus*) as domestic mammals and Egyptian Fruit Bat (*Rousettus aegyptiacus*) as wild mammals using scanning electron microscopic specimens. *International Journal of Morphology*, **32 (4):** 1407 - 1417.

Abumandour, M. M. A. and R. M. A. El-Bakary (2013). Morphological and scanning electron microscopic studies of the tongue of the Egyptian fruit bat (*Rousettus aegyptiacus*) and their lingual adaptation for its feeding habits. *Veterinary Research Communications*, **37 (3):** 229 - 238. doi: 10.1007/s11259-013-9567-9.

Abumandour, M. M. A. and W. Pérez (2017). Morphological and scanning electron microscopy studies of the stomach of the Egyptian fruit bat (*Rousettus aegyptiacus*). *International Journal of Morphology*, **35 (1):** 242 - 250.

Acharya, L. (1992). *Epomophorus wahlbergi. Mammalian Species*, **376:** 1 - 4, 3 figs.

Acloque, A. (1899). *Faune de France, Mammifères.* J.P. Baillière et Fils: 84 pp.

ACR, (2006). African Chiroptera Report 2006. African Chiroptera Project, Pretoria. 1198 pp. URL: www.africanbats.org/Documents/ACR/2006/ACR_2006.pdf.

ACR, (2007). African Chiroptera Report 2007. African Chiroptera Project, Pretoria. ixiii + 1562 pp. URL: www.africanbats.org/Documents/ACR/2007/ACR_2007.pdf.

ACR, (2008). African Chiroptera Report 2008. African Chiroptera Project, Pretoria. 1868 pp. URL: www.africanbats.org/Documents/ACR/2008/ACR_2008.pdf.

ACR, (2009). African Chiroptera Report 2009. African Chiroptera Project, Pretoria. 2960 pp.2960 pp. URL: www.africanbats.org/Documents/ACR/2009/ACR_2009.pdf.

ACR, (2010). African Chiroptera Report 2010. African Chiroptera Project, Pretoria. i - xviii. 1 - 4325 pp. URL: www.africanbats.org/Documents/ACR/2010/ACR_2010.pdf.

ACR, (2011). African Chiroptera Report 2011. African Chiroptera Project, Pretoria. i - xvii; 1 - 4474 pp. URL: www.africanbats.org/Documents/ACR/2011/ACR_2011.pdf.

ACR, (2012). African Chiroptera Report 2012. AfricanBats, Pretoria. i - xviii, 1 - 5902 pp. URL: www.africanbats.org/Documents/ACR/2012/ACR_2012.pdf.

ACR, (2013). African Chiroptera Report 2013. AfricanBats, African Chiroptera Project, Pretoria. i - xix, 1 - 6330 pp. URL: www.africanbats.org/Documents/ACR/2013/ACR_2013.pdf.

ACR, (2014). African Chiroptera Report 2014. AfricanBats, Pretoria. i – xix, 1 - 6591 pp.

ACR, (2015). African Chiroptera Report 2015. AfricanBats, Pretoria. i - xix, 1 - 7001 pp. doi: 10.13140/RG.2.1.2201.7762.

ACR, (2016). *African Chiroptera Report.* AfricanBats, Pretoria. i -xvii, 1 - 7380 pp.

ACR, (2017). *African Chiroptera Report.* AfricanBats NPC, Pretoria. i - xxi, 1 - 7635 pp. doi: 10.13140/RG.2.2.18439.09129.

ACR, (2018). *African Chiroptera Report.* AfricanBats NPC, Pretoria. i - xvi, 1 - 8028 pp. doi: 10.13140/RG.2.2.18794.82881.

Adam, F. and V. Aellen (1975). Présence de *Glauconycteris beatrix* Thomas, 1901 (Chiroptera, Vespertilionidae) en Côte d'Ivoire. *Mammalia*, **39 (1):** 150 - 152.

Adam, F., V. Aellen and M. Tranier (1993). Nouvelles données sur le genre *Myopterus*. Le statut de *Myopterus daubentonii* Desmarest, 1820 (Chiroptera: Molossidae). *Revue suisse de zoologie*, **100 (2):** 317 - 326. doi: 10.5962/bhl.part.79863. [Abstract]

Adam, F. and B. Hubert (1972). Chiroptères nouveaux pour le Sénégal. *Mammalia*, **36 (1):** 59 - 70. [Abstract]

Adam, F. and B. Hubert (1976). Les Nycteridae (Chiroptera) du Sénégal: Distribution, biométrie et dimorphisme sexuel. *Mammalia*, **40 (4):** 597 - 613. [Abstract]

Adam, J. P. (1973). Hematozoaires des Chiroptères en Afrique Centrale. Unpublished report ?: 8 pp. URL: https://www.google.be/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwi3rejmhN7WAhWGAxoKHde4Cz8QFggtMAA&url=http%3A%2F%2Fhorizon.documentation.ird.fr%2Fexl-doc%2Fpleins_textes%2Fpleins_textes_5%2Fb_fdi_04-05%2F06075.pdf&usg=AOvVaw29VP8q4QTjnnIJ4dCmyuc5. [Abstract]

Adam, J. P. and I. Landau (1973a). Developmental stages of *Polychromophilus* sp., a parasite of insectivorous bats from Congo-Brazzaville, in the nycteribiid fly *Penicilidia fulvida* Bigot 1889. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **67 (1):** 5 - 6.

Adam, J. P. and I. Landau (1973b). *Polychromophilus* sp. Haemoproteidae parasite de Microchiroptères au Congo (Brazzaville). *Cahiers de l'ORSTOM, série Entomologie, Médicine et Parasitologie*, **11 (2):** 147 - 152. [Abstract]

Adam, J. P. and F. LePont (1974). Les chiroptères cavernicoles de la république populaire du Congo. Notes bioécologiques et parasitologiques. *Annales de Spéléologie*, **29 (1):** 143 - 154. [Abstract]

Adams, R. A., F. J. Bonaccorso and J. R. Winkelmann (2015). Revised distribution for *Otomops martiensseni* (Chiroptera: Molossidae) in southern Africa. *Global Ecology and Conservation*, **3:** 707 - 714. doi: 10.1016/j.gecco.2015.03.006.

Adams, R. A. and R. T. Carter (2017). Megachiropteran bats profoundly unique from microchiropterans in climbing and walking locomotion: Evolutionary implications. *PLoS ONE*, **12 (9):** e0185634. doi: 10.1371/journal.pone.0185634.

Adams, R. A. and M. A. Hayes (2008). Water availability and successful lactation by bats as related to climate change in arid regions of western North America. *Journal of Animal Ecology*, **77 (6):** 1115 - 1121. doi: 10.1111/j.1365-2656.2008.01447.x.

Adams, R. A. and G. Kwiecinski (2018). Sonar surveys for bat species richness and activity in the southern Kalahari Desert, Kgalagadi Transfrontier Park, South Africa. *Diversity*, **10 (3):** 103. doi: 10.3390/d10030103.

Adams, R. A., S. C. Pedersen, K. M. Thibault, J. Jadin and B. Petru (2003). Calcium as a limiting resource to insectivorous bats: can water holes provide a supplemental mineral source?. *Journal of Zoology*, **260 (2):** 189 - 194. doi: 10.1017/S0952836903003613.

Adams, R. A. and E. R. Snode (2013). Unique insights into dispersion distances among calling males of Wahlberg's epauletted fruit bat in Kruger National Park, South Africa. *The Open Ecology Journal*, **6:** 54 - 60. doi: 10.2174/1874213001306010054.

Adams, R. A. and E. R. Snode (2015). Differences in the male mating calls of co-occurring epauletted fruit bat species (Chiroptera, Pteropodidae, *Epomophorus wahlbergi* and *Epomophorus crypturus*) in Kruger National Park, South Africa. *Zoological Studies*, **54 (15):** 1-6. doi: 10.1186/s40555-014-0087-2.

Addy, P. A. K., P. M. Tukei and B. C Killango (1978). *The immune status of East African bats to arboviruses.* Proceedings of the Fourth International Bat Research Conference - Nairobi: 21 - 38.

Adedeji, A. O., I. O. Okonko, O. D. Eyarefe, O. B. Adedeji, E. T. Babalola, M. O. Ojezele, J. C. Nwanze and T. A. Amusan (2010). An overview of rabies - History, epidemiology, control and possible elimination. *African Journal of Microbiology Research*, **4 (22):** 2327 - 2338. URL: http://www.academicjournals.org/AJMR/PDF/Pdf2010/18%20Nov/Adedeji%20et%20al.pdf.

Adeeyo, O. A., A. E. Caxton-Martins, Ofusori D. A., E. A. Ashamu, Omotoso E. O., Odukoya S. A., U. A. Yusuf and (2008). Comparative histological features of the pancreas in fruit-eating bat (*Eidolon-helvum*) and pangolin (*Manis tricuspis*). *Journal of Cell and Animal Biology*, **2 (6):** 134 - 139.

Adeniyi, P. A. O., J. O. Owolabi, O. K. Ghazal, I. D. Fatunke, A. O. Oyowopo, G. O. Omotoso, T. O. Oyesomi, O. R. Jimoh and E. A. Caxton-Martins (2010). A comparative histomorphology of tongue and dentition in rats, bats and hedgehogs. *International Journal of Biomedical and Health Sciences*, **6 (3):** 137 - 141. URL: http://www.klobex.org/journals/ijbhs/ijbhs6/ijbhs630510053.pdf.

Adeniyi, T., A. Tijani, D. Adekomi and T. Abayomi (2012). A comparative study of the lateral geniculate body of rat (*Rattus norvegicus*), bat (*Eidolon helvum*) and pangolin (*Manis tricuspis*). *Global Journal of Health Science*, **4 (4):** 118 - 125. doi: 10.5539/gjhs.v4n4p118.

Adeosun, D. A. (1974). *Nycteribiid and Spinturnicid ectoparasites of the bat, Eidolon helvum, Kerr, roosting on campus of University of Ife, Ile-Ife, Nigeria.* University of Ife - Ile-Ife: 1 - 48.

Aderounmou, E. A. (1973). Parasites of the Straw-coloured Fruit Bat at the University of Ife. *The Nigerian Field*, **38 (3):** 138 - 141.

Adjemian, J., E. C. Farnon, F. Tschioko, J. F. Wamala, E. Byaruhanga, G. S. Bwire, E. Kansiime, A. Kagirita, S. Ahimbisibwe, F. Katunguka, B. Jeffs, J. J. Lutwama, R. Downing, J. W. Tappero, P. Formenty, B. (R.) Amman, C. Manning, J. Towner, S. T. Nichol, Rollin and P. E. (2011). Outbreak of Marburg Hemorrhagic Fever among miners in Kamwenge and Ibanda Districts, Uganda, 2007. *The Journal of Infectious Diseases*, **204 (Suppl. 3):** S796 - S799. doi: 10.1093/infdis/jir312.

Adler, K. (2016). *Theodor Cantor (1809 - 1860): Pioneer Scientific Herpetologist in China.* Society for the study of Amphibians and Reptiles - Hangzhou: v - xi.

Aellen, V. (1950). Un mégachiroptère nouveau: *Epomophorus reii*, n. sp. *Revue suisse de zoologie*, **57 (3):** 559 - 563.

Aellen, V. (1951). Les chauves-souris frugivores du musée d'Histoire naturelle. *Bibliotheque du Muséum de la Ville de Neuchâtel*, **1950:** 43 - 48.

Aellen, V. (1952). Contribution à l'étude des chiroptères du Cameroun. *Mémoire de la Société neuchâteloise de Sciences naturelles*, **8 (1):** 1 - 121.

Aellen, V. (1954). Description d'un nouvel *Hipposideros* (Chiroptera) de la Côte d'Ivoire. *Revue suisse de zoologie*, **61 (24):** 473 - 483.

Aellen, V. (1955). *Rhinolophus blasii* Peters (1866), chauve-souris nouvelle pour l'Afrique du Nord. *Mammalia*, **19 (3):** 361 - 366. doi: 10.1515/mamm.1955.19.3.361.

Aellen, V. (1956a). Speologica africana. Chiroptères des grottes de Guinée. *Bulletin de l'Institut fondamental d'Afrique noire: sciences naturelles*, **18 A (3):** 884 - 894. [Abstract]

Aellen, V. (1956b). Le Parc National du Niokolo-Koba. (Premier fascicule). II. Chiroptères. *Mémoires de l'Institut français d'Afrique noire*, **48A:** 23 - 34. [Abstract]

Aellen, V. (1957). Les Chiroptères africains du Musée zoologique de Strasbourg. *Revue suisse de zoologie*, **64 (6):** 189 - 214. doi: 10.5962/bhl.part.75480. [Abstract]

Aellen, V. (1959a). Chiroptères nouveaux d'Afrique. *Archives Scientifique de Genève*, **12 (2):** 217 - 235.

Aellen, V. (1959b). Contribution a l'étude de la fauna d'Afghanistan. 9. Chiroptères. *Revue suisse de zoologie*, **66 (2):** 353 - 386.

Aellen, V. (1962). Le baguement des chauves-souris au Col de Bretolet (Valais). *Archives Scientifique de Genève*, **14 (3):** 365 - 392 (for 1961).

Aellen, V. (1963). La réserve naturelle intégrale du Mont Nimba. XXIX. Chiroptères. *Mémoires de l'Institut français d'Afrique noire*, **66:** 629 - 638. [Abstract]

Aellen, V. (1966a). Notes sur *Tadarida teniotis* (Raf.) (Mammalia, Chiroptera). I. Systématique, paléontologie et peuplement, répartition géographique. *Revue suisse de zoologie*, **73 (6):** 119 - 159.

Aellen, V. (1966b). Addenda on the collections of the Muséum d"Histoire Naturelle, Geneva. In Hayman, R. W., X. Misonne and W. N. Verheyen : *The Bats of the Congo and Rwanda and Burundi. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 154:** 69 - 71.

Aellen, V. (1973). Un *Rhinolophus* nouveau d'Afrique centrale. *Periodicum biologorum - Societas Scientiarum Naturalium Croatica*, **75 (1):** 101 - 105. [Abstract]

Aellen, V. and A. Brosset (1968). Chiroptères du sud du Congo (Brazzaville). *Revue suisse de zoologie*, **75 (14):** 435 - 458, 1 pl. doi: 10.5962/bhl.part.97040.

Aellen, V. and P. Strinati (1969). Liste des chiroptères de la Tunisie. *Revue suisse de zoologie*, **76 (17):** 421 - 431.

Aellen, V. and P. Strinati (1970). Chauves-souris cavernicoles de Tunisie. *Mammalia*, **34 (2):** 228 - 236. [Abstract]

Agassiz, L. (1846). *Nomenclatoris zoologici index universalis, continens nomina systematica classium, ordinum, familiarum et generum animalium omnium, tam viventium quam fossilium, secundum ordinem alphabeticum unicum disposita, adjectis homonymiis plantarum, nec non variis adnotationibus et mendationibus.* Soloduri. (Jent & Gassmann): i - viii; 1 - 393.

Agboola, F. K., B. S. Fagbohunka and G. A. Adenuga (2006). Activities of thiosulphate and 3-mercaptopyruvate-cyanide-sulphurtransferases in poultry birds and the fruit bat. *Journal of Biological Sciences*, **6 (5):** 833 - 839.

Agboola, F. K. and R. E. Okonji (2004). Presence of rhodanese in the cytosolic fraction of the fruit bat (*Eidolon helvum*) liver. *Journal of Biochemistry and Molecular Biology*, **37 (3):** 275 - 281.

Agboola, F. K., A. Thomson and A. Afolayan (2003). Isolation and properties of cytoplastic alpha-glacerol 3-phosphate dehydrogenase from the pectoral muscle of the fruit bat, *Eidolon helvum*. *Journal of Biochemistry and Molecular Biology*, **36 (2):** 159 - 166.

Aggundey, I. R. and D. A. Schlitter (1984). Annotated checklist of the mammals of Kenya. I. Chiroptera. *Annals of Carnegie Museum*, **53 (5):** 119 - 153. [Abstract]

Aggundey, I. R. and D. A. Schlitter (1986). Annotated checklist of the mammals of Kenya. II. Insectivora and Macroscelidae. *Annals of Carnegie Museum*, **55 (14):** 325 - 347. [Abstract]

Aghomo, H. O., A. K. Ako-Nai, O. O. Oduye, O. Tomori and C. E. Rupprecht (1990). Detection of rabies virus antibodies in fruit bats (*Eidolon helvum*) from Nigeria. *Journal of wildlife diseases*, **26 (2):** 258 - 261. [Abstract]

Agnarsson, I., C. M. Zambrana-Torrelio, N. P. Flores-Saldana and L. J. May-Collado (2011). A time-calibrated species-level phylogeny of bats (Chiroptera, Mammalia). *PLoS Currents: Tree of Life*, **3:** RRN1212. doi: 10.1371/currents.RRN1212. URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3038382/.

Águeda-Pinto, A., L. F. C. Castro and P. J. Esteves (2019). The evolution of *S100A7*: an unusual gene expansion in *Myotis* bats. *BMC Evolutionary Biology*, **19:** 102. doi: 10.1186/s12862-019-1433-0.

Aharoni, I. (1944). An Egyptian bat, new to Palestine. *Bulletin of the Zoological Society of Egypt*, **6:** 26.

Ahlén, I. (2004). *Heterodyne and time-expansion methods for identification of bats in the field and through sound analysis.* In Brigham, R.M., E.K.V. Kalko, G. Jones, S. Parsons and H.J.G.A. Limpens : *Bat Echolocation Research. Tools, techniques and analysis* Bat Conservation International - Austin, Texas: 72 - 79. URL: http://www.batcon.org/pdfs/stories/BatEcholocationResearch.pdf.

Ahmim, M. (2017). Current status, distribution and conservation status of Algerian bats (Mammalia: Chiroptera). *Journal of Threatened Taxa*, **9 (1):** 9723 - 9733. doi: 10.11609/jot.2576.9.1.9723-9733.

Ahmim, M. and A. Moali (2011). The diet of the Maghrebian mouse-eared bat *Myotis punicus* (Mammalia, Chiroptera) in Kabylia, Northern Algeria. *Ecologia mediterranea*, **37 (1):** 45 - 51.

Ahmim, M. and A. Moali (2013). The diet of four species of horseshoe bat (Chiroptera: Rhinolophidae) in a mountainous region of Algeria: evidence for gleaning. *Hystrix, Italian Journal of Mammalogy*, **24 (2):** 174 - 176. doi: 10.4404/hystrix-24.2-8728.

Ahmim, M. and R. Tahri (2017). New record of *Rhinopoma cystops* Thomas, 1903 (Mammalia, Chiroptera) in arid southwestern Sahara of Algeria. *Arid Ecosystems*, **7 (1):** 69 - 71. doi: 10.1134/S2079096117010024.

Aihartza, J. (R.), D. Almenar, E. Salsamendi, U. Goiti and I. Garin (2008). Fishing behaviour in the long-fingered bat *Myotis capaccinii* (Bonaparte, 1837): an experimental approach. *Acta Chiropterologica*, **10 (2):** 287 - 301. doi: 10.3161/150811008X414863.

Aihartza, J. R., U. Goiti, D. Almenar and I. Garin (2003). Evidences of piscivory by *Myotis capaccinii* (Bonaparte, 1837) in southern Iberian Peninsula. *Acta Chiropterologica*, **5 (2):** 193 - 198.

Aizpurua, O., A. Alberdi, J. (R.) Aihartza and I. Garin (2011). Unveiling fishing behaviour: prey species, size and quantity consumed by *Myotis capaccinii*. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 48. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.

Aizpurua, O., I. Garin, A. Alberdi and J. (R.) Aihartza (2013). Comparison of echolocation and capture-flight by *Myotis capaccinii* when hunting insects and fishing in the wild. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 4 - 5. URL: http://www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Akani, G. C., D. Dendi and L. Luiselli (2015). Ebola virus effects on the bushmeat trade in West Africa. *African Journal of Ecology*, **53 (4):** 613 - 615. doi: 10.1111/aje.12231.

Akilu, I., M. I. K. Gadzama and S. P. Bako (2016). Bat roosts and associated nuisance in public primary and secondary schools in Zaria, Nigeria: a problem worth addressing. *International Journal of Education and Research*, **4 (1):** 47 - 56.

Akite, P. (2009). *Chapter 6. Straw-coloured fruit bat (Eidolon helvum) populations in Kampala.* In Pomeroy, D. and H. Tushabe : *The State of Uganda' Biodiversity in 2008.* NBDB - MUIENR - with support from DANIDA – ENRECA: 28 - 29. URL: http://static.zsl.org/secure/files/uganda-biodiversity-report-2008-1054.pdf.

Akobi, B., O. Aboderin, T. Sasaki and A. Shittu (2012). Characterization of *Staphylococcus aureus* isolates from faecal samples of the Straw-Coloured Fruit Bat (*Eidolon helvum*) in Obafemi Awolowo University (OAU), Nigeria. *BMC Microbiology*, **12:** 279. doi: 10.1186/1471-2180-12-279.

Alagaili, A. N., D. A. James and O. B. Mohammed (2011). Timing and pattern of molt in Kuhl's bat, *Pipistrellus kuhlii*, in Saudi Arabia. *Acta Chiropterologica*, **13 (2):** 465 - 470. doi: 10.3161/150811011X624956.

Albariño, C. G., M. Foltzer, J. S. Towner, L. A. Rowe, S. Campbell, C. M. Jaramillo, B. H. Bird, D. M. Reeder, M. E. Vodzak, P. Rota, M. G. Metcalfe, C. F. Spiropoulou, B. Knust, J. P. Vincent, M. A. Frace, S. T. Nichol, P. E. Rollin and U. Ströher (2014). Novel paramyxovirus associated with severe acute febrile disease, South Sudan and Uganda, 2012. *Emerging Infectious Diseases*, **20 (2):** 211 - 216. doi: 10.3201/eid2002.131620.

Albariño, C. G., T. Shoemaker, M. L. Khristova, J. F. Wamala, J. J. Muyembe, S. Balinandi, A. Tumusiime, S. Campbell, D. Cannon, A. Gibbons, E. Bergeron, B. Bird, K. Dodd, C. Spiropoulou, B. R. Erickson, L. Guerrero, B. Knust, S. T. Nichol, P. E. Rollin and U. Ströher (2013a). Genomic analysis of filoviruses associated with four viral hemorrhagic fever outbreaks in Uganda and the Democratic Republic of the Congo in 2012. *Virology*, **442 (2):** 97 - 100. doi: 10.1016/j.virol.2013.04.014.

Albariño, C. G., L. S. Uebelhoer, J. P. Vincent, M. L. Khristova, A. K. Chakrabarti, A. McElroy, S. T. Nichol and J. S. Towner (2013b). Development of a reverse genetics system to generate recombinant Marburg virus derived from a bat isolate. *Virology*, **446 (1-2):** 230 - 237. doi: 10.1016/j.virol.2013.07.038.

Albayrak, I. (2006). Karyotype of *Miniopterus schreibersii* (Kuhl, 1819) in Turkey (Chiroptera). *Mammalia*, **70 (1-2):** 177 - 178 (for 2006). doi: 10.1515/MAMM.2006.022.

Albayrak, I. and N. Asan (1999). Distributional status of the bats from Turkey (Mammalia: Chiroptera). *Communication of the faculty of Sciences of the University of Ankara*, **C 17:** 59 - 68.

Albayrak, I., N. Asan and T Yorulmaz (2008). The Natural History of the Egyptian Fruit Bat, *Rousettus aegyptiacus*, in Turkey (Mammalia: Chiroptera). *Turkish Journal of Zoology*, **32 (1):** 11 - 18.

Alcalde, J. T. (1999). New ecological data on the noctule bat (*Nyctalus noctula* Schreber, 1774) (Chiroptera, Vespertilionidae) in two towns of Spain. *Mammalia*, **63 (3):** 273 - 280. doi: 10.1515/mamm.1999.63.3.273.

Aldridge, H. D. J. N., M. Obrist, H. G. Merriam and M. B. Fenton (1990). Roosting, vocalizations, and foraging by the African bat, *Nycteris thebaica*. *Journal of Mammalogy*, **71 (2):** 242 - 246.

Aldridge, H. D. J. N. and I. L. Rautenbach (1987). Morphology, echolocation and resource partitioning in insectivorous bats. *Journal of Animal Ecology*, **56 (3):** 763 - 778. [Abstract]

Alexander, K. A., C. E. Sanderson, M. Marathe, B. L. Lewis, C. M. Rivers, J. Shaman, J. M. Drake, E. Lofgren, V. M. Dato, M. C. Eisenberg and S. Eubank (2015). What factors might have led to the emergence of Ebola in West Africa? *PLoS Neglected Tropical Diseases*, **9 (6):** e0003652. doi: 10.1371/journal.pntd.0003652.

Ali, R. A. M. (2011). Molecular phylogenetic relationship between and within the fruit bat (*Rousettus aegyptiacus*) and the Lesser Tailed Bat (*Rhinopoma hardwickei*) deduced from RAPD-PCR analysis. *Journal of American Science*, **7 (10):** 678 - 687. URL: http://www.jofamericanscience.org/journals/am-sci/am0710/082_7251am0710_678_687.pdf.
Al-Jumaily, M. M. (1999). First record of *Otomops martiensseni* (Matschie 1897) for the Republic of Yemen. *Senckenbergiana biologica*, **78:** 241 - 245.
Al-Jumaily, M. M. (2002). *Chaerephon nigeriae* Thomas, 1913, an addition to the bat fauna of the Republic of Yemen (Mammalia: Chiroptera: Molossidae). *Myotis*, **40:** 55 - 58.
Al-Jumaily, M. M. (2004). Recent records of bats from Yemen including *Plecotus cf. austriacus* (Fischer, 1829) (Mammalia; Vespertilionidae) new to the country. *Myotis*, **41/42:** 57 - 68.
Allard, M. W., R. L. Honeycutt and M. J. Novacek (1999). Advances in higher level mammalian relationships. *Cladistics: the International Journal of the Willi Henning Society*, **15:** 213 - 219.
Allegrini, B., G. Durand, E. Durand and O. Peyre (2011). On some bats recorded in the Adrar region, Mauritania. *African Bat Conservation News*, **26:** 2-4.
Allen, G. M. (1908). Notes on Chiroptera. *Bulletin of the Museum of Comparative Zoology*, **52 (3):** 25 - 62. [Abstract]
Allen, G. M. (1911). Bats from British East Africa. *Bulletin of the Museum of Comparative Zoology*, **54 (9):** 321 - 331.
Allen, G. M. (1914a). Mammals from the Blue Nile Valley. *Bulletin of the Museum of Comparative Zoology*, **58 (7):** 305 - 357.
Allen, G. M. (1918a). Vertebrata from madagascar. *Bulletin of the Museum of Comparative Zoology*, **61 (14):** 475 - 516.
Allen, G. M. (1918b). Vertebrata from madagascar. 4. Mammalia. *Bulletin of the Museum of Comparative Zoology*, **61 (14):** 511 - 516.
Allen, G. M. (1921). A new horseshoe bat from West Africa. *Revue de zoologie africaine*, **9 (3):** 193 - 196.
Allen, G. M. (1923). New Chinese bats. *American Museum Novitates*, **85:** 1 - 8. [Abstract]
Allen, G. M. (1931). Type specimens of mammals in the Museum of Comparative Zoology. *Bulletin of the Museum of Comparative Zoology*, **71 (4):** 229 - 289.
Allen, G. M. (1939a). A checklist of African mammals. *Bulletin of the Museum of Comparative Zoology*, **83:** 1 - 763.
Allen, G. M. (1939b). *Bats.* Harvard University Press - Cambridge, Mass.: 1 - 368.
Allen, G. M. (1945). A second specimen of an African bat, *Plerotes anchietae* (Seabra). *Annals of Carnegie Museum*, **30 (10):** 93 - 95.
Allen, G. M. and H. J. , Jr. Coolidge (1930). *Mammals of Liberia.* In ??? : *The African Republic of Liberia and the Belgian Congo. Based on the observations made and material collected during the Harvard African Expedition 1926-1927, Vol. 2.* Harvard University Press - Cambridge, Mass.: i - ix; 569 - 1064.
Allen, G. M. and B. Lawrence (1936). Scientific results of an expedition to rain forest regions in eastern Africa. III. Mammals. *Bulletin of the Museum of Comparative Zoology*, **79 (3):** 31 - 126.
Allen, G. M. and A. Loveridge (1927). Mammals from the Uluguru and Usambara Mountains, Tanganyika Territory. *Proceedings of the Boston Society of Natural History*, **38 (9):** 413 - 441.
Allen, G. M. and A. Loveridge (1933). Reports on the scientific results of an expedition to the southwestern highlands of Tanganyika Territory. II. Mammals. *Bulletin of the Museum of Comparative Zoology*, **75 (2):** 47 - 140.
Allen, G. M. and A. Loveridge (1942). Scientific results of a fourth expedition to forested areas in East and Central Africa. I. Mammals. *Bulletin of the Museum of Comparative Zoology*, **89 (4):** 147 - 214.
Allen, H. (1861). Description of new pteropine bats from Africa. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **13 (11):** 156 - 160.
Allen, H. (1864). Monograph of North American bats. *Smithsonian Miscellaneous Collection*, **7 (publ 165):** 1 - 45.
Allen, H. (1866). Notes on the Vespertilionidae of Tropical America. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **18 (3):** 279 - 288.
Allen, H. (1892). ?? Title still needs to be checked. ?? *Proceedings of the Academy of Natural Sciences of Philadelphia*43.
Allen, H. (1894). A monograph of the bats of North America. *Bulletin of the United States National Museums*, **43 (43):** i - ix; 1 - 198, 1 fig., 38 pls. (for 1893).
Allen, J. A. (1895). On the names of mammals given by Kerr in his 'Animal Kingdom,' published in 1792. *Bulletin of the American Museum of Natural History*, **7 (5):** 179 - 192.
Allen, J. A. (1914b). Mammals from British East Africa, collected on the third African expedition of the American Museum by William S. Rainsford. *Bulletin of the American Museum of Natural History*, **33 (18) (26):** 337 - 344.
Allen, J. A. (1917). Part I. Systematic List. In Allen, J. A., H. Lang and J. P. Chapin : *The American Museum Congo Expedition Collection of Bats. Bulletin of the American Museum of Natural History*, **37 (18):** 405 - 496.
Allen, J. A. (1922). I. The American Museum Congo expedition collection of Insectivora. *Bulletin of the American Museum of Natural History*, **47:** 1 - 38.
Allen, J. A., H. Lang and J. P. Chapin (1917). The American Museum Congo Expedition collection of Bats. *Bulletin of the American Museum of Natural History*, **37 (18):** 405 - 563. doi: 10.5962/bhl.title.89200.
Alluaud, Ch and R. Jeannel (1914). Biospeologica XXXIII. Grottes visitées. *Archives de Zoologie Expérimentale et Générale*, **53:** 363 - 385.
Almeida, F. C., N. P. Giannini, R. DeSalle and N. B. Simmons (2011a). Evolutionary relationships of the old world fruit bats (Chiroptera, Pteropodidae): Another star phylogeny? *BMC Evolutionary Biology*, **11 (281):** 1 - 17. doi: 10.1186/1471-2148-11-281. URL: http://www.biomedcentral.com/1471-2148/11/281.
Almeida, F. C., N. P. Giannini and N. B. Simmons (2011b). A phylogenetic analysis of Pteropodidae based on multi-locus molecular data. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 1 - 356.
Almeida, F. C., N. P. Giannini and N. B. Simmons (2016). The evolutionary history of the African fruit bats (Chiroptera: Pteropodidae). *Acta Chiropterologica*, **18 (1):** 73 - 90. doi: 10.3161/15081109ACC2016.18.1.003.
Almeida, F. C., N. P. Giannini, N. B. Simmons and K. M. Helgen (2014). Each flying fox on its own branch: A phylogenetic tree for *Pteropus* and related genera (Chiroptera: Pteropodidae). *Molecular and Phylogenetic Evolution*, **77:** 83 - 95. doi: 10.1016/j.ympev.2014.03.009.
Almenar, D. (2008). Uso y selección de recursos por el murciélago patudo (Myotis capaccinii): presas, hábitats y áreas de caza. University of the Basque Country.
Almenar, D., J. (R.) Aihartza, U. Goiti, E. Salsamendi and I. Garin (2006). Habitat selection and spatial use by the trawling bat *Myotis capaccinii* (Bonaparte, 1837). *Acta Chiropterologica*, **8 (1):** 157 - 167. doi: 10.3161/1733-5329(2006)8[157:HSASUB]2.0.CO;2.

Almenar, D., J. (R.) Aihartza, U. Goiti, E. Salsamendi and I. Garin (2012). Hierarchical patch choice by an insectivorous bat through prey availability components. *Behavioral ecology and sociobiology*, **67 (2):** 311 - 320 (for 2013). doi: 10.1007/s00265-012-1451-z.

Al-Omari, K. A., M. A. Abu Baker and Z. S Amr (2000). First record of the Egyptian Slit-faced Bat, *Nycteris thebaica*, from Jordan. *Zoology in the Middle East*, **21 (1):** 5 - 7. doi: 10.1080/09397140.2000.10637826.

Alonso, L. E., T. S. Schulenberg, S. Radilofe and O. Missa (2002). *Evaluation rapide de la diversité biologique de reptiles et amphibians de la Reserve Naturelle Integrale d'Ankarafantsika.* RAP Bulletin of Biological Assessment No. 23. Conservation International, Washington, DC, USA: 1 - 139.

Alonso-Zarazaga, M. A. (2005). Nomenclature of Higher Taxa: a new approach. *Bulletin of Zoological Nomenclature*, **62 (4):** 189 - 199.

Al-Safadi, M. M. (1991). Chiropteran fauna of Yemen Arab republic. *Mammalia*, **55 (2):** 269 - 274. [Abstract]

Álvarez, Y., J. Juste B. , E. Tabares, A. Garrido-Pertierra, C. Ibáñez and J. M. Bautista (1999). Molecular phylogeny and morphological homoplasy in fruitbats. *Molecular biology and evolution*, **16 (8):** 1061 - 1067.

Álvarez-Castañeda, S. T. and T. Álvarez Solórzano (1996). Etimologías de los géneros de mamíferos mexicanos. *Ciencia*, **47:** 39 - 49.

Amador, L. I., V. Abdala and N. P. Giannini (2015). Homology of the chiropteran "dactylopatagium" brevis. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **80 (6):** 447 - 450. doi: 10.1016/j.mambio.2015.06.003.

Amador, L. I., R. L. Moyers Arévalo, F. C. Almeida, S. A. Catalano and N. P. Giannini (2016). Bat systematics in the light of unconstrained analyses of a comprehensive molecular supermatrix. *Journal of Mammalian Evolution*, **25 (1):** 37 - 70 (for 2018). doi: 10.1007/s10914-016-9363-8.

Ameghino, F. (1889). Contribución al conocimiento de los mamíferos fósiles de la república Argentina. *Actas de la Academia Nacional de Ciencias de la República Argentina en Córdoba*, **6:** 1 - 1027.

Amichai, E., G. Blumrosen and Y. Yovel (2015). Calling louder and longer: how bats use biosonar under severe acoustic interference from other bats. *Proceedings of the Royal Society of London*, **B 282:** 20152064. doi: 10.1098/rspb.2015.2064.

Amichai, E., E. Levin, N. Kronfeld-Schor, U. Roll and Y. Yom-Tov (2012). Natural history, physiology and energetic strategies of *Asellia tridens* (Chiroptera). *Mammalian biology (Zeitschrift für Säugetierkunde)*, **78 (2):** 94 - 103 (for 2013). doi: 10.1016/j.mambio.2012.06.006.

Amichai, E., S. Tal, A. Boonman and Y. Yovel (2019). Ultrasound imaging reveals accelerated in-utero development of a sensory apparatus in echolocating bats. *Scientific Reports*, **9:** 5275. doi: 10.1038/s41598-019-41715-y.

Amichai, E. and Y. Yovel (2013). Do bats talk funny in helium? A test of echolocation flexibility. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 6. URL: http://www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Amitai, O., S. Holtze, S. Barkan, E. Amichai, C. Korine, B. Pinshow and C. C. Voigt (2010). Fruit bats (Pteropodidae) fuel their metabolism rapidly and directly with exogenous sugars. *Journal of experimental biology*, **213:** 2693 - 2699. doi: 10.1242/jeb.043505.

Amman, B. R., C. G. Albariño, B. H. Bird, L. Nyakarahuka, T. K. Sealy, S. Balinandi, A. J. Schuh, S. M. Campbell, U. Ströher, M. E. B. Jones, M. E. Vodzack, D. M. Reeder, W. Kaboyo, S. T. Nichol and J. S. Towner (2015a). A recently discovered pathogenic paramyxovirus, Sosuga Virus, is present in *Rousettus aegyptiacus* fruit bats at multiple locations in Uganda. *Journal of wildlife diseases*, **51 (3):** 774 - 779. doi: 10.7589/2015-02-044.

Amman, B. R., S. A. Carroll, Z. D. Reed, T. K. Sealy, S. Balinandi, R. Swanepoel, A. Kemp, B. R. Erickson, J. A. Comer, S. Campbell, D. L. Cannon, M. L. Khristova, P. Atimnedi, C. D. Paddock, R. J. Kent Crockett, T. D. Flietstra, K. L. Warfield, R. Unfer, E. Katongole-Mbidde, R. Downing, J. W. Tappero, S. R. Zaki, P. E. Rollin, T. G. Ksiazek, S. T. Nichol and J. S. Towner (2012). Seasonal pulses of Marburg virus circulation in juvenile *Rousettus aegyptiacus* bats coincide with periods of increased risk of human infection. *PloS Pathogens*, **8 (10):** e1002877. doi: 10.1371/journal.ppat.1002877.

Amman, B. (R.), S. (A.) Carroll and J. (S.) Towner (2013). Marburg virus outbreaks: understanding virus spillover from the natural reservoir. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 6 - 7. URL: http://www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Amman, B. R., M. E. B. Jones, T. K. Sealy, L. S. Uebelhoer, A. J. Schuh, B. H. Bird, J. D. Coleman-McCray, B. E. Martin, S. T. Nichol and J. S. Towner (2015b). Oral shedding of Marburg virus in experimentally infected Egyptian fruit bats (*Rousettus aegyptiacus*). *Journal of wildlife diseases*, **51 (1):** 113 - 124. doi: 10.7589/2014-08-198.

Amman, B. R., L. Nyakarahuka, A. K. McElroy, K. A. Dodd, T. K. Sealy, A. J. Schuh, T. R. Shoemaker, S. Balinandi, P. Atimnedi, W. Kaboyo, S. T. Nichol and J. S. Towner (2014). Marburgvirus resurgence in Kitaka mine bat population after extermination attempts, Uganda. *Emerging Infectious Diseases*, **20 (10):** 1761 - 1764. doi: 10.3201/eid2010.140696.

Ammerman, L. K., W. A. Brashear and S. N. Bartlett (2013). Further evidence for the basal divergence of *Cheiromeles* (Chiroptera: Molossidae). *Acta Chiropterologica*, **15 (2):** 307 - 312. doi: 10.3161/150811013X678946.

Ammerman, L. K., D. N. Lee and T. M. Tipps (2012). First molecular phylogenetic insights into the evolution of free-tailed bats in the subfamily Molossinae (Molossidae, Chiroptera). *Journal of Mammalogy*, **93 (1):** 12 - 28. doi: http://dx.doi.org/10.1644/11-MAMM-A-103.1.

Amori, G., S. Gippoliti and L. Luiselli (2013). A short review of the roles of climate and man in mammal extinctions during the Anthropocene. *Rendiconti Lincei: Scienze Fisiche e Naturali*, **25 (1):** 95 - 99 (for 2014). doi: 10.1007/s12210-013-0240-6.

Amori, G., G. H. Segniagbeto, J. Decher, D. Assou, S. Gippoliti and L. Luiselli (2016). Non-marine mammals of Togo (West Africa): an annotated checklist. *Zoosystema*, **38 (2):** 201 - 244. doi: 10.5252/z2016n2a3.

Amorim, F., R. Godinho, J. Juste, C. Ibañez, S. Rossiter, P. Beja and H. Rebelo (2013). Phylogeography of the European free-tailed bat in the western Palearctic. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 7. URL: http://www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Amorim, F., R. Godinho, J. Juste, C. Ibáñez, S. Rossiter, P. Beja and H. Rebelo (2017). A bat out of Africa: new insights on the existence of a north African refugium for western Palaearctic bat fauna (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 38. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.

Amorim, F., V. A. Mata, P. Beja and H. Rebelo (2015). Effects of a drought episode on the reproductive success of European free-tailed bats (*Tadarida teniotis*). *Mammalian biology (Zeitschrift für Säugetierkunde)*, **80 (3):** 228 - 236. doi: 10.1016/j.mambio.2015.01.005.

Amouri, I. K., H. Kharmachi, A. Djebbi, M. Saadi, N. Hogga, L. Ben Zakour and A. Ghram (2010). Molecular characterization of rabies virus isolated from dogs in Tunisia: Evidence of two phylogenetic variants. *Virus Research*, **158 (1-2):** 246 - 250. doi: 10.1016/j.virusres.2010.10.015.

Amponsah-Mensah, K., A. A. Cunningham, J. L. N. Wood and Y. Ntiamoa-Baidu (2019). Seasonal variation in food availability and relative importance of dietary items in the Gambian epauletted fruit bat (*Epomophorus gambianus*). *Ecology and Evolution*, **9 (10):** 5683 - 5693. doi: 10.1002/ece3.5150.

Amr, Z. S. (2000). *Mammals of Jordan.* United Nations Environment Programme. Amman.

Amr, Z. S. and M. B. Qumsiyeh (1993). Records of bat flies from Jordan, Libya and Algeria. *Entomological News*, **104 (1):** 43 - 46. [Abstract]

Amrein, I., D. K. N. Dechmann, Y. Winter and H.-P Lipp (2007). Absent or low rate of adult neurogenesis in the hippocampus of bats (Chiroptera). *PLoS ONE*, **2 (5):** e455. doi: 10.1371/journal.pone.0000455.

Amrine-Madsen, H., K.-P. Koepfli, R. K. Wayne and M. S. Springer (2003). A new phylogenetic marker, apolipoprotein B, provides compelling evidence for eutherian relationships. *Molecular and Phylogenetic Evolution*, **28 (2):** 225 - 240. doi: 10.1016/S1055-7903(03)00118-0.

Anchieta, (1882). 3. Liste des mammifères envoyés de Caconda "Angola". *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **33:** 25 - 29.

Anciaux de Faveaux, F. (1958). Speologica Africana. Chiroptères des grottes du Haut-Katanga (Congo Belge). *Bulletin de l'Institut fondamental d'Afrique noire: sciences naturelles*, **(A) 20 (1):** 263 - 275.

Anciaux de Faveaux, F. (1959). Notes biospéléologiques et parasitologiques sur des grottes du Katanga. *Bulletin de la Société Spéléologique de Katanga*, **1 :** 23-36.

Anciaux de Faveaux, F. (1960a). Notes biospéléologiques et parasitologiques sur des grottes du Katanga. *Bulletin de la Société Spéléologique de Katanga*, **2:** 19 - 22.

Anciaux de Faveaux, F. (1960b). Reproduction des Chiroptères du Haut-Katanga. *Bulletin de la Société Spéléologique de Katanga*, **2:** 23 - 30.

Anciaux de Faveaux, F. (1960c). Baguage des Chiroptères au Katanga. *Bulletin de la Société Spéléologique de Katanga*, **2:** 30 - 33.

Anciaux de Faveaux, F. (1963). *La fauna des grottes de Katanga.* 3. Int. Kongr. Speläologie: 11 - 21.

Anciaux de Faveaux, M. (1965). Les Parasites de Chiroptères. Rôle épidémiologiques chez les animaux et l'homme au Katanga. *Annales de Parasitologie*, **40 (1):** 21 - 38. doi: https://doi.org/10.1051/parasite/1965401021. [Abstract]

Anciaux de Faveaux, M. (1971). Catalogue des Acariens parasites et commensaux des Chiroptères. (Seconde et troisième parties). *Koninklijk Belgisch Instituut voor Natuurwetenschappen. Mededelingen*Doc. de travail no 7.

Anciaux de Faveaux, M. (1972). Répartition biogéographique et cycles annuels de Chiroptères d'Afrique centrale. Thèse de doctorat. - Univérsite de Paris VI: 2 vol, 425 pp.

Anciaux de Faveaux, M. (1973). Essai de synthèse sur la reproduction de chiroptères d'Afrique (région faunistique éthiopienne). *Periodicum biologorum - Societas Scientiarum Naturalium Croatica*, **75:** 195 - 199. [Abstract]

Anciaux de Faveaux, M. (1976a). La léthargie chez les chiroptères cavernicoles d'Afrique Centrale. *International Journal of Speleology*, **8:** 291 - 303. [Abstract]

Anciaux de Faveaux, M. (1976b). Distribution des chiroptères en Algérie, avec notes écologiques et parasitologiques. *Bulletin de la Société d'histoire naturelle de l'Afrique du nord*, **67 (1-2):** 69 - 80.

Anciaux de Faveaux, M. (1977). Déplacements saisonniers chez *Miniopterus schreibersi natalensis* (A. Smith,1834) au Shaba méridional (S.E. Zaïre, Afrique Centrale) (Mammalia Chiroptera). *Revue de zoologie africaine*, **91 (3):** 721 - 729.

Anciaux de Faveaux, M. (1978a). Définition de l'Equateur Biologique en fonction de la reproduction de Chiroptères d'Afrique Centrale. *Annalen van de Koninklijke Vereniging voor Dierkunde*, **107 (1-2):** 79 - 89. [Abstract]

Anciaux de Faveaux, M. (1978b). Notes éco-éthologique et parasitologiques sur les Chiroptères cavernicoles du Shaba (Zaïre). *International Journal of Speleology*, **10 (3-4):** 331 - 350. doi: 10.5038/1827-806X.10.3.9. [Abstract]

Anciaux de Faveaux, M. (1978c). Les cycles annuels de reproduction chez les chiroptères cavernicoles du Shaba (S.E. Zaïre) et du Rwanda. *Mammalia*, **42 (4):** 453 - 490. doi: 10.1515/mamm.1978.42.4.453. [Abstract]

Anciaux de Faveaux, M. (1981). Cycles de reproduction chez des Chiroptères phytophiles du Shaba (Zaïre) et du Rwanda. Abstract. *African Small Mammal Newsletter*, **Special Number:** 10 - 11. [Abstract]

Anciaux de Faveaux, M. (1983). Les cycles annuels de reproduction chez les Chiroptères phytophiles au Shaba (S.E. Zaïre) et au Rwanda. In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 27 - 34. [Abstract]

Anciaux de Faveaux, M. (1984). Les parasites des chiroptères du continent Africain. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **244:** i - ix; 1 - 92.

Ancillotto, L. and D. Russo (2014). Selective aggressiveness in European free-tailed bats (*Tadarida teniotis*): influence of familiarity, age and sex. *Die Naturwissenschaften*, **101 (3):** 221 - 228. doi: 10.1007/s00114-014-1146-6.

Andersen, K. (1904a). Five new Rhinolophi from Africa. *Annals and Magazine of Natural History*, **ser. 7, 14 (77):** 378 - 388.

Andersen, K. (1904b). ?? Title still needs to be checked. ?? *Annals and Magazine of Natural History*ser. 7, 14 (83).

Andersen, K. (1904c). On von Heuglin's Rüppell's, and Sundevall's types of African Rhinolophi. *Annals and Magazine of Natural History*, **ser. 7, 14 (84):** 451 - 458.

Andersen, K. (1905a). Further descriptions of new Rhinolophi from Africa. *Annals and Magazine of Natural History*, **ser. 7, 15 (85):** 70 - 76.

Andersen, K. (1905b). On some bats of the genus *Rhinolophus* with remarks on their mutual affinities, and descriptions of twenty-six new forms. *Proceedings of the Zoological Society of London*, **1905, II (1):** 75 - 145; pl. III & IV.

Andersen, K. (1905c). On the bats of the *Rhinolophus philippinensis* group, with description of five new species. *Annals and Magazine of Natural History*, **ser. 7, 16 (92):** 243 - 257.

Andersen, K. (1905d). A list of the species and subspecies of the genus *Rhinolophus* with some notes on their geographical distribution. *Annals and Magazine of Natural History*, **ser. 7, 16 (96):** 648 - 662. doi: 10.1080/03745480509443310.

Andersen, K. (1906a). On the bats of the *Hipposiderus armiger* and *commersoni* types. *Annals and Magazine of Natural History*, **ser. 7, 17 (97):** 35 - 48.

Andersen, K. (1906b). On *Hipposiderus caffer* Sund., and its closest allies; with some notes on *H. fuliginosus*, Temm. *Annals and Magazine of Natural History*, **ser. 7, 17 (99):** 269 - 283.

Andersen, K. (1906c). On some new or little-known bats of the genus *Rhinolophus* in the collection of the Museo Civico, Genova. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 3, 2 (O.S. 42):** 1 - 23: pl. III. doi: 10.5962/bhl.title.77372.

Andersen, K. (1907a). On *Pterocyon*, *Rousettus*, and *Myonycteris*. *Annals and Magazine of Natural History*, **ser. 7, 19 (114):** 501 - 515.
Andersen, K. (1907b). Chiropteran Notes. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 3, 3 (O.S. 43):** 1 - 45.
Andersen, K. (1908a). On four little-known names of Chiropteran genera. *Annals and Magazine of Natural History*, **ser. 8, 1 (5):** 431 - 435.
Andersen, K. (1908b). Twenty new forms of *Pteropus*. *Annals and Magazine of Natural History*ser. 8, 2 (10). 361 - 370.
Andersen, K. (1908c). Preliminary descriptions of two species of *Myonycteris*. *Annals and Magazine of Natural History*, **ser. 8, 2 (11):** 450 - 451.
Andersen, K. (1910a). Preliminary description of a new genus of Epomophorine bats. *Annals and Magazine of Natural History*, **ser. 8, 5 (25):** 97 - 99.
Andersen, K. (1910b). On some species of the genus *Epomops*. *Annals and Magazine of Natural History*, **ser. 8, 5 (25):** 99 - 106.
Andersen, K. (1912a). Brief diagnoses of eight new *Petalia*, with a list of the known forms of the genus. *Annals and Magazine of Natural History*, **ser. 8, 10 (59):** 546 - 550. doi: 10.1080/00222931208693267.
Andersen, K. (1912b). *Catalogue of the Chiroptera in the British Museum. Second Edition. Volume I: Megachiroptera.* Trustees of the British Museum (Natural History) - London: i - ci; 1 - 854. doi: 10.5962/bhl.title.8322.
Andersen, K. (1914). A new *Nycteris* from N.W. Rhodesia. *Annals and Magazine of Natural History*, **ser. 8, 13 (78):** 563.
Andersen, K. (1918). Diagnoses of new bats of the families Rhinolophidae and Megadermatidae. *Annals and Magazine of Natural History*, **ser. 9, 2 (10):** 374 - 384.
Andersen, K. and P. Matschie (1904). Uebersicht einiger geographischen Formen der Untergattung *Euryalus*. *Sitzungsberichte Gesellschaft naturforschenden Freunde Berlin*, **1904 (5):** 71 - 83.
Andersen, K. and R. C. Wroughton (1907). On the bats of the family Megadermatidae. *Annals and Magazine of Natural History*, **ser. 7, 19 (110):** 129 - 145.
Anderson, J. (1881). *Catalogue of mammalia in the Indian Museum, Calcutta. Part I. Primates, Prosimiae, Chiroptera and Insectivora.* Calcutta: 223 pp.
Anderson, J. (1892). On a small collection of mammals, reptiles and bactracians from Barbary. *Proceedings of the Zoological Society of London*, **1892, I:** 3 - 24.
Anderson, J. and W. E. de Winton (1902). *Zoology of Egypt: Mammalia.* Hugh Rees - London: xvii + 374 pp.
Anderson, S. (1997). Mammals of Bolivia, taxonomy and distribution. *Bulletin of the American Museum of Natural History*, **231:** 652 pp, 785 figs, 21 tables.
Ando, K., F. Yasuzumi, A. Tagawa and T. A. Uchida (1983). Further study on the karyotypic evolution in the genus *Rhinolophus* (Mammalia: Chiroptera). *Caryologia*, **36 (2):** 101 - 111. [Abstract]
Andral, L., P. Brès, C. Sérié, J. Casals and R. Panthier (1968). Études sur la fièvre jaune en Ethiopie. 3. Étude sériologique et virologique de la faune sylvatique. *Bulletin of the World Health Organization*, **38 (6):** 855 - 861. URL: http://whqlibdoc.who.int/bulletin/1968/Vol38/Vol38-No6/bulletin_1968_38(6)_855-861.pdf. [Abstract]
Andreas, M. (2010). *Study of diet in Middle East and African bats.* In Horácek, I. and M. Uhrin : *A tribute to bats.* Kostelec nad Cernými lesy: Lesnická práce, s.r.o., 265 - 267 (400 pp).
Andreas, M., A. Reiter and P. Benda (2012). Prey selection and seasonal diet changes in the western barbastelle bat (*Barbastella barbastellus*). *Acta Chiropterologica*, **14 (1):** 81 - 92. doi: 10.3161/150811012X654295.
Andreas, M., A. Reiter, E. Cepáková and M. Uhrin (2013). Body size as an important factor determining trophic niche partitioning in three syntopic rhinolophid bat species. *Biologia*, **68 (1):** 170 - 175. doi: 10.2478/s11756-012-0139-1.
Andreas, M., A. Reiter and H. Svitavska-Svobodova (2011). Factors determining trophic niche overlap of three sympatric rhinolophid bats, diet and foraging habitat of *Rhinolophus euryale*. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 17 - 18. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.
Andrews, M. M. and P. T. Andrews (2003). Ultrasound social calls made by greater horseshoe bats (*Rhinolophus ferrumequinum*) in a nursery roost. *Acta Chiropterologica*, **5 (2):** 221 - 234. doi: 10.3161/001.005.0212.
Andrews, M. M., P. T. Andrews, D. F. Wills and S. M. Bevis (2006). Ultrasound social calls of greater horseshoe bats (*Rhinolophus ferrumequinum*) in a hibernaculum. *Acta Chiropterologica*, **8 (1):** 197 - 212. doi: 10.3161/1733-5329(2006)8[197:USCOGH]2.0.CO;2.
Andriafidison, D., R. (A.) Andrianaivoarivelo and R. K. B Jenkins (2006a). Records of tree roosting bats from western Madagascar. *African Bat Conservation News*, **8:** 5 - 6.
Andriafidison, D., R. A. Andrianaivoarivelo, O. R. Ramilijaona, M. R. Razanahoera, J. MacKinnon, R. K. B. Jenkins and P. A. Racey (2006b). Nectarivory by endemic Malagasy fruit bats during the dry season. *Biotropica*, **38 (1):** 85 - 90. doi: 10.1111/j.1744-7429.2006.00112.x.
Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, A. Rabearivelo, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008a). *Pteropus rufus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008b). *Eidolon dupreanum*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008c). *Eptesicus malagasyensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008d). *Hipposideros commersoni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008e). *Miniopterus gleni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008f). *Miniopterus manavi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008g). *Mormopterus jugularis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008h). *Myotis goudoti*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008l). *Otomops madagascariensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008j). *Scotophilus borbonicus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008k). *Scotophilus robustus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008l). *Tadarida jobimena*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008m). *Tadarida leucostigma*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008n). *Triaenops auritus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008o). *Triaenops furculus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008p). *Triaenops rufus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranvo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008q). *Rousettus madagascariensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., S. G. Cardiff, S. M. Goodman, A. M. M. Hutson, R. K. B. Jenkins, A. F. Kofoky, P. A. Racey, J. Ranivo, F. H. Ratrimomanarivo and H. J. Razafimanahaka (2008r). *Eptesicus matroka*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Andriafidison, D., A. Kofoky, T. Mbohoahy, P. A. Racey and R. K. B. Jenkins (2007). Diet, reproduction and roosting habits of the Madagascar free-tailed bat, *Otomops madagascariensis* Dorst, 1953 (Chiroptera: Molossidae). *Acta Chiropterologica*, **9 (2):** 445 - 450.

Andriamandimby, S. F., J.-M. Héraud, R. Ramiandrasoa, M. Ratsitorahina, J. H. Rasambainarivo, L. Dacheux, A. Lepelletier, S. M. Goodman, J.-M. Reynes and H. Bourhy (2013). Surveillance and control of rabies in La Reunion, Mayotte, and Madagascar. *Veterinary Research*, **44:** 77. doi: 10.1186/1297-9716-44-77.

Andrianaivoarivelo, A. R., N. Ranaivoson, P. A. Racey and R. K. B. Jenkins (2006). The diet of three synanthropic bats (Chiroptera: Molossidae) from eastern Madagascar. *Acta Chiropterologica*, **8 (2):** 439 - 444. doi: 10.3161/1733-5329(2006)8[439:TDOTSB]2.0.CO;2.

Andrianaivoarivelo, A. R., G. D. Shore, S. M. McGuire, R. K. B. Jenkins, O. Ramilijaona, E. E. Jr. Louis and R. A. Brenneman (2008). Characterization of 22 microsatellite marker loci in the Madagascar rousette (*Rousettus madagascariensis*). *Conservation Genetics*, **10 (4):** 1025 - 1028 (for 2009). doi: 10.1007/s10592-008-9679-x.

Andrianaivoarivelo, R. A., D. Andriafidison, C. Rahaingonirina, S. Raharimbola, A. A. Rakotoarivelo, O. R. Ramilijaona, P. A. Racey and R. K. B. Jenkins (2011b). A conservation assessment of *Rousettus madagascariensis* (G. Grandidier, 1928, Pteropodidae) roosts in eastern Madagascar. *Madagascar Conservation & Development*, **6 (2):** 78 - 82. doi: 10.4314/mcd.v6i2.6.

Andrianaivoarivelo, R. A., R. K. B. Jenkins, E. J. Petit, O. Ramilijaona, N. Razafindrakoto and P. A. Racey (2012). *Rousettus madagascariensis* (Chiroptera: Pteropodidae) shows a preference for native and commercially unimportant fruits. *Endangered Species Research*, **19 (1):** 19 - 27. doi: 10.3354/esr00441.

Andrianaivoarivelo, R. A., O. R. Ramilijaona and D. Andriafidison (2007). *Rousettus madagascriensis* Grandidier 1929 Feeding on *Dimocarpus longan* in Madagascar. *African Bat Conservation News*, **11:** 3 - 4.

Andrianaivoarivelo, R. A., O. R. Ramilijaona, P. A. Racey, N. Razafindrakoto and R. K. B. Jenkins (2011a). Feeding ecology, habitat use and reproduction of *Rousettus madagascariensis* Grandidier, 1928 (Chiroptera: Pteropodidae) in eastern Madagascar. *Mammalia*, **75 (1):** 69 - 78. doi: 10.1515/MAMM.2010.071.

Andriollo, T., Y. Naciri and M. Ruedi (2015). Two mitochondrial barcodes for one biological species: the case of European Kuhl's pipistrelles (Chiroptera). *PLoS ONE*, **10 (8):** e0134881. doi: 10.1371/journal.pone.0134881.

Angelici, F. M., S. W. Wariboko, L. Luiselli and E. Politano (2000). A long-term ecological survey of bats (Mammalia, Chiroptera) in the eastern Niger Delta (Nigeria). *Italian Journal of Zoology*, **67:** 169 - 174.

Annan, A., H. J. Baldwin, M. Corman, S. M. Klose, M. Owusu, E. E. Nkrumah, E. K. Badu, P. Anti, O. Agbenyega, B. Meyer, S. Oppong, Y. A. Sarkodie, E. K. V. Kalko, P. H. C. Lina, E. V. Godlevska, C. Reusken, A. Seebens, F. Gloza-Rausch, P. Vallo, M. Tschapka, C. Drosten and J. F. Drexler (2013). Human Betacoronavirus 2c EMC/2012-related viruses in bats, Ghana and Europe. *Emerging Infectious Diseases*, **19 (3):** 456 - 459. doi: 10.3201/eid1903.121503.

Anonymus, (1929). Suspension rules of *Nycteris* 1795. *Smithsonian Miscellaneous Collection*, **73 (6):** 18.

Anonymus, (1959). Kruger National Park. Annual Report of the Biologist 1958/1959. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **3:** 56 - 59.

Anonymus, (1964). *East African Virus Research Report. July 1963 - December 1964.* Entebbe.

Anonymus, (1988). Results of the locust pesticide testing trials in Sudan. Technical Report - USAID Contract No. AFR-0517-C-00-7035-00. (Prepared by Dynamac Corporation. Rockvill, MD). U.S. Agency for International Development. African Grasshpper/Locust Pesticide Testing Project: 179 pp.

Anonymus, (19xx). *Tableaux climatologique de l'Afrique occidentale française et du territoire du Togo.* Service central de la meteologie de la France d'outre-mer.

Anonymus, (2000). Strategie nationale et plan d'action pour la conservation de la diversité biologique. République fédérale islamique des Comores. Ministère de la production et de l'environment. Direction de l'environment. Moroni: i - viii; 1 - 153. URL: http://bch-cbd.naturalsciences.be/comores/comor-fra/implementation/documents/sndb/stratnatbiodiv.pdf.

Anonymus, (2002a). Strategie nationale et plan d'action pour la conservation de la biodiversité biologique. République du Bénin. Ministère de l'environment, de l'habitat et de l'urbanisme. Cotonou: 1 - 144. URL: http://bch-cbd.naturalsciences.be/benin/implementation/documents/strategie/strat_brute.pdf.

Anonymus, (2002b). OPINION 2005 (Case 3022): Catalogue des mammifères du Muséum National d'Histoire Naturelle by Etienne Geoffroy Saint-Hilaire (1803): placed on the Official List of Works Approved as Available for Zoological Nomenclature. *Bulletin of Zoological Nomenclature*, **59 (2):** 153 - 154.

Anonymus, (2003). Opinion 2028 (Case 3073) *Vespertilio pipistrellus* Schreber, 1774 and *V. pygmaeus* Leach, 1825 (currently *Pipistrellus pipistrellus* and *P. pygmaeus*; Mammalia, Chiroptera); neotypes designated. *Bulletin of Zoological Nomenclature*, **60 (1):** 85 - 87.

Anonymus, (2004a). The scientific name for the African Banana Bat. *African Bat Conservation News*, **1:** 7.

Anonymus, (2004b). Proposal to place the Long-fingered bats (*Miniopterus* spp.) in their own family - Miniopteridae. *African Bat Conservation News*, **1:** 7.

Anonymus, (2004c). Three distinct population of the Long-fingered bat (*Miniopterus schreibersi natalensis*) in South Africa. *African Bat Conservation News*, **1:** 7.

Anonymus, (2004d). Southern African *Pipistrellus kuhlii* are now *Pipistrellus hesperidus*. *African Bat Conservation News*, **1:** 8.

Anonymus, (2004e). Individual call signatures in the Large-eared Free-tailed Bats. *African Bat Conservation News*, **1:** 8.

Anonymus, (2004f). Report on a feasibility study on additional bats agreements under CMS. Twelfth Meeting of the CMS Scientific Council - Glasgow, Scotland, United Kingdom, 31 March-3 April 2004: 68 pp. URL: http://www.cms.int/bodies/ScC/12th_scientific_council/pdf/English/Doc_13_Bats_Study_combined_E.pdf.

Anonymus, (2005). *Vespertilio nanus* Peters, 1852 (currently *Pipistrellus nanus*; Mammalia, Chiroptera): specific name given precedence over *Vespertilio pipistrellus africanus* Rüppell, 1842. *Bulletin of Zoological Nomenclature*, **62 (2):** 120 - 121.

Anonymus, (2006). Counting bats. *The Mauritian Wildlife Foundation - Newsletter*, **5:** 4. URL: http://www.mauritian-wildlife.org/newsletter/Newsletter%20MWF%20No%2005%20(August%202006).pdf.

Anonymus, (2007a). Southern Sudan environmental threats and opportunities assessment. Biodiversity and tropical forest assessment. International Resources Group - Washington, D.C.: i - iv; 1 - 64. URL: http://pdf.usaid.gov/pdf_docs/PNADL108.pdf.

Anonymus, (2007b). Repoblikan'i Madagasikara - Tanindrazana-Fahafahana-Fandrosoana - Ministère de l'environnement, des eaux et forets. Decret N° 2006 - 400. Portant classement des espèces de faune sauvage. *Lemur News*, **12:** 5 - 6. URL: http://www.dpz.gwdg.de/fileadmin/dpz_home/web/abtlg/lnews/lemurnews_vol-12_hp-gesamt.pdf.

Anonymus, (2008). Terestrial environments of Abu Dhabi Emirate, United Arab Emirates. Environment Agency Abu Dhabi: i - xvii; 1 - 113. URL: http://www.soe.ae/English/Documents/Terrestrial_forweb.08.01.09.pdf.

Anonymus, (2009). 50 years of Zoological Research: reflections and insights. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 95 pp. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.

Anonymus, (2010a). Giba Gorge Environmental Precinct: Conservation Management Plan. Version 2. April 2010. Giba Gorge Environemental Precinct: 1 - 45; 7 maps. URL: http://ggep.org/wp-content/uploads/2010/05/GGEP_managementplan_April2010.pdf.

Anonymus, (2010b). 70th Anniversary Meeting Society of Vertebrate Paleontology. Program and Abstracts. Pittsburgh, Pennsylvania USA, October 10-13, 2010: 211 pp. URL: http://www.vertpaleo.org/meetings/documents/SVP10Abstracts_WEB.pdf.

Anonymus, (2011a). Environmental impact assessment for a wind farm in the Kouga Local Municipality. Volume 1 of 3. Revised draft environmental impact report. Reference number 12/12/20/1756. Red Cap Investments (Pty) Ltd./ Arcus GIBB (Pty) Ltd Reg, Port Elizabeth, South Africa: 256 pp. URL: http://projects.gibb.co.za/Projects/KougaWindFarmEIA/tabid/298/language/en-US/Default.aspx.

Anonymus, (2011b). CCBA Project Implementation Report for TIST Program in Kenya CCB-001 for validation under The Climate, Community and Biodiversity Standard. Second Edition. The International Small Group & Tree Planting Program: 58 pp. URL: https://s3.amazonaws.com/CCBA/Projects/TIST+Programin+Kenya/TIST_KE_PD-CCB-001f_App05_Implementation_Rpt_110224.pdf.

Ansell, W. F. H. (1957). Some mammals from Northern Rhodesia. *Annals and Magazine of Natural History*, **ser. 12, 10 (115):** 529 - 551.

Ansell, W. F. H. (1960a). *Mammals of Northern Rhodesia.* The Government Printer - Lusaka.

Ansell, W. F. H. (1960b). Some fruit bats from Northern Rhodesia, with the description of a new race of *Epomophorus gambianus* Ogilby. *Revue de zoologie et de botanique africaines*, **61 (1-2):** 160 - 166.

Ansell, W. F. H. (1967). Additional records of Zambian Chiroptera. *Arnoldia (Rhodesia)*, **2 (38):** 1 - 29. [Abstract]

Ansell, W. F. H. (1969). Addenda and corrigenda to "Mammals of Northern Rhodesia" Number 3. *The Puku*, **5:** 1 - 48. [Abstract]

Ansell, W. F. H. (1973). Addenda and Corrigenda to "Mammals of Northern Rhodesia", Number 4. *The Puku*, **7:** 1 - 19. [Abstract]

Ansell, W. F. H. (1974). Some mammals from Zambia and adjacent countries. *Occasional Papers of the National Parks and Wildlife Services, Zambia*, **suppl 1:** 1 - 49. [Abstract]

Ansell, W. F. H. (1978). *The mammals of Zambia.* The National Parks and Wildlife Service - Chilanga: i - ii, 1 - 126, maps A - J, maps 1 - 204.

Ansell, W. F. H. (1985). Mammals from Malawi, Part I. *Nyala*, **11 (1):** 18 - 24. [Abstract]

Ansell, W. F. H. (1986). Some Chiroptera from South-central Africa. *Mammalia*, **50 (4):** 507 - 519. [Abstract]

Ansell, W. F. H. and P. D. H. Ansell (1973). Mammals of the north-eastern montane areas of Zambia. *The Puku*, **7:** 21 - 69.

Ansell, W. F. H., C. W. Benson and B. L. Mitchell (1962). Notes on some mammals from Nyasaland and adjacent areas. *The Nyasaland Journal*, **15:** 38 - 54.

Ansell, W. F. H. and R. J. Dowsett (1988). *Mammals of Malawi. An annotated check list and atlas.* The Trendrine Press - Zennor, St. Ives, Cornwall: 170 pp. + 180 maps.

Anthony, B. P., V. Tatayah and D. de Chazal (2018). Taking the first steps: Initial mapping of the human-wildlife interaction of the Mauritius Fruit Bat *Pteropus niger* (Mammalia: Chiroptera: Pteropodidae) in Mauritius by conservation organizations. *Journal of Threatened Taxa*, **10 (8):** 12073 - 12081. doi: 10.11609/jott.4063.10.8.12073-12081.

Anthony, E. L. P. (2000). *1. Endocrinology of Reproduction in Bats: Central Control.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 1 - 26.

Anthony, H. E. (1926). Preliminary report on Ecuadorean mammals. No 7. *American Museum Novitates*, **240:** 1 - 6. [Abstract]

Anthony, M. R. L. and R. F. Kay (1993). Tooth form and diet in ateline and alouttine primates: Reflections on the comparative method. *American Journal of Science*, **293-A:** 356 - 382.

Anthony, S. J., J. H. Epstein, K. A. Murray, I. Navarrete-Macias, C. M. Zambrana-Torrelio, A. Solovyov, R. Ojeda-Flores, N. C. Arrigo, A. Islam, S. A. Khan, P. Hosseini, T. L. Bogich, K. J. Olival, M. D. Sanchez-Leon, W. B. Karesh, T. Goldstein, S. P. Luby, S. S. Morse, J. A. K. Mazet, P. Daszak and I. Lipkina (2013). A strategy to estimate unknown viral diversity in mammals. *mBio*, **4 (5):** e00598-13. doi: 10.1128/mBio.00598-13.

Anthony, S. J., K. Gilardi, V. D. Menachery, T. Goldstein, B. Ssebide, R. Mbabazi, I. Navarrete-Macias, E. Liang, H. Wells, A. Hicks, A. Petrosov, D. K. Byarugaba, K. Debbink, K. H. Dinnon, T. Scobey, S. H. Randell, B. L. Yount, M. Cranfield, C. K. Johnson, R. S. Baric, W. I. Lipkin and J. A. K. Mazet (2017a). Further evidence for bats as the evolutionary source of Middle East Respiratory Syndrome Coronavirus. *mBio*, **8 (2):** e00373-17. doi: 10.1128/mBio.00373-17.

Anthony, S. J., C. K. Johnson, D. J. Greig, S. Kramer, X. Che, H. Wells, A. L. Hicks, D. O. Joly, N. D. Wolfe, P. Daszak, P. Karesh, W. I. Lipkin, S. S. Morse, PREDICT Consortium, J. A. K. Mazet and T. Goldstein (2017b). Global patterns in coronavirus diversity. *Virus Evolution*, **3 (1):** vex012. doi: 10.1093/ve/vex012.

Anti, P., M. Owusu, O. Agbenyega, A. Annan, E. K. Badu, E. E. Nkrumah, M. Tschapka, S. Oppong, Y. Adu-Sarkodie and C. Drosten (2015). Human-bat interactions in rural West Africa. *Emerging Infectious Diseases*, **21 (8):** 1418 - 1421. doi: 10.3201/eid2108.142015.

Ao, L., X. Mao, W. Nie, X. Gu, Q. Feng, J. Wang, W. Su, Y. Wang, M. Volleth and F. Yang (2007). Karyotypic evolution and phylogenetic relationships in the order Chiroptera as revealed by G-banding comparison and chromosome painting. *Chromosome Research*, **15:** 257 - 267. doi: 10.1007/s10577-007-1120-7.

Appleton, B. R. and S. M. Goodman (2008). The Malagasy *Miniopterus*. Abstracts from the 13th Australasian Bat Society Conference, Charles Sturt University, Thurgoona, NSW, 26-28 March 2008. *The Australasian Bat Society Newsletter*30.

Appleton, B. R., J. A. McKenzie and L. Christidis (2004). Molecular systematics and biogeography of the bent-wing bat complex *Miniopterus schreibersii* (Kuhl, 1817) (Chiroptera: Vespertilionidae). *Molecular phylogenetics and evolution*, **31 (2):** 431 - 439. doi: 10.1016/ympev.2003.08.017.

Arai, S., F. Kikuchi, S. Bawm, N. T. Son, K. S. Lin, V. T. Tú, K. Aoki, K. Tsuchiya, K. Tanaka-Taya, S. Morikawa, K. Oishi and R. Yanagihara (2019). Molecular phylogeny of mobatviruses (*Hantaviridae*) in Myanmar and Vietnam. *Viruses*, **11 (3):** 228. doi: 10.3390/v11030228.

Arai, S., S. Taniguchi, K. Aoki, Y. Yoshikawa, S. Kyuwa, K. Tanaka-Taya, J. S. Masangkay, T. Omatsu, R. Jr. Puentespina, S. Watanabe, P. Alviola, J. Alvarez, E. Eres, E. Cosico, M. N. R. M. Quibod, S. Morikawa, R. Yanagihara and K. Oishi (2016). Molecular phylogeny of a genetically divergent hantavirus harbored by the Geoffroy's rousette (*Rousettus amplexicaudatus*), a frugivorous bat species in the Philippines. *Infection, Genetics and Evolution*, **45:** 26 - 32. doi: 10.1016/j.meegid.2016.08.008.

Arata, A. A. and B. Johnson (1978). *Approaches towards studies on potential reservoirs of viral Haemorrhagic Fever in southern Sudan (1977).* In Pattyn, S.R. : *Ebola Virus Haemorrhagic Fever.* Elsevier / North-Holland Biomedical Press - Amsterdam: 134 - 139. [Abstract]

Arbour, J. H., A. A. Curtis and S. E. Santana (2019). Signatures of echolocation and dietary ecology in the adaptive evolution of skull shape in bats. *Nature Communications*, **10:** 2036. doi: 10.1038/s41467-019-09951-y.

Archbold, R. (193x). Mammals of the French English American Madagascar Expedition May 13, 1929-May 2, 1931 (Fieldnotes). . URL: http://digitallibrary.amnh.org/handle/2246/6801. [Abstract]

Archer, A. L. (1977). Results of the Winifred T. Carter Expedition 1975 to Botswana, Mammals - Chiroptera. *Botswana Notes & Records*, **9:** 145 - 154. [Abstract]

Ar Gouilh, M., S. J. Puechmaille, L. Diancourt, M. Vandenbogaert, J. Serra-Cobo, M. L. Roïg, P. Brown, F. Moutou, V. Caro, A. Vabret, J. C. Manuguerra and on behalf of the EPICOREM consortium (2018). SARS-CoV related *Betacoronavirus* and diverse *Alphacoronavirus* members found in western old-world. *Virology*, **517:** 88 - 97. doi: 10.1016/j.virol.2018.01.014.

Arita, H. T. and J. Ortega (1998). *The middle American bat fauna. Conservation in the Neotropical-Nearctic border.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 295 - 308.

Arlettaz, R. and S. Aulagnier (1988). Statut de trois espèces de chiroptères rares au Maroc: *Nycteris thebaica*, *Hipposideros caffer* et *Pipistrellus rueppelli*. *Zeitschrift für Säugetierkunde*, **53:** 321 - 324. [Abstract]

Arlettaz, R., G. Dändliker, E. Kaybekov, J. M. Pillet, S. Rybin and J. Zima (1995). Feeding habits of the Long-eared Desert bat, *Otonycteris hemprichtii* (Chiroptera: Vespertilionidae). *Journal of Mammalogy*, **76 (3):** 873 - 876. [Abstract]

Arlettaz, R., S. Godat and H. Meyer (2000). Competition for food by expanding pipistrelle bat populations (*Pipistrellus pipistrellus*) might contribute to the decline of lesser horseshoe bats (*Rhinolophus hipposideros*). *Biodiversity and conservation*, **93 (1):** 55 - 60. doi: 10.1016/S0006-3207(99)00112-3.

Arlettaz, R., H. Goerlitz, G. Jones, P. Jones, S. Puechemaille, J. Rydell, D. Schmieder, B. Siemers and D. Russo (2013). The revolutionary foraging niche of the barbastelle bat. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 9. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Arlettaz, R., M. Ruedi, C. Ibañez, J. Palmeirin and J. Hausser (1997). A new perspective on the zoogeography of the sibling mouse-eared bat species *Myotis myotis* and *Myotis blythii*: morphological, genetical and ecological evidence. *Journal of Zoology*, **242 (1):** 45 - 62. [Abstract]

Armstrong, K. N. (2002). Morphometric divergence among populations of *Rhinonicteris aurantius* (Chiroptera: Hipposideridae) in northern Australia. *Australian Journal of Zoology*, **50:** 649 - 669.

Arnold, C. E., J. C. Guito, L. A. Altamura, S. P. Lovett, E. R. Nagle, G. F. Palacios, M. Sanchez-Lockhart and J. S. Towner (2018). Transcriptomics reveal antiviral gene induction in the Egyptian rousette bat is antagonized in vitro by Marburg virus infection. *Viruses*, **10 (11):** 607. doi: 10.3390/v10110607.

Aronson, J. and D. S. Jacobs (2010). The relationship between geographic range size and niche breadth in African horseshoe bats. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 90.

Aronson, J., E. (K.), MacEwan, K. Richardson, D. Jacobs, W. Marais, S. Aiken, P. Taylor, S. Sowler and C. Hein (2014). South African good practice guidelines for operational monitoring for bats at wind energy facilities. 1st edition. South African Bat Assessment Advisory Panel: 17 pp. URL: http://https://www.ewt.org.za/WEP/pdf/SAGPG%20for%20Operational%20Monitoring_1stEdition.pdf.

Aronson, J. B., A. J. Thomas and S. L. Jordaan (2013). Bat fatality at a wind energy facility in the Western Cape, South Africa. *African Bat Conservation News*, **31:** 9 - 12.

Arrizabalaga-Escudero, A., E. L. Clare, A. Alberdi, E. Salsamendi, J. R. Aihartza, I. Garin and U. Goiti (2014a). Resource partitioning in the sympatric sibling bat species *Rhinolophus euryale* and *Rhinolophus mehelyi*, based on molecular diet

analysis (Abstract). In Lina, P.H.C., A.M. Hutson, M. Kipson, V. Zrncic and D. Hamidovic : *Book of Abstracts.* XIIIth European Bat Research Symposium. 1 - 5 September 2014, Šibenik, Croatia: 29. URL: http://13ebrs2014.com/wp-content/uploads/2014/10/13EBRS_Croatia2014_Abstracts.pdf.

Arrizabalaga-Escudero, A., E. L. Clare, E. Salsamendi, A. Alberdi, I. Garin, J. Aihartza and U. Goiti (2018). Assessing niche partitioning of co-occurring sibling bat species by DNA metabarcoding. *Molecular Ecology*, **27 (5):** 1273 - 1283. doi: 10.1111/mec.14508.

Arrizabalaga-Escudero, A., J. Dandart, L. Torres, I. Garin, J. R. Aihartza and U. Goiti (2014b). Comparison of macromoth communities around two contrasting *Rhinolophus euryale* colonies. In Lina, P.H.C., A.M. Hutson, M. Kipson, V. Zrncic and D. Hamidovic : *Book of Abstracts.* XIIIth European Bat Research Symposium. 1 - 5 September 2014, Šibenik, Croatia: 30. URL: http://13ebrs2014.com/wp-content/uploads/2014/10/13EBRS_Croatia2014_Abstracts.pdf.

Arroyo-Cabrales, J., R. Gregorin, D. A. Schlitter and A. Walker (2002). The oldest African Molossid bat cranium (Chiroptera: Molossidae). *Journal of Vertebrate Paleontology*, **22 (2):** 380 - 387.

Arroyo Nombela, J. J., M. C. Rodriguez, Ibanes and U. C. (1986). Analisis citogenetico cariotipo bandeado de *Tadarida teniotis* Rafinesque 1814 (Molossidae - Chiroptera). .

Arslan, A. and J. Zima (2014). Karyotypes of the mammals of Turkey and neighbouring regions: a review. *Folia zoologica: International journal of vertebratology*, **63 (1):** 1 - 62.

Arthur, D. R. (1956). The *Ixodes* ticks of Chiroptera (Ixodoidea, Ixodidae). *Journal of parasitology*, **42:** 180 - 196.

Artyushin, I. V., A. A. Bannikova, V. S. Lebedev and S. V. Kruskop (2009). Mitochondrial DNA relationships among North Palaearctic *Eptesicus* (Vespertilionidae, Chiroptera) and past hybridization between Common Serotine and Northern Bat. *Zootaxa*, **2262:** 40 - 52.

Artyushin, I. V., S. V. Kruskop, V. S. Lebedev and A. A. Bannikova (2018). Molecular phylogeny of serotines (Mammalia, Chiroptera, *Eptesicus*): Evolutionary and taxonomical aspects of the E. serotinus species group. *Biology Bulletin*, **45 (5):** 469 - 477. doi: 10.1134/S1062359018050035.

Asan, N. and I. Albayrak (2007). Some taxonomic features of *Taphozous nudiventris* Cretzschmar, 1830 vel 1831 from Turkey (Chiroptera: Emballonuridae). *Turkish Journal of Zoology*, **31:** 165-170.

Asan Baydemir, N. (2015). Nucleolus organizer regions of *Myotis myotis* (Borkhausen, 1797) and *Miniopterus schreibersii* (Kuhl, 1817) (Mammalia: Chiroptera) from Turkey. *Turkish Journal of Zoology*, **39:** 349 - 352. doi: 10.3906/zoo-1402-55.

Aspetsberger, F., D. Brandsen and D. S. Jacobs (2003). Geographic variation in the morphology, echolocation and diet of the little free-tailed bat, *Chaerephon pumilus* (Mollosidae). *African Zoology*, **38 (2):** 245 - 254.

Atagana, P. J., E. M. Bakwo fils, D. W. Mbeng, J. A. Tsague Kenfack and S. Kekeunou (2018). The bat fauna of the Mpem and Djim National Park, Cameroon (Mammalia Chiroptera). *Biodiversity Journal*, **9 (3):** 241 - 254. doi: 10.31396/Biodiv.Jour.2018.9.3.241.254.

Atallah, S. I. (1977). Mammals of the eastern Mediterranean region: their ecology, systematics and zoogeographical relationships. *Säugetierkundlige Mitteilungen*, **4:** 241 - 320.

Auerbach, M. (1913). Kameruner Säugetiere des Grossh. Naturalienkabinetts zu Karlsruhe. I. Theil. *Verhandlungen der Naturwissenschaftlichen Verein Karlsruhe*, **25:** 3 - 29.

Augros, S. (2017). Update on the distribution of "Chiroptera sp1" in the southern and eastern parts of La Réunion Island based on acoustic surveys. *African Bat Conservation News*, **45:** 5 - 9.

Augros, S., B. Denis, P. Crozet, S. G. Roué and P.-Y. Fabulet (2016). La cohabitation entre l'homme et les microchiroptères à La Réunion : bilan actualisé, retours d'expérience et outils de conservation. *Le Vespère*, **5:** 371 - 384.

Aulagnier, S. (1989). *Les Chauves-souris (Chiroptera) dans le régime alimentaire des Rapaces nocturnes (Strigiformes) au Maroc.* In Hanák, V., I. Horácek and J. Gaisler Charles University Press - Praha: 457 - 463. [Abstract]

Aulagnier, S. (1990). Zoogeography of Moroccon bats. Abstract. Fifth European Bat Research Symposium: 20 - 25 august 1990 - Nyborg Strand, Denmark: no 38. [Abstract]

Aulagnier, S. (1991). Zoogeographical notes on Moroccan bat fauna. *Myotis*, **29:** 83 - 90. [Abstract]

Aulagnier, S. (2004a). *Rhinopoma macinnesi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Aulagnier, S. (2004b). *Rhinopoma microphyllum*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Aulagnier, S. (2004c). *Pipistrellus kuhlii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Aulagnier, S. (2008). *Rhinopoma macinnesi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Aulagnier, S. (2013a). *Genus Asellia Trident Leaf-nosed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 360.

Aulagnier, S. (2013b). *Asellia patrizii Patrizi's Trident Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 360 - 361.

Aulagnier, S. (2013c). *Asellia tridens Geoffroy's Trident Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 362 - 364.

Aulagnier, S. (2013d). *Family Rhinopomatidae Mouse-tailed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 409 - 410.

Aulagnier, S. (2013e). *Genus Rhinopoma Mouse-tailed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 410 - 411.

Aulagnier, S. (2013f). *Rhinopoma hardwickii Lesser Mouse-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 412 - 414.

Aulagnier, S. (2013g). *Rhinopoma macinnesi MacInnes's Mouse-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 414 - 415.

Aulagnier, S. (2013h). *Rhinopoma microphyllum Greater Mouse-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 415 - 417.

Aulagnier, S. (2013i). *Eptesicus serotinus Common Serotine.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 558 - 559.

Aulagnier, S. (2013j). *Genus Nyctalus Notules.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 589 - 590.

Aulagnier, S. (2013k). *Nyctalus leisleri Leisler's Noctule (Leisler's Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 592 - 593.

Aulagnier, S. (2013l). *Pipistrellus pipistrellus Common Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 643 - 645.
Aulagnier, S. (2013m). *Pipistrellus savii Savi's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 651 - 652.
Aulagnier, S. (2013n). *Genus Plecotus Long-eared Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 660 - 661.
Aulagnier, S. (2013o). *Myotis emarginatus Geoffroy's Myotis.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 697 - 699.
Aulagnier, S. (2013p). *Myotis mystacinus Whiskered Myotis (Whiskered Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 700 - 702.
Aulagnier, S. (2013q). *Myotis nattereri Natterer's Myotis (Natterer's Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 702 - 703.
Aulagnier, S. and P. Benda (2004a). *Pipistrellus pipistrellus.* In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Aulagnier, S. and P. Benda (2004b). *Plecotus christiei.* In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Aulagnier, S. and P. Benda (2008). *Plecotus christii.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S. and P. 2013 Benda (2013). *Pipistrellus hanaki Hanák's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 626 - 627.
Aulagnier, S. and E. Cosson (2013). *Myotis capaccinii Long-fingered Myotis.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 694 - 696.
Aulagnier, S. and C. Denys (2000). Présence du Taphien à ventre nu, *Taphozous nudiventris*, (Chiroptera, Emballonuridae) au Maroc. *Mammalia*, **64 (1):** 116 - 118.
Aulagnier, S. and R. Destre (1985). Introduction à l'étude des Chiroptères du Tafilalt (sud-est marocain). *Mammalia*, **49 (3):** 329 - 337. [Abstract]
Aulagnier, S., A. M. Hutson, F. Spitzenberger, J. Juste, A. Karatas, J. Palmeirim and M. Paunovic (2008a). *Rhinolophus ferrumequinum.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S. and J. Juste (2004). *Myotis punicus.* In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Aulagnier, S., J. Juste, A. Karatas, J. Palmeirim and M. Paunovic (2008b). *Pipistrellus kuhlii.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S., J. Juste, A. Karatas, J. Palmeirim and M Paunovic (2008c). *Myotis punicus.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S., A. Karatas and K. Tsytsulina (2008d). *Eptesicus bottae.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S. and J. Palmeirim (2008a). *Pipistrellus hanaki.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S. and P. Palmeirim (2008b). *Rhinopoma microphyllum.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S., M. Paunovic, A. Karatas, J. Palmeirim, A. M. Hutson, F. Spitzenberger, J. Juste and P. Benda (2008e). *Tadarida teniotis.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Aulagnier, S. and M. Thevenot (1986). *Catalogue des mammifères sauvages du Maroc.* Institut Scientifique Charia Ibn Batouta - PB. 703 Rabat-Agdal: 1 - 163.
Avenant, N. L. (1997). Mammals recorded in the QwaQwa National Park (1994 - 1995). *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **40 (1):** 31 - 40. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/261. [Abstract]
Avenant, N. L. (1999). Small mammals community characteristics as indicators of ecological disturbance in the Willem Pretorius Nature Reserve, Free State, South Africa. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 110.
Avenant, N. L. (2007). Barn owl pellets: a useful tool for monitoring small mammal communities?. *Belgian Journal of Zoology*, **135 (for 2005) (supplement):** 39 - 43.
Avenant, N. L., J. Balona, L. Cohen, D. Jacobs, K. (L.) MacEwan, A. Monadjem, L. R. Richards, (M.) C. Schoeman, T. Sethusa, Taylor and P. (J.) (2016a). *A conservation assessment of Laephotis wintoni.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Avenant, N. L., K. (L.) MacEwan, J. Balona, L. Cohen, D. Jacobs, A. Monadjem, L. (R.) Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016b). *A conservation assessment of Cistugo lesueuri.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Avenant, N. L. and J. P. Watson (2002). Mammals of Sandveld Nature Reserve, Free State Province, South Africa. *Navorsinge van die Nasionale Museum Bloemfontein*, **18 (1):** 1 - 9.
Averianov, A. O. and A. V. Lopatin (2014). High level systematics of placental mammals: Current status of the problem. *Biology Bulletin*, **41 (9):** 801 - 816. doi: 10.1134/S1062359014090039.
Avery, D. M. (1991). Late Quaternary incidence of some micromammalian species in Natal. *Durban Museum Novitates*, **16:** 1 - 11. [Abstract]
Avery, D. M. (1998). An assessment of the lower Pleistocene Micromammalian fauna from Swartkrans Members 1-3, Gauteng, South Africa. *Geobios*, **31 (3):** 393 - 414. [Abstract]
Avery, D. M. (2007). Pleistocene micromammals from Wonderwerk Cave, South Africa: practical issues. *Journal of Archaeological Science*, **34 (4):** 613 - 625. doi: 10.1016/j.jas.2006.07.001.
Avery, D. M. and G. Avery (2011). Micromammals in the Northern Cape Province of South Africa, past and present. *African Natural History*, **7:** 9 - 39.

Avery, D. M., G. Avery and B. D. Colahan (2003). Micromammals and barn owls in the Free State, South Africa: Prey distribution and predator behaviour. *Navorsinge van die Nasionale Museum Bloemfontein*, **19 (1):** 1 - 17.

Avery, D. M., G. Avery and N. G. Palmer (2005). Micromammalian distribution and abundance in the Western Cape Province, South Africa, as evidence by barn owls *Tyto alba* (Scopoli). *Journal of natural history*, **39 (22):** 2047 - 2071. doi: 10.1080/00222930500044631.

Avery, D. M., G. Avery and A. Roberts (2002). A contribution from barn owl pellets to known micromammalian distributions in KwaZulu-Natal, South Africa. *African Zoology*, **37 (2):** 131 - 140.

Avery, D. M., I. L. Rautenbach and R. M. Randall (1990). An annotated check list of the land mammal fauna of the West Coast National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **33 (1):** 1 - 18. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/448. [Abstract]

Ayala, S. C., J. Bradbury and S. Bradbury (1981). *Hepatocystis* in *Hypsignathus monstrosus* (Pteropinea) in Gaboon. I. *Hepatocystis* malaria in a hammerhead bat population in Gaboon, West Africa. *Annales de Parasitologie*, **56 (1):** 21 - 22. [Abstract]

Ayensu, E. S. (1974). Plant and bat interactions in West Africa. *Annals of the Missouri Botanical Garden*, **61:** 702 - 727. [Abstract]

Ayivor, J. S., F. Ohemeng, E. Tweneboah Lawson, L. Waldman, M. Leach and Y. Ntiamoa-Baidu (2017). Living with bats: The case of Ve Golokuati Township in the Volta Region of Ghana. *Journal of Environmental and Public Health*, **2017:** 5938934. doi: 10.1155/2017/5938934.

Ayoade, O. J., S. O. Oke and E. O. Omisore (2012). The impact of bats on the greens (landscape features): a case study of Obafemi Awolowo University Campus, Ile-Ife, Nigeria. *Agricultural Science Research Journals*, **2 (7):** 405 - 411.

Azzaroli Puccetti, M. L. and B. Zava (1988). Nouvelles données sur les chiroptères des îles du Cap-Vert. *Bollettino del Museo Regionale di Scienze Naturali*, **6 (2):** 603 - 615. [Abstract]

Baagøe, H. J. (2001). Danish bats (Mammalia: Chiroptera): Atlas and analysis of distribution, occurrence and abundance. *Steenstrupia*, **26 (for 2000) (1):** 1 - 117.

Babayan, S. A., R. J. Orton and D. G. Streicker (2018). Predicting reservoir hosts and arthropod vectors from evolutionary signatures in RNA virus genomes. *Science*, **362 (6414):** 577 - 580. doi: 10.1126/science.aap9072.

Babiker, H. and D. S. Jacobs (2010). The influence of abiotic factors on the distribution of bats in South Africa. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 93 - 94.

Babiker Salata, H. A. (2012). Environmental factors influencing the distribution of bats (Chiroptera) in South Africa. University of Cape Town: i - xix; 1 - 303. URL: https://open.uct.ac.za/handle/11427/6887.

Bachirou, H., C. Mapoung and M. Zourmba (2011). Quelques aspects du métabolisme hydrique de la Chauve-souris frugivore *Epomophorus gambianus* (Ordre des Chiroptères, Famille des Ptéropodidés) de la ville de Maroua : Extrême-Nord Cameroun. Mémoire présenté en vue de l'obtention du Diplôme de Professeur d'Enseignement Secondaire de deuxième grade (DIPES II) - Ecole Normale Supérieure - Université de Maroua: i - vi; 1 - 47.

Bader, E., M. Acácio and A. Monadjem (2015). The importance of water bodies for insectivorous bats in a Malagasy dry deciduous forest: A case example from Kirindy (CNFEREF). *Malagasy Nature*, **9:** 88 - 96.

Badrane, H. and N. Tordo (2001). Host switching in *Lyssavirus* history from the Chiroptera to the Carnivora orders. *Journal of Virology*, **75 (17):** 8096 - 8104. doi: 10.1128/jvi.75.17.8096-8104.2001.

Badwaik, N. K. and J. J. IV Rasweiler (2000). *6. Pregnancy.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 221 - 293.

Baer, J. G. (1972). Liste critique des parasites (Monogènes, Cestodes et Trématodes) et de leurs hôtes en République de Côte d'Ivoire. *Acta Tropica*, **29:** 341 - 361.

Baeten, B., V. Van Cakenberghe and F. De Vree (1984). An annotated inventory of a collection of bats from Rwanda (Chiroptera). *Revue de zoologie africaine*, **98 (1):** 183 - 196. [Abstract]

Bahlman, J. W., R. M. Price-Waldman, H. W. Lippe, K. S. Breuer and S. M. Swartz (2016). Simplifying a wing: diversity and functional consequences of digital joint reduction in bat wings. *Journal of Anatomy*, **229 (1):** 114 - 127. doi: 10.1111/joa.12457.

Bai, Y., D. T. S. Hayman, C. D. McKee and M. Y. Kosoy (2015). Classification of *Bartonella* strains associated with straw-colored fruit bats (*Eidolon helvum*) across Africa using a multilocus sequence typing platform. *PLoS Neglected Tropical Diseases*, **9 (1):** e0003478. doi: 10.1371/journal.pntd.0003478.

Bai, Y. and M. Kosoy (2012). *Chapter 4. Bartonella infections in rodents and bats in tropics.* In Rodriguez-Morales, A.J. [Ed]: *Current Topics in Tropical Medicine* Intech - Croatia: 51 - 66.

Bai, Y., M. O. V. Osinubi, L. Osikowicz, C. McKee, N. M. Vora, M. R. Rizzo, S. Recuenco, L. Davis, M. Niezgoda, A. M. Ehimiyein, G. S. N. Kia, A. Oyemakinde, O. S. Adeniyi, Y. H. Gbadegesin, O. A. Saliman, A. Ogunniyi, A. B. Ogunkoya, M. Y. Kosoy and Idanre Bat Festival Investigation Team (2018). Human exposure to novel *Bartonella* species from contact with fruit bats. *Emerging Infectious Diseases*, **24 (12):** 2317 - 2323. doi: 10.3201/eid2412.181204.

Bailey, L. A., R. M. Brigham, S. J. Bohn, J. G. Boyles and B. Smit (2019). An experimental test of the allotonic frequency hypothesis to isolate the effects of light pollution on bat prey selection. *Oecologia*, **190 (2):** 367 - 374. doi: 10.1007/s00442-019-04417-w.

Baillie, J. and B. Groombridge (1996). 1996 IUCN Redlist of Threatened Animals. IUCN - Gland, Switzerland: intro 1 - 70; 1 - 368; annex 1 - 10.

Baillon, L. A. F. (1833). Catalogue des Mammifères, Oiseaux, Reptiles, Poissons et Mollusques testacés marins, observés dans l'arrondissement d'Abbeville. *Mémoires de la Société royale d'emulation d'Abbeville*49 - 52.

Baize, S., D. Pannetier, L. Oestereich, T. Rieger, L. Koivogui, N. Magassouba, B. Soropogui, M. S. Sow, S. Keïta, H. De Clerck, A. Tiffany, G. Dominguez, M. Loua, A. Traoré, M. Kolié, E. R. Malano, E. Heleze, A. Bocquin, S. Mély, H. Raoul, V. Caro, D. Cadar, M. Gabriel, M. Pahlmann, D. Tappe, J. Schmidt-Chanasit, B. Impouma, A. K. Diallo, P. Formenty, M. Van Herp and S. Günther (2014). Emergence of Zaire Ebola Virus Disease in Guinea. *The New England Journal of Medicine*, **371:** 1418 - 1425. doi: 10.1056/NEJMoa1404505.

Bakarr, M., J. F. Oates, J. Fahr, M. Parren, M.-O. Rödel and R. Demey (2004). *Guinean forests of West Africa.* In Mittermeier, R.A., P.R. Gil, M. Hoffmann, J. Pilgrim, T. Brooks, C.G. Mittermeier, J. Lamoreux and G.A.B. da Fonesca : *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions.* Conservation International & CEMEX - Washington, D.C. 392 pp. (pp: 123 - 130).

Baker, H. G. and B. J. Harris (1957). The pollination of *Parkia* by bats and its attendant evolutionary problems. *Evolution*, **11 (4):** 449 - 460.

Baker, H. G. and B. J. Harris (1959). Bat pollination of the silk-cotton tree, *Ceiba pentandra* Gaertn. (sensu lato), Ghana. *Journal of the West African Science Association*, **5:** 1 - 9.

Baker, K. S., M. Caccamo, G. Daly, N. B. Field, P. Kellam, R. Suu-Ire, D. T. S. Hayman, J. Heeney, A. A. Cunningham, J. L. N. Wood and P. Murcia (2010). Volant Viruses: a metaviromic study of a West African bat population. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 95 - 96.

Baker, K. (S.), P. Kellam, R. Suu-Ire, A. Cunningham, J. Wood, M. Caccamo and P. Murcia (2011a). Next generation surveillance? A metaviromic study of a West African bat population using next generation sequencing. In Anonymus : *1st International One Health Congress. EcoHealth*, **7 (Suppl. 1):** S41 - S42. doi: 10.1007/s10393-010-0376-0. URL: http://www.springerlink.com/content/0976673444566520/fulltext.pdf.

Baker, K. S., R. M. Leggett, N. H. Bexfield, M. Alston, G. Daly, S. Todd, M. Tachedjian, C. E. G. Holmes, S. Crameri, L.-F. Wang, J. L. Heeney, R. Suu-Ire, P. Kellam, A. A. Cunningham, J. L. N. Wood, M. Caccamo and P. R. Murcia (2013a). Metagenomic study of the viruses of African straw-coloured fruit bats: Detection of a chiropteran poxvirus and isolation of a novel adenovirus. *Virology*, **441 (2):** 95 - 106. doi: 10.1016/j.virol.2013.03.014.

Baker, K. S. and P. R. Murcia (2014). Poxviruses in Bats … so What? *Viruses*, **6 (3):** 1564 - 1577. doi: 10.3390/v6041564.

Baker, K. S., R. Suu-Ire, J. Barr, D. T. S. Hayman, C. C. Broder, D. L. Horton, C. Durrant, P. R. Murcia, A. A. Cunningham and J. L. N. Wood (2013b). Viral antibody dynamics in a chiropteran host. *Journal of Animal Ecology*, **83 (2):** 415 - 428 (for 2014). doi: 10.1111/1365-2656.12153.

Baker, K. S., S. Todd, G. Marsh, A. Fernandez-Loras, R. Suu-Ire, J. L. N. Wood, L. F. Wang, P. R. Murcia and A. A. Cunningham (2011b). Co-circulation of diverse paramyxoviruses in an urban African fruit bat population. *Journal of general virology*, **93 (4):** 850 - 856 (for 2012). doi: 10.1099/vir.0.039339-0.

Baker, K. S., S. Todd, G. A. Marsh, G. Crameri, J. (A.) Barr, A. O. Kamins, A. J. Peel, M. Yu, D. T. S. Hayman, B. Nadjm, G. Mtove, B. Amos, H. Reyburn, E. Nyarko, R. Suu-Ire, P. R. Murcia, A. A. Cunningham, J. L. N. Wood and L.-F. Wang (2012). Novel, potentially zoonotic paramyxoviruses from the African Straw-Colored Fruit Bat *Eidolon helvum*. *Journal of Virology*, **87 (3):** 1348 - 1358 (for 2013). doi: 10.1128/JVI.01202-12.

Baker, R. J. (1970). *Karyotypic trends in bats.* In Wimsatt, W. A. : *Biology of bats.* Academic Press - New York & London: 65 - 96.

Baker, R. J. and J. W. Bickham (1980). Karyotypic evolution in bats: evidence of extensive and conservative chromosomal evolution in closely related taxa. *Systematic zoology*, **29 (3):** 239 - 253. [Abstract]

Baker, R. J., B. L. Davis, R. G. Jordan and A. Binous (1974). Karyotypic and morphometric studies of Tunisian mammals: Bats. *Mammalia*, **38 (4):** 695 - 710. [Abstract]

Baker, R. J., R. L. Honeycutt and R. A. Van den Bussche (1991a). Examination of monophyly of bats: restriction map of the ribosomal DNA cistron. In Griffiths, T. A. and D. Klingerer : *Contributions to Mammalogy in honor of Karl F. Koopman. Bulletin of the American Museum of Natural History*, **206:** 42 - 53. [Abstract]

Baker, R. J., C. S. Hood and R. L. Honeycutt (1989). Phylogenetic relationships and classification of the higher categories of the new world bat family Phyllostomidae. *Systematic zoology*, **38 (3):** 228 - 238. [Abstract]

Baker, R. J., M. Maltbie, J. G. Owen, M. J. Hamilton and R. D. Bradley (1992). Reduced number of ribosomal sites in bats: evidence for a mechanism to contain genome size. *Journal of Mammalogy*, **73(4):** 847-858. [Abstract]

Baker, R. J., M. J. Novacek and N. B. Simmons (1991b). On the Monophyly of Bats. *Systematic zoology*, **40 (2):** 216 - 231.

Baker, R. J. and J. L. Patton (1967). Karyotypes and karyotypic variation of North American Vespertilionid Bats. *Journal of Mammalogy*, **48 (2):** 270 - 286. [Abstract]

Bakloushinskaya, I., G. A. Bazykin, A. P. Kryukov and E. P. Kryukova (2012). Sergey Ivanovitch Ognev and the formation of theriology in Russia. *Mammalia*, **76 (4):** 375 - 382. doi: 10.1515/mammalia-2012-0013.

Bakwo, E. Jr. (2009). Inventaire des chauves souris de la réserve de biosphère du Dja, Cameroun. *Le Vespère*, **2:** 11 - 20.

Bakwo Fils, E. M. (2010). The bats of Cameroon: Proving the benefits of forgotten fruit bats. *Bats*, **28 (2):** 11 - 13.

Bakwo Fils, E. M. (2012). Save bats of Cameroon. Poster - The Rufford Small Grants Foundation - Bat Conservation International - Global Grassroots Conservation Fund.

Bakwo Fils, E. M. (2014). Voucher specimen details for Bakwo Fils et al. (2014). *African Bat Conservation News*, **35:** 4.

Bakwo Fils, E. M., A. Bol A Anong and F.-N. Tchuenguem Fohouo (2012). First record of the Giant House Bat *Scotophilus nigrita* (Schreber, 1774) in Cameroon (Mammalia, Chiroptera). *Biodiversity Journal*Bakwo Fils, E.M.; Bol A Anong, A.; Tchuenguem Fohouo, F.-N.

Bakwo Fils, E. M., A. Bol A Anong, D. B. Tsala, B. B. Guieké, D. E. Tsala and A. K. Fotso (2014). Diversity of bats of the Far North Region of Cameroon - with two first records for the country. *Biodiversity*, **15 (1):** 16 - 22. doi: 10.1080/14888386.2014.889578.

Bakwo Fils, E. M., A. M. Mongombe, D. E. Tsala and J. L. Tamesse (2018). Acoustic identification of five insectivorous bats by their echolocation calls in the Sahelian zone of Far North Cameroon. *The Journal of Basic and Applied Zoology*, **79:** 28. doi: 10.1186/s41936-018-0041-7.

Balazuc, J. (1971). Notes sur les Laboulbeniales. III. Rectifications, synonymies et mises au point (suite). *Bulletin mensuel de la Société linnéenne de Lyon*, **40 (7):** 211 - 216. URL: http://www.persee.fr/doc/linly_0366-1326_1971_num_40_7_9935.

Balboni, A., M. Battilani and S. Prosperi (2012). The SARS-like coronaviruses: the role of bats and evolutionary relationships with SARS coronavirus. *New Microbiologica*, **35 (1):** 1 - 16.

Balboni, A., A. Palladini, G. Bogliani and M. Battilani (2010). Detection of a virus related to betacoronaviruses in Italian greater horseshoe bats. *Epidemiology and Infection*, **139 (1):** 216 - 219 (for 2011). doi: 10.1017/S0950268810001147.

Baldwin, H., V. Corman, S. Klose, E. Nkrumah, E. Badu, P. Anti, A. Annan, M. Owusu, O. Agbenyega, S. Oppong, Y. Adu-Sarkodie, P. Vallo, E. Kalko, J. Drexler, C. Drosten and M. Tschapka (2013). Ecological correlates of coronavirus dynamics in West African bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 14. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Balkema-Buschmann, A., M. Rissmann, N. Kley, R. Ulrich, M. Eiden and M. H. Groschup (2018). Productive propagation of Rift Valley fever phlebovirus Vaccine Strain MP-12 in Rousettus aegyptiacus fruit bats. *Viruses*, **10 (12):** 681. doi: 10.3390/v10120681.

Ball, N. (2004). A possible high-altitude roost of Seychells sheath-tailed bats *Coleura seychellensis*. *Phelsuma*, **12:** 136 - 140.

Balmori, A. (2003). Avances en el conocimiento de la biologia y organizacion social del murcielago rabudo (*Tadarida teniotis*). *Galemys*, **15 (special issue):** 37 - 53.

Balmori, A. (2012). *Murciélago rabudo - Tadarida teniotis (version 2 February 2012).* In Salvador, A. and J. Cassinello : *Enciclopedia Virtual de los Vertebrados Españoles* 1 - 14. URL: http://www.vertebradosibericos.org/.

Balmori, A. (2017). Advances on the group composition, mating system, roosting and flight behaviour of the European free-tailed bat (*Tadarida teniotis*). *Mammalia*, **82 (5):** 460 - 468. doi: 10.1515/mammalia-2017-0083.
Balona, J. (2016). New distribution records of the Short-eared Trident Bat, *Cloeotis percivali* Thomas, 1901 (Chiroptera: Rhinonycteridae) in South Africa. *African Bat Conservation News*, **41:** 3 - 9.
Balona, J., L. Cohen, W. White, D. Jacobs, K. (L.) MacEwan, A. Monadjem, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016). *A conservation assessment of Cloeotis percivali.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Balvín, O., P. Munclinger, L. Kratochvíl and J. Vilímová (2012). Mitochondrial DNA and morphology show independent evolutionary histories of bedbug *Cimex lectularius* (Heteroptera: Cimicidae) on bats and humans. *Parasitological Research*, **111 (1):** 457 - 469. doi: 10.1007/s00436-012-2862-5.
Bambini, L., A. Blyth, T. Bradford, R. Bristol, S. Burthe, L. Craig, N. Downs, S. Laing, L. Marshall-Ball, D. McGowan, T. Vel and P. Racey (2006). Another Seychelles endemic close to extinction: The emballonurid bat *Coleura seychellensis*. *Oryx*, **40 (3):** 310 - 318. doi: 10.1017/S0030605306000809.
Bambini, L., A. Blyth, T. Bradford, S. Burthe, L. Craig, N. Downs, S. (ed), Marshal-Ball, L. Laing and D. McGowan (2005). 'Bats on the brink': Conserving the Critically Endangered Seychelles Sheath-tailed bat (*Coleura seychellensis*). Final Report. BP Conservation Programme: 81 pp.
Bambini, L., A. F. Kofoky, T. Mbohoahy, M. Ralisata, T. Manjoazy, D. J. Hosken and R. K. B. Jenkins (2011). Do bats need trees? Habitat use of two Malagasy hipposiderid bats *Triaenops furculus* and *T. menamena* in the dry southwest. *Hystrix, Italian Journal of Mammalogy*, **(n.s.) 22 (1):** 81 - 92. doi: 10.4404/Hystrix-22.1-4467.
Banaszek, A., A. M. Ratkiewicz, S. Fedyk, K. A. Szalaj and W. Chetnicki (1996). The chromosomes and isoenzymes in marginal populations of the Common shrew (*Sorex araneus*) in the Vistula delta. *Zeitschrift für Säugetierkunde*, **61:** 65 - 72.
Banerjee, A., K. Kulcsar, V. Misra, M. Frieman and K. Mossman (2019). Bats and Coronaviruses. *Viruses*, **11 (1):** 41. doi: 10.3390/v11010041.
Banerjee, A., N. Rapin, T. Bollinger and V. Misra (2017). Lack of inflammatory gene expression in bats: a unique role for a transcription repressor. *Scientific Reports*, **7:** 2232. doi: 10.1038/s41598-017-01513-w.
Bannerman, D. A. (1922). *The Canary Islands. Their history, natural history and scenery. An account of an ornithologists camping trips in the archipelago.* Gurney & Jackson - London: 365 pp.
Bannikova, A. A., V. A. Matveev and D. A. Kramerov (2002). Using inter-SINE-PCR to study mammalian phylogeny. *Russian Journal of Genetics*, **38 (6):** 714 - 724.
Banyard, A. C., J. S. Evans, T. R. Luo and A. R. Fooks (2014). Lyssaviruses and bats: emergence and zoonotic threat. *Viruses*, **6 (8):** 2974 - 2990. doi: 10.3390/v6082974.
Banyard, A. C. and A. R. Fooks (2017). The impact of novel lyssavirus discovery. *Microbiology Australia*, **38 (1):** 17 - 21. doi: 10.1071/MA17006.
Barak, Y. and Y. Yom Tov (1989). The advantage of group hunting in Kuhl's bat *Pipistrellus kuhlii* (Microchiroptera). *Journal of Zoology*, **219:** 670 - 675. [Abstract]
Barak, Y. and Y. Yom-Tov (1991). The mating system of *Pipistrellus kuhli* (Microchiroptera) in Israel. *Mammalia*, **55 (2):** 285 - 292. doi: mamm.1991.55.2.285. [Abstract]
Baranga, J. and B. Kiregyera (1982). Estimation of the fruit bat population in the Kampala Bat Valley, Uganda. *African Journal of Ecology*, **20 (4):** 223 - 229. [Abstract]
Barataud, M. (2002). *Acoustic method for European bat identification (+ CD).* - Sittelle, Mens. - 14pp.
Barataud, M. (2005). Acoustic variability and identification possibilities in 7 species of the genus *Myotis*. *Le Rhinolophe*, **17:** 43 - 62.
Barataud, M. (2011). Adaptation du sonar de la Barbastelle *Barbastella barbastellus* à la capture de papillons tympanés: un cas de mimétisme acoustique trompeur? *Le Vespère*, **2:** 95 - 105.
Barataud, M., G. Beuneux, J.-F. Desmet, P. Favre, S. Giosa and S. Roué (2014). Découverte de signaux sonar d'un chiroptère inconnu sur l'île de La Réunion. *Le Vespère*, **3:** 231 - 240.
Barataud, M. and S. Giosa (2013). Identification et écologie acoustique des chiroptères de La Réunion. *Le Rhinolophe*, **19:** 147 - 175.
Barbosa, A. D., J. T. Mackie, R. Stenner, A. Gillett, P. Irwin and U. Ryan (2016). *Trypanosoma teixeirae*: A new species belonging to the *T. cruzi* clade causing trypanosomosis in an Australian little red flying fox (*Pteropus scapulatus*). *Veterinary Parasitology*, **223:** 214 - 221. doi: 10.1016/j.vetpar.2016.05.002.
Barclay, R. M. R. (1985a). Long- versus short-range foraging strategies of hoary (*Lasiurus cinereus*) and silver-haired (*Lasionycteris noctivagans*) bats and the consequences for prey selection. *Canadian journal of zoology*, **63:** abstract.
Barclay, R. M. R. (1985b). Foraging behavior of the African insectivorous bat, *Scotophilus leucogaster*. *Biotropica*, **17 (1):** 65 - 69.
Barclay, R. M. R., L. E. Barclay and D. S. Jacobs (2006). Deliberate insectivory by the fruit bat *Rousettus aegyptiacus*. *Acta Chiropterologica*, **8 (2):** 549 - 553.
Barclay, R. (M. R.) and D. S. Jacobs (2005). Foraging behaviour of Egyptian fruit bats in Cape Town (Abstract). *African Bat Conservation News*, **6:** 8.
Barclay, R. M. R. and D. S. Jacobs (2011). Differences in the foraging behaviour of male and female Egyptian fruit bats (*Rousettus aegyptiacus*). *Canadian journal of zoology*, **89 (6):** 466 - 473. doi: 10.1139/Z11-013.
Barclay, R. M. R., D. S. Jacobs, C. T. Harding, A. E. McKechnie, S. D. McCulloch, W. Markotter, J. Paweska and R. M. Brigham (2017). Thermoregulation by captive and free-ranging Egyptian rousette bats (*Rousettus aegyptiacus*) in South Africa. *Journal of Mammalogy*, **98 (2):** 572 - 578. doi: 10.1093/jmammal/gyw234.
Barghoorn, S. F. (1977). New material of *Vespertiliavus* Schlosser (Mammalia, Chiroptera) and suggested relationships of Emballonurid bats based on cranial morphology. *American Museum Novitates*, **2618:** 1 - 29, 12 figs., 3 tables.
Barkley, L. J. (1984). Evolutionary relationships and natural history of *Tomopeas ravus* (Mammalia: Chiroptera). M.S. Thesis, Louisiana State University, Baton Rouge, 100 pp.
Barlow, K. E. and G. Jones (1997a). Function of pipistrelle social calls: field data and a playback experiment. *Animal Behaviour*, **53:** 991 - 999. [Abstract]
Barlow, K. E. and G. Jones (1997b). Differences in songflight calls and social calls between two phonic types of the vespertilionid bat *Pipistrellus pipistrellus*. *Journal of Zoology*, **241 (2):** 315 - 324. [Abstract]

Barlow, K. E., G. Jones and E. M. Barratt (1997). Can skull morphology be used to predict ecological relationships between bat species? A test using two cryptic species of pipistrelle. *Proceedings of the Royal Society of London*, **ser. B, 264:** 1695 - 1700. [Abstract]
Barnett, A. A. and M. L. Prangley (1997). Mammalogy in the Republic of Guinea: an overview of research from 1946 to 1996, a preliminary check-list and a summary of research recommendations for the future. *Mammal Review*, **27 (3):** 115 - 164. doi: 10.1111/j.1365-2907.1997.tb00376.x. [Abstract]
Baron, B. (2012). *Piecing the punicus puzzle.* In Fusté, M.C. : *Studies in population genetics.* Intech publishing: 1 - 16. doi: 10.5772/34437.
Baron, B. and J. J. Borg (2013). Niche expansion in the *Myotis punicus* (Mammalia Chiroptera) of the Maltese islands. *Il Naturalista siciliano*, **(4) 35 (3-4):** 407 - 417.
Baron, F. (1999). Le parc nationale d'Odzala, Congo (?). ECOFAC - Libreville, Gabon: 56 pp.
Barraclough, D. A. (1998). *Katacamilla* Papp, 1978, a genus of Camillidae (Diptera: Schizophora) associated with the dung of bats, birds and hyraxes in Africa and the Arabian Peninsula. *African Entomology*, **6 (2):** 159 - 176. [Abstract]
Barragán, M. J. L., S. Martínez, J. A. Marchal, M. Bullejos, R. Díaz de la Guardia and A. Sánchez (2002). Repeated DNA sequences in the microbat species *Miniopterus schreibersi* (Vespertilionidae; Chiroptera). *Hereditas*, **137 (1):** 65 - 71.
Barratt, E. M., M. W. Bruford, T. M. Burland, G. Jones, P. A. Racey and R. K. Wayne (1995). Characterization of mitochondrial DNA variability within the microchiropteran genus *Pipistrellus*: approaches and applications. *Symposia of the zoological Society of London*, **67:** 377 - 386. [Abstract]
Barratt, E. M., R. Deaville, T. M. Burland, M. W. Bruford, G. Jones, P. A. Racy and Wayne R. K. (1997). DNA answers the call of pipistrelle bat species. *Nature*, **387:** 138 - 139.
Barrett, J. (2011). *Chapter 5. Significant zoonotic diseases identified in bats. Lyssaviruses.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 80 - 101. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.
Barrette, R. W., L. Xu, J. M. Rowland and M. T. McIntosh (2011). Current perspectives on the phylogeny of Filoviridae. *Infection, Genetics and Evolution*, **11 (7):** 1514 - 1519. doi: 10.1016/j.meegid.2011.06.017.
Barrett-Hamilton, G. E. H. (1906). XIII. Descriptions of two new species of *Pterygistes*. *Annals and Magazine of Natural History*, **ser. 7, 17 (97):** 98 - 100.
Barrett-Hamilton, G. E. H. (1907). LXXV. Descriptions of two new species of *Plecotus*. *Annals and Magazine of Natural History*, **ser. 7, 20 (120):** 520 - 521.
Barrett-Hamilton, G. E. H. (1910). XLII. Description of a new species and a new subspecies of European bat. *Annals and Magazine of Natural History*, **ser. 8, 5 (27):** 291 - 294.
Barrière, P., J. C. Beaucournu, K. Ménier and M. Colyn (2002). Une nouvelle puce du genre *Allopsylla* Beacournu et Fain, 1982 (Siphonaptera: Ischnopsyllidae) en République Centrafricaine, sur un chiroptère Molossidae méconnu. *Parasite*, **9:** 233 - 237.
Barrière, P., P. Formenty, R. Hutterer, O. Perpète and M. Colyn (1999). Veille écologique-épidémiologique saisonnière du peuplement Soricidae en Forêt de Taï: à la recherche du réservoir du virus Ebola. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 57.
Barriere, P., V. Nicolas and L. K. Oduro (2008). *Rapid survey of the small mammals of Ajenjua Bepo and Mamang River Forest Reserves, Ghana.* In McCullough, J., P. Hoke, P. Naskrecki and Y. Osei-Owusu : *A Rapid Biological Assessment of the Ajenjua Bepo and Mamang River Forest Reserves, Ghana.* Conservation International - Arlington, Virginia: 54-57, 89-93.
Bartlett, E. (1875). 3. List of the mammals and birds collected by Mr. Waters in Madagascar. *Proceedings of the Zoological Society of London*, **1875,I :** 62 - 69.
Bartlett, E. (1880). 2. Second list of mammals and birds collected by Mr. Thomas Waters in Madagascar. *Proceedings of the Zoological Society of London*, **1879,IV:** 767 - 773.
Bartonicka, T., R. Lucan, P. Benda, P. Jedlicka, Š. Rerucha, R. Bilgin, M. Abi-Said, M. Porteš, A. Reiter, W. Shohdi, M. Šálek, M. Uhrin and I. Horácek (2013). Reproductive biology and seasonal dynamics of spatial activity of *Rousettus aegyptiacus* in the eastern Mediterranean. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 17. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Barus, V. (1973). The finding of nematods and Acanthocephalans in Egyptian bats. *Folia parasitologica*, **20:** 213 - 222. [Abstract]
Basilio, A. (1962). *La vida animal en la Guinea Española. Descripcion y vida de los animales en la selva tropical africana. Segunda edicion.* Madrid.
Bastian, A. and D. (S.) Jacobs (2013). Evidence for ecologically mediated perception of species specific signatures in echolocation calls of the same peak frequency. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 18. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Bastian, A. and D. S. Jacobs (2015). Listening carefully: increased perceptual acuity for species discrimination in multispecies signalling assemblages. *Animal Behaviour*, **101:** 141-154. doi: 10.1016/j.anbehav.2014.12.010.
Basuony, M. I. (2000). *Ecological survey of Burullus Nature Protectorate. Mammals.* Nature Conservation Sector - Egyptian Environmental Affairs Agency: 32 pp.
Bateman, J. A. (1961). The mammals occurring in the Bredasdorp and Swellendam Districs, C.P., since European Settlement. Including a list comparing the types in these districs with those of the Cradock and Uitenhage Districs, C.P. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **4:** 78 - 100.
Bates, G. L. (1905). 3. Notes on the mammals of southern Cameroons and the Benito. *Proceedings of the Zoological Society of London*, **1905, I (1):** 65 - 85.
Bates, P. (J. J.), P. Benda, S. Aulagnier, P. Benda, W. Bergmans, J. Fahr, A. M. Hutson, Z. (S.) Amr and D. Kock (2008). *Taphozous nudiventris.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Bates, P. J. J., K. Cameron, M. J. Pearch and B. Hayes (2013). A review of the bats (Chiroptera) of the Republic of Congo, including eight species new to the country. *Acta Chiropterologica*, **15 (2):** 313 - 340. doi: 10.3161/150811013X678955.
Bates, P. J. J. and D. L. Harrison (1997). *Bats of the Indian subcontinent.* Harrison Zoological Museum Publication - Sevenoaks: i - xvi; 1 - 258.
Bates, P. J. J., D. L. Harrison and M. Muni (1994). The bats of Western India revisited. Part 2. *Journal of the Bombay Natural History Society*, **91 (2):** 224 - 240.

Bates, P. J. J., F. H. Ratrimomanarivo, D. L. Harrison and S. M. Goodman (2006). A description of a new species of *Pipistrellus* (Chiroptera: Vespertilionidae) from Madagascar with a review of related Vespertilioninae from the island. *Acta Chiropterologica*, **8 (2):** 299 - 324.

Bates, P. J. J., Tin Nwe, M. J. Pearch, Khin Maung Swe, Si Si Hla Bu and Thanda Tun (2000). A review of bat research in Myanmar (Burma) and results of a recent survey. *Acta Chiropterologica*, **2 (1):** 53 - 82.

Bates, P. J. J., Tin Nwe, Si Si Hla Bu, Khin Mie Mie, Khin Maung Swe, Nyo Nyo, Aye Aye Khaing, Nu Nu Aye, Yin Yin Toke, Naing Naing Aung, Mar Mar Thi and I. Mackie (2005). A review of the genera *Myotis, Ia, Pipistrellus, Hypsugo*, and *Arielulus* (Chiroptera: Vespertilionidae) from Myanmar (Burma), including three species new to the country. *Acta Chiropterologica*, **7 (2):** 205 - 236.

Battersby, J. (2005). *UK Mammals: Species status and population trends.* First Report by the Tracking Mammals Partnership. JNCC / The Tracking Mammals Partnership: 1 - 166; pl. I - XXXII. URL: http://www.jncc.gov.uk/page-3311#download.

Baud, F. J. (1977). Catalogue des types de mammifères et d'oiseaux du Muséum d'histoire naturelle de Genève. *Revue suisse de zoologie*, **84 (1):** 201 - 220.

Baud, F. J. (1998). Louis de Roguin (1948 - 1998). *Revue suisse de zoologie*, **105 (4):** 767 - 770.

Baudel, H., H. De Nys, E. Mpoudi Ngole, M. Peeters and A. Desclaux (2019). Understanding Ebola virus and other zoonotic transmission risks through human-bat contacts: Exploratory study on knowledge, attitudes and practices in Southern Cameroon. *Zoonoses and Public Health*, **66 (3):** 288 - 295. doi: 10.1111/zph.12563.

Bauer, K. (1992). *Laephotis botswanae - a bat new for Tanzania.* In Horácek, I. and V. Vohralik : *Prague studies in Mammalogy.* Charles University Press - Praha: 13 - 15. [Abstract]

Bauer, K. and J. Niethammer (1960). Über eine kleine Säugetierausbeute aus Südwest-Afrika. *Bonner zoologische Beitrage*, **10 (3 - 4):** 236 - 260 (for 1959). URL: http://zfmk.de/BZB/1959/1959%20Bauer%20K.%20u.%20Niethammer%20J.%20p236-260.pdf.

Baum, D. A. (1995). The comparative pollination and floral biology of baobabs (*Adansonia* - Bombacaceae). *Annals of the Missouri Botanical Garden*, **82:** 323 - 348. [Abstract]

Baumgarten, J. E. and E. M. Vieira (1994). Reproduction seasonality and development of *Anoura geoffroyi* (Chiroptera: Phyllostomidae) in central Brazil. *Mammalia*, **58 (3):** 415 - 422.

Bausch, D. G. and L. Schwarz (2014). Outbreak of Ebola virus disease in Guinea: where ecology meets economy. *PLoS Neglected Tropical Diseases*, **8 (7):** e3056. doi: 10.1371/journal.pntd.0003056.

Bayefsky-Anand, S. (2005). Effect of location and season on the arthropod prey of *Nycteris grandis* (Chiroptera: Nycteridae). *African Zoology*, **40 (1):** 93 - 97.

Bayliss, J. and B. Hayes (1999). *The status and distribution of bats, primates, and butterflies from the Makira Plateau, Madagascar.* Fauna and Flora International - London, UK.

Bayliss, J., J. Branch, W. Timberlake, C. Bruessow, S. Collins, C. Congdon, M. Curran, C. de Sousa, R. Dowsett, F. Dowsett-Lemaire, L. Fishpool, T. Harris, E. Herrmann, S. Georgiadis, Mirjam Kopp, B. Liggitt, A. Monadjem, H. Patel, D. Ribeiro, C. Spottiswoode, P. Taylor, S. Willcock and P. Smith (2014). The discovery, biodiversity and conservation of Mabu forest - the largest medium-altitude rainforest in southern Africa. *Oryx*, **48 (2):** 177-185. doi: 10.1017/S0030605313000720.

Beale, C. M., C. J. C. Mustaphi, T. A. Morrison, S. Archibald, T. M. Anderson, A. P. Dobson, J. E. Donaldson, G. P. Hempson, J. Probert and C. L. Parr (2018). Pyrodiversity interacts with rainfall to increase bird and mammal richness in African savannas. *Ecology Letters*, **21 (4):** 557 - 567. doi: 10.1111/ele.12921.

Beard, K. C., B. Sigé and L. Krishtalka (1992). A primitive vespertilionoid bat from the early Eocene of central Wyoming. *Comptes Rendus de l'Académie des Sciences, Paris*, **(2) 314:** 735 - 741.

Beaucournu, J.-C., D. Bach-Hamba, H. Launay, H. Hellal and C. Chastel (1983). Deux chiroptères peu connus de Tunisie. *Mammalia*, **47 (1):** 127 - 128. doi: 10.1515/mamm.1983.47.1.123.

Beaucournu, J. C. and J. Fahr (2003). Notes sur les Ischnopsyllinae du Continent Africain, IV: Quelques *Lagaropsylla* Jordan & Rothschild 1921 de Côte d'Ivoire; description de *L. senckenbergiana* n. sp. (Insecta, Siphonaptera, Ischnopsyllidae). *Senckenbergiana biologica*, **82 (1/2):** 157 - 162, 9 figs.

Beaucournu, J.-C. and D. Kock (1996). Notes sur les Ischnopsyllinae du continent Africain, III. Compléments à la répartition des espèces (Insecta: Siphonaptera: Ischnopsyllidae). *Senckenbergiana biologica*, **75 (1/2):** 163 - 169. [Abstract]

Beaucournu, J.-C. and J.-F. Noblet (1985). Une Nyctéribie (Diptera, Pupipara) nouvelle pour la faune Française: présence de *Basilia mediterranea* Hurka, 1970 en Corse. *Annales de Parasitologie humaine et comparée*, **60 (5):** 635 - 638. [Abstract]

Bechstein, J. M. (1800). *Thomas Pennant's allgemeine Uebersicht der vierfüssigen Thiere. Aus dem englischen übersetzt und mit Anmerkungen und Zusätzen versehen von J. M. Bechstein.* Vol. 2; pp. Xi; 323 - 768; pls 35 - 54.

Becquart, P., N. Wauquier, T. Mahlakoiv, D. Nkoghe, C. Padilla, M. Souris, B. Ollomo, J.-P. Gonzalez, X. De Lamballerie, M. Kazanji and E. M. Leroy (2010). High prevalence of both humoral and cellular immunity to Zaire ebolavirus among rural populations in Gabon. *PLoS ONE*, **5 (2):** e9126. doi: 10.1371/journal.pone.0009126.

Bedford, G. A. H. (1932). *A synoptic check-list and host-list of the ectoparasites found on South African Mammalia, Aves, and Reptilia (Second Edition).* 1st Report of the Director of Veterinary Services and Animal Industry of South Africa.: 223 - 489?.

Behner, L., L. Zimmermann, M. Ringel, M. Weis and A. Maisner (2018). Formation of high-order oligomers is required for functional bioactivity of an African bat henipavirus surface glycoprotein. *Veterinary Microbiology*, **218:** 90 - 97. doi: 10.1016/j.vetmic.2018.03.031.

Behrensmeyer, A. K., N. E. Todd, R. Potts and G. E. McBrinn (1977). Late Pliocene faunal turnover in the Turkana Basin of Kenya and Ethiopia. *Science*, **278 (5343):** 1589 - 1594. doi: 10.1126/science.278.5343.1589. [Abstract]

Beja, P., P. Vaz Pinto, L. Veríssimo, E. Bersacola, E. Fabiano, J. M. Palmeirim, A. Monadjem, P. Monterroso, M. S. Svensson and P. J. Taylor (2019). *Chapter 15. The mammals of Angola.* In Huntley, B.J., V. Russo, F. Lages and N. Ferrand [Eds]: *Biodiversity of Angola - Science & Conservation: a modern synthesis. Transboundary and Emerging Diseases*, **Springer Open - Cham, Switzerland:** i - x; 1 - 549. doi: 10.1007/978-3-030-03083-4_15.

Bekker, J. P. and M. R. M. Ekué (2004). *Preliminary report on the small mammals collected during the mission RéRE-VZZ 2002 in Benin (Mammalia: Insectivora, Chiroptera, Rodentia).* In Mensah, G. A., B. Sinsin and E. Thomassen : *Actes du seminaire-atelier sur la mammalogie et la biodiversité Abomey-Calavi/Bénin, 30/10 - 18/11/2002 - Proceedings of symposium-workshop on mammal study and biodiversity Abomey-Calavi/Bénin, 30/10 - 18/11/2002.* VZZ Rapport 2004-13: 273 - 298.

Bell, E., E. Price, S. Balthes, M. Cordon and D. Wormell (2019). Flight patterns in zoo-housed fruit bats (*Pteropus* spp.). *Zoo Biology*, **38 (3):** 248 - 257. doi: 10.1002/zoo.21481.

Bell, G. P. (1987). Evidence of a harem social system in *Hipposideros caffer* (Chiroptera: Hipposideridae) in Zimbabwe. *Journal of Tropical Ecology*, **3:** 87 - 90.

Bell, G. P. and M. B. Fenton (1984). The use of Doppler-shifted echoes as a flutter detection and clutter rejection system: the echolocation and feeding behavior of *Hipposideros ruber* (Chiroptera: Hipposideridae). *Behavioral ecology and sociobiology*, **15 (2):** 109 - 114. doi: 10.1007/BF00299377. [Abstract]

Benarbia, A. and B. Fentrouci (2017). Caractérisation morphométrique, de quelques espèces de chauve-souris en Algérie occidentale. Masters thesis - Université de Tleclem, Algeria: 105 pp.

Benda, P. (1994). Biometrics of *Myotis myotis* and *Myotis blythi*: age variation and sexual dimorphism. *Folia zoologica: International journal of vertebratology*, **43 (4):** 297 - 306. [Abstract]

Benda, P. (2004a). *Pipistrellus deserti*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Benda, P. (2004b). *Rhinopoma hardwickei*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Benda, P. (2004c). *Hypsugo ariel*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Benda, P. (2010). Ceské vernakulární jmenosloví netopýru. I. Návrh úplného jmenosloví [Czech vernacular nomenclature of bats. I. Proposal of complete nomenclature]. *Vespertilio*, **13-14:** 263 - 308.

Benda, P., M. Abi-Said, T. Bartonicka, R. Bilgin, K. Faizolahi, R. K. Lucan, H. Nicolaou, A. Reiter, W. M. Shohdi, M. Uhrin and I. Horácek (2011a). *Rousettus aegyptiacus* (Pteropodidae) in the Palaearctic: list of records and revision of the distribution range. *Vespertilio*, **15:** 3 - 36.

Benda, P., M. M. Al-Jumaily, A. Reiter and A. K. Nasher (2011b). Noteworthy records of bats from Yemen with description of a new species from Socotra. *Hystrix, Italian Journal of Mammalogy*, **(n.s.) 22 (1):** 23 - 56. doi: 10.4404/Hystrix-22.1-4473.

Benda, P., M. Andreas, D. Kock, R. K. Lucan, P. Munclinger, P. Nová, J. Obuch, K. Ochman, A. Reiter, M. Uhrin and D. Weinfurtová (2006). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean. Part 4. Bat fauna of Syria: Distribution, systematics, ecology. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **70 (1-4):** 1 - 329.

Benda, P., T. Andriollo and M. Ruedi (2014a). Systematic position and taxonomy of *Pipistrellus deserti* (Chiroptera: Vespertilionidae). *Mammalia*, **79 (4):** 419 - 438 (for 2015). doi: 10.1515/mammalia-2014-0024.

Benda, P. and S. Aulagnier (2008). *Pipistrellus ariel*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Benda, P. and S. Aulagnier (2013a). *Plecotus christii Christie's Long-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 663 - 664.

Benda, P. and S. Aulagnier (2013b). *Plecotus gaisleri Gaisler's Long-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 664 - 666.

Benda, P., S. Aulagnier, A. M. Hutson, Z. S. Amr, D. Kock, M. Sharifi, A. Karatas, S. Mickleburgh, W. Bergmans and K. Howell (2008a). *Rousettus aegyptiacus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Benda, P., S. Aulagnier, A. M. Hutson, M. Sharifi and K. Tsytsulina (2008b). *Barbastella leucomelas*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Benda, P., S. Aulagnier and A. M. M. Hutson (2008c). *Otonycteris hemprichii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Benda, P., S. Aulagnier and J. Palmeirim (2008d). *Pipistrellus deserti*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Benda, P., S. Aulagnier and J. Palmeirim (2008e). *Rhinopoma hardwickii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Benda, P., J. Cervený, A. Konecný, A. Reiter, M. Ševcík, M. Uhrin and P. Vallo (2010a). Some new records of bats from Morocco (Chiroptera) [Neco nových nálezu netopýru z Maroka (Chiroptera)]. *Lynx (Praha)*, **41:** 151 - 166.

Benda, P., C. Dietz, M. Andreas, J. Hotový, R. K. Lucan, A. Maltby, K. Meakin, J. Truscott and P. Vallo (2008f). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 6. Bats of Sinai (Egypt) with some taxonomic, ecological and echolocation data on that fauna. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **72:** 1 - 103.

Benda, P. and S. Engelberger (2016). Bats from Lebanon at the Natural History Museum, Vienna: a cautionary tale on the reliability of museum specimen data (Chiroptera). *Lynx (Praha)*, **47:** 17 - 43.

Benda, P., K. Faizolâhi, M. Andreas, J. Obuch, A. Reiter, M. Ševcík, M. Uhrin, P. Vallo and S. Ashraf (2012a). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 10. Bat fauna of Iran. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **76:** 163 - 582.

Benda, P. and J. Gaisler (2015). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 12. Bat fauna of Afghanistan: revision of distribution and taxonomy. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **79:** 267 - 458.

Benda, P., P. Georgiakakis, C. Dietz, V. Hanák, K. Galanaki, V. Markantonatou, A. Chudárková, P. Hulva and I. Horácek (2009a). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 7. The bat fauna of Crete, Greece. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **72:** 105 - 190 (for 2008).

Benda, P. and V. Gvoždík (2010). Taxonomy of the genus *Otonycteris* (Chiroptera: Vespertilionidae: Plecotini) as inferred from morphological and mtDNA data. *Acta Chiropterologica*, **12 (1):** 83 - 102. doi: 10.3161/150811010X504617.

Benda, P., V. Hanák, M. Andreas, A. Reiter and M. Uhrin (2004a). Two new species of bats (Chiroptera) for the fauna of Libya: *Rhinopoma hardwickii* and *Pipistrellus rueppellii*. *Myotis*, **41/42:** 91 - 107.

Benda, P., V. Hanák and J. Cervený (2011c). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 9. Bats from Transcaucasia and West Turkestan in collection of the National Museum, Prague. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **75:** 159 - 222.

Benda, P., V. Hanák, I. Horácek, P. Hulva, R. Lucan and M. Ruedi (2007). Bats (Mammalia: Chiroptera) of the eastern Mediterranean. Part 5. Bat fauna of Cyprus: review of records with confirmation of six species new for the island and description of a new subspecies. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **71:** 71 - 130.

Benda, P. and I. Horácek (1995a). Biometrics of *Myotis myotis* and *Myotis blythi*. *Myotis*, **32-33:** 45 - 55. [Abstract]

Benda, P. and I. Horácek (1995b). Geographic variation in three species of *Myotis* (Mammalia: Chiroptera) in south of the western Palearctics. *Acta Societatis Entomologicae Bohemoslovacae*, **59:** 17 - 39. [Abstract]

Benda, P., P. Hulva and J. Gaisler (2004b). Systematic status of African populations of *Pipistrellus pipistrellus* complex (Chiroptera: Vespertilionidae), with a description of a new species from Cyrenaica, Libya. *Acta Chiropterologica*, **6 (2):** 193 - 217.

Benda, P. and J. Juste (2004). *Eptesicus bottae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Benda, P. and A. Karatas (2005). On some Mediterranean populations of bats of the *Myotis mystacinus* morpho-group (Chiroptera: Vespertilionidae). *Lynx (Praha)*, **n.s. 36:** 9 - 38.
Benda, P., A. Kiefer, V. Hanák and M. Veith (2004c). Systematic status of African populations of long-eared bats, genus *Plecotus* (Mammalia: Chiroptera). *Folia zoologica: International journal of vertebratology*, **53 (Monogr. 1):** 1 - 47.
Benda, P. and L. Lavrenchenko (2004). *Myotis scotti*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Benda, P. and L. Lavrenchenko (2008). *Myotis scotti*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Benda, P., R. K. Lucan, J. Obuch, A. Reiter, M. Andreas, P. Backor, T. Bohnenstengel, E. K. Eid, M. Ševcík, P. Vallo and Z. S. Amr (2010b). Bats (Mammalia: Chiroptera) of the eastern Mediterranean and Middle East. Part 8. Bats of Jordan: fauna, ecology, echolocation, ectoparasites. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **74:** 185 - 353.
Benda, P., R. K. Lucan, W. M. Shohdi, M. Porteš and I. Horácek (2014b). Microbats of the western oases of Egypt, Libyan Desert. *Vespertilio*, **17:** 45 - 58.
Benda, P. and J. Mlíkovský (2008). Nomenclatural notes on the Asian forms of *Barbastella* bats (Chiroptera: Vespertilionidae). *Lynx (Praha)*, **n.s. 39 (1):** 31 - 46.
Benda, P., A. Reiter, M. (M.) Al-Jumaily, A. K. Nasher and P. Hulva (2009b). A new species of mouse-tailed bat (Chiroptera: Rhinopomatidae: *Rhinopoma*) from Yemen. *Journal of the National Museum (Prague), Natural History Series*, **177 (6):** 53 - 68.
Benda, P., A. Reiter and M. Uhrin (2011d). First record of *Nycteris macrotis* in Mauritania (Chiroptera: Nycteridae). *Lynx (Praha)*, **n.s. 42:** 267 - 270.
Benda, P., A. Reiter, M. Uhrin and Z. Varadínová (2016). A new species of pipistrelle bat (Chiroptera: Vespertilionidae) from southern Arabia. *Acta Chiropterologica*, **18 (2):** 301 - 323. doi: 10.3161/15081109ACC2016.18.2.001.
Benda, P. and M. Ruedi (2004). Systematic status of *Pipistrellus deserti* Thomas, 1902 (Vespertilionidae) within the *P. kuhlii* group. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 5.
Benda, P., M. Ruedi and S. Aulagnier (2004d). New data on the distribution of bats (Chiroptera) in Morocco. *Vespertilio*, **8:** 13 - 44.
Benda, P., F. Spitzenberger, V. Hanák, M. Andreas, A. Reiter, M. Ševcík, J. Šmíd and M. Uhrin (2014c). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part II. On the bat fauna of Libya II. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **78:** 1 - 162.
Benda, P. and K. A. Tsytsulina (2000). Taxonomic revision of *Myotis mystacinus* group (Mammalia: Chiroptera) in the western Palearctic. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **64:** 331 - 398.
Benda, P. and P. Vallo (2009). Taxonomic revision of the genus *Triaenops* (Chiroptera: Hipposideridae) with description of a new species from southern Arabia and definitions of a new genus and tribe. *Folia zoologica: International journal of vertebratology*, **58 (Monograph 1):** 1-45.
Benda, P. and P. Vallo (2012). New look on the geographical variation in *Rhinolophus clivosus* with description of a new horseshoe bat species from Cyrenaica, Libya. *Vespertilio*, **16:** 69 - 96. URL: http://www.ceson.org/vespertilio/16/069_096_Benda.pdf.
Benda, P., P. Vallo, P. Hulva and I. Horácek (2012b). The Egyptian fruit bat *Rousettus aegyptiacus* (Chiroptera: Pteropodidae) in the Palaearctic: Geographical variation and taxonomic status. *Biologia*, **67 (6):** 1230 - 1244. doi: 10.2478/s11756-012-0105-y.
Benda, P., P. Vallo and A. Reiter (2011e). Taxonomic revision of the genus *Asellia* (Chiroptera: Hipposideridae). XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 51 - 52. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.
Benda, P., P. Vallo and A. Reiter (2011f). Taxonomic revision of the genus *Asellia* (Chiroptera: Hipposideridae) with a description of a new species from southern Arabia. *Acta Chiropterologica*, **13 (2):** 245 - 270. doi: 10.3161/150811011X624749.
Benda, P. J., M. Obuch, A. Andreas, A. Reiter and M. Uhrin (2001). *New records of bats from Iran.* In Woloszyn, B.W. [Ed]: *Distribution, ecology, paleontology and systematics of bats* p. 208. in Proceedings of the VIIIth European Bat Research Symposium. Volume II. Chiropterological Information Center, Institute of Systematics and Evolution of Animals PAS, Krakow, 315 pp.
Bendjeddou, M. L., B. Bakhouche and Z. Bouslama (2014). A new locality for *Tadarida teniotis* (Rafinesque, 1814) (Mammalia, Chiroptera, Molossidae) in Algeria. *Natura Rerum*, **3:** 37 - 39.
Bendjeddou, M. L., I. Bitam, A. Abiadh, Z. Bouslama and Z. S. Amr (2013). New records of arthropod ectoparasites of bats from north-eastern Algeria. *Jordan Journal of Biological Sciences*, **6 (4):** 324 - 327.
Bendjeddou, M. L., Z. Bouslama, Z. S. Amr and R. BaniHani (2016a). Infestation and seasonal activity of *Ixodes vespertilionis* Koch, 1844 (Acari: Ixodidae) on the Maghreb Mouse-Eared Bat, *Myotis punicus* Felten, 1977, in Northeastern Algeria. *Journal of Vector Ecology*, **41 (1):** 109 - 112. doi: 10.1111/jvec.12201.
Bendjeddou, M. L., H. A. Loumassine, I. Scheffler, Z. Bouslama and Z. Amr (2017). Bat ectoparasites (Nycteribiidae, Streblidae, Siphonaptera, Heteroptera, Mesostigmata, Argasidae, and Ixodidae) from Algeria. *Journal of Vector Ecology*, **42 (1):** 13 - 23. doi: 10.1111/jvec.12235.
Bendjeddou, M. L., H. E. Loumassine, W. Metallaoui, K. Chiheb, A. Farfar, F. Bounaceur, F. Boukheroufa, Z. Bouslama and C. Dietz (2016b). First record of *Nyctinomus aegyptiacus* for Tunisia. *Vespertilio*, **18:** 23 - 27.
Benedict, F. A. (1957). Hair structure as a generic character in bats. *University of California publications in zoology*, **59:** 285 - 548. [Abstract]
Ben-Hamo, M., A. Muñoz-Garcia, P. Larrain, B. Pinshow, C. Korine and J. B. Williams (2016). The cutaneous lipid composition of bat wing and tail membranes: a case of convergent evolution with birds. *Proceedings of the Royal Society of London*, **B 283:** 20160636. doi: 10.1098/rspb.2016.0636.
Bennett, A. J., T. Bushmaker, K. Cameron, A. Ondzie, F. R. Niama, H.-J. Parra, J.-V. Mombouli, S. H. Olson, V. J. Munster and T. L. Goldberg (2018). Diverse RNA viruses of arthropod origin in the blood of fruit bats suggest a link between bat and arthropod viromes. *Virology*, **528:** 64 - 72 (for 2019). doi: 10.1016/j.virol.2018.12.009.
Bennett, D. and F. A. Kofu (2000). Surveys of microchiropteran bats in Madagascar 2000. BP Conservation Programme: 23 pp. URL: http://www.conservationleadershipprogramme.org/project/surveys-microchiropteran-bats-madagascar/.
Bennett, E. T. (1835). III. On a remarkable species of Pteropine bat. *Transactions of the Zoological Society of London*, **2 (3):** 31 - 38.
Bennett, E. T. (1836a). On a remarkable Pteropine bat from the Gambia. *Proceedings of the Zoological Society of London*, **1835, III (xxxiv):** 149.
Bennett, E. T. (1836b). ?? Title still needs to be checked. ?? *Transactions of the Zoological Society of London*2 (1).

Bennett, S. N., S. H. Gu, H. J. Kang, S. Arai and R. Yanagihara (2014). Reconstructing the evolutionary origins and phylogeography of hantaviruses. *Trends in Microbiology*, **22 (8):** 473 - 482. doi: 10.1016/j.tim.2014.04.008.
Benoit, P. L. G. (1958a). Les Polyctenidae du Congo Belge (Hemiptera - Cimicoidea). *Revue de zoologie et de botanique africaines*, **57 (1-2):** 68 - 72. [Abstract]
Benoit, P. L. G. (1958b). Contribution a l'étude de Spinturnicidae du Congo Belge. *Revue de zoologie et de botanique africaines*, **57 (1-2):** 96 - 100. [Abstract]
Benzal, J. (1999). *Nyctalus lasiopterus.* In Mitchell-Jones, A. J., G. Amori, W. Bogdanowicz, B. Kryštufek, P. J. H. Reijnders, F. Spitzenberger, M. Stubbe, J. B. M. Thissen, V. Vohralík and J. Zima : *The Atlas of European Mammals.* Academic Press, London, UK.
Beolens, B., M. Watkins and M. Grayson (2009). *The Eponym Dictionary of Mammals.* John Hopkins University Press.
Bergmann, C. (1847). Über die Verhältnisse der Wärmeökonomie der Thiere zu ihrer Grösse. *Göttinger Studien*, **1:** 595 - 708.
Bergmans, W. (1973). New data on the rare African fruit bat *Scotonycteris ophiodon* Pohle, 1943. *Zeitschrift für Säugetierkunde*, **38 (5):** 285 - 289. [Abstract]
Bergmans, W. (1975). On the differences between sympatric *Epomops franqueti* (Tomes, 1860) and *Epomops buettikoferi* (Matschie, 1899), with additional notes on the latter species (Mammalia, Megachiroptera). *Beaufortia*, **23 (304):** 141 - 152. [Abstract]
Bergmans, W. (1976). A revision of the African genus *Myonycteris* Matschie, 1899 (Mammalia, Megachiroptera). *Beaufortia*, **24 (317):** 189 - 216. [Abstract]
Bergmans, W. (1977a). Notes on new material of *Rousettus madagascariensis* Grandidier, 1929 (Mammalia, Megachiroptera). *Mammalia*, **41 (1):** 67 - 74. [Abstract]
Bergmans, W. (1977b). An annotated inventory of three small collections of Nigerian Microchiroptera (Mammalia, Chiroptera). *Zeitschrift für Säugetierkunde*, **42 (5):** 279 - 289. [Abstract]
Bergmans, W. (1978a). Rediscovery of *Epomophorus pousarguesi* Trouessart, 1904 in the Central African Empire (Mammalia, Megachiroptera). *Journal of natural history*, **12 (6):** 681 - 687. doi: 10.1080/00222937800770511. [Abstract]
Bergmans, W. (1978b). Review of drinking behavior of African Fruit Bats (Mammalia: Megachiroptera). *Bulletin of the Carnegie Museum of Natural History*, **6:** 20 - 25. [Abstract]
Bergmans, W. (1979a). Taxonomy and zoogeography of the fruit bats of the Peoples Republic of Congo, with notes on their reproductive biology (Mammalia, Megachiroptera). *Bijdragen tot de Dierkunde*, **48 (2):** 161 - 186. [Abstract]
Bergmans, W. (1979b). First records of *Epomops dobsoni* (Bocage, 1889) from Tanzania and Rwanda, with a note on its size range (Mammalia, Megachiroptera). *Zeitschrift für Säugetierkunde*, **44 (4):** 239 - 240.
Bergmans, W. (1980). A new fruit bat of the genus *Myonycteris* Matschie, 1899, from eastern Kenya and Tanzania (Mammalia, Megachiroptera). *Zoologische Mededelingen*, **55 (14):** 171 - 181. [Abstract]
Bergmans, W. (1982). Noteworthy extensions of known ranges of three African fruit bat species (Mammalia, Megachiroptera). *Bulletin Zoologisch Museum, Universiteit Amsterdam*, **8 (19):** 157 - 163. [Abstract]
Bergmans, W. (1988). Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 1. General introduction; Material and methods; Results: The genus *Epomophorus* Bennett, 1836. *Beaufortia*, **38 (5):** 75 - 146. [Abstract]
Bergmans, W. (1989). Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 2. The genera *Micropteropus* Matschie, 1899, *Epomops* Gray, 1870, *Hypsignatus* H. Allen, 1861, *Nanonycteris*, Matschie, 1899 and *Plerotes* Andersen, 1910. *Beaufortia*, **39 (4):** 89 - 153. [Abstract]
Bergmans, W. (1991). Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 3. The genera *Scotonycteris* Matschie, 1894, *Casinycteris* Thomas, 1910, *Pteropus* Brisson, 1762, and *Eidolon* Rafinesque, 1815. *Beaufortia*, **40 (7):** 111 - 177 (for 1990).
Bergmans, W. (1994). Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 4. The genus *Rousettus* Gray, 1821. *Beaufortia*, **44 (4):** 79 - 126. [Abstract]
Bergmans, W. (1997). Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 5. The genera *Lissonycteris* Andersen, 1913, *Myonycteris* Matschie, 1899 and *Megaloglossus* Pagenstecher, 1885; General remarks and conclusions; annex: Key to all species. *Beaufortia*, **47 (2):** 11 - 90. [Abstract]
Bergmans, W. (1999). *Conservation status of African fruit bats (Mammalia, Megachiroptera).* In De Iong, H. and H. Prins : *International seminar on species conservation - The IUCN Red List categories discussed.* Nederlandse Commissie voor Internationale Natuurbescherming Mededelingen: 75 - 88.
Bergmans, W. (2001). Notes on distribution and taxonomy of Australasian bats. 1. Pteropodinae and Nyctimeninae (Mammalia, Megachiroptera, Pteropodidae). *Beaufortia*, **51 (8):** 119 - 152.
Bergmans, W. (2011). An annotated list of mammal type specimens in the collections of the former Zoological Museum of the University of Amsterdam (1890-2010). *Zoologische Mededelingen, Leiden*, **85 (12):** 835 - 848.
Bergmans, W. (2013). *Epomophorus anselli Ansell's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 238 - 240.
Bergmans, W., L. Bellier and J. Vissault (1974). A taxonomical report on a collection of Megachiroptera (Mammalia) from the Ivory Coast. *Revue de zoologie africaine*, **88 (1):** 18 - 48. [Abstract]
Bergmans, W. and J. Fahr (2004). *Nycteris gambiensis.* In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Bergmans, W. and J. Fahr (2008). *Nycteris gambiensis.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Bergmans, W. and H. Jachmann (1983). Bat records from Malawi (Mammalia, Chiroptera). *Bulletin Zoologisch Museum, Universiteit Amsterdam*, **9 (13):** 117 - 122. [Abstract]
Bergmans, W. and F. G. Rozendaal (1988). Notes on collections of fruit bats from Sulawesi and some off-lying islands (Mammalia, Megachiroptera). *Zoologische Verhandelingen*, **248:** 1 - 74.
Bergmans, W. and P. J. H. Van Bree (1972). The taxonomy of the African bat *Megaloglossus woermanni* Pagenstecher, 1885 (Megachiroptera, Macroglossinae). *Biologica Gabonica*, **? (3-4):** 291 - 299.
Bergmans, W. and N. J. Van Strien (2004). Systematic notes on a collection of bats from Malawi. I. Megachiroptera: Epomophorinae and Rousettinae (Mammalia: Chiroptera). *Acta Chiropterologica*, **6 (2):** 249 - 268. doi: 10.3161/150811004.
Bergmans, W. and N. J. van Strien (2008). *Epomophorus anselli.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Bernard, R. T. F. (1976). Some aspects of the dynamics of a bat population in Natal, South Africa. Honours thesis, University of Natal, South Africa.

Bernard, R. T. F. (1980a). Reproductive cycles of *Miniotерus schreibersi natalensis* (Kuhl, 1819) and *Miniopterus fraterculus* Thomas and Schwann, 1906. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **32 (3):** 55 - 64. [Abstract]

Bernard, R. T. F. (1980b). Female reproductive anatomy and development of ovarian follicles in *Miniopterus fraterculus*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **15 (2):** 111 - 116. doi: 10.1080/02541858.1980.11447696. [Abstract]

Bernard, R. T. F. (1980c). Female reproduction in five species of Natal cave-dwelling microchiroptera. PhD thesis, University of Natal - Pietermaritzburg.

Bernard, R. T. F. (1982a). Female reproductive cycle of *Nycteris thebaica* (Microchiroptera) from Natal, South Africa. *Zeitschrift für Säugetierkunde*, **47:** 12 - 18. [Abstract]

Bernard, R. T. F. (1982b). Monthly changes in the female reproductive organs and the reproductive cycle of *Myotis tricolor* (Vespertilionidae: Chiroptera). *South African Journal of Sciences*, **17 (2):** 79 - 84. doi: 10.1080/02541858.1982.11447784. [Abstract]

Bernard, R. T. F. (1984). The occurrence of spermiophagy under natural conditions in the cauda epididymidis of the Cape horseshoe bat (*Rhinolophus capensis*). *Journal of Reproduction and Fertility*, **71:** 539 - 543. doi: 10.1530/jrf.0.0710539. [Abstract]

Bernard, R. T. F. (1985). Reproduction in the Cape horseshoe bat (*Rhinolophus capensis*) from South Africa. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **20 (3):** 129 - 135. [Abstract]

Bernard, R. T. F. (2013a). *Rhinolophus capensis Cape Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 314 - 316.

Bernard, R. T. F. (2013b). *Myotis tricolor Temminck's Myotis (Temminck's Hairy Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 706 - 708.

Bernard, R. T. F. and G. J. Bester (1988). Roost selection by the long-fingered bat, *Miniopterus schreibersii*, is influenced by reproductive condition, and roost microclimate and structure. *South African Journal of Sciences*, **84:** 921 - 922.

Bernard, R. T. F., C. Bojarski and R. P. Millar (1991). Plasma progesterone and luteinizing hormone concentrations and the role of the corpus luteum and LH gonadotrophs in the control of delayed implantation in Schreibers' long-fingered bat (*Miniopterus schreibersii*). *Journal of Reproduction and Fertility*, **93 (1):** 31 - 42. doi: 10.1530/jrf.0.0930031. [Abstract]

Bernard, R. T. F. and G. S. Cumming (1997). African bats: evolution of reproductive patterns and delays. *The Quarterly Review of Biology*, **72 (3):** 253 - 274. [Abstract]

Bernard, R. T. F. and A. Davison (1996). Does calcium constrain reproductive activity in insectivorous bats? Some empirical evidence for Schreibers' longfingered bat (*Miniopterus schreibersii*). *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **31 (4):** 218 - 220. [Abstract]

Bernard, R. T. F., D. C. D. Happold and M. Happold (1997). Sperm storage in a seasonally reproducing African vespertilionid, the banana bat (*Pipistrellus nanus*) from Malawi. *Journal of Zoology*, **241 (1):** 161 - 174. [Abstract]

Bernard, R. T. F. and M. Happold (2013a). *Rhinolophus clivosus Geoffroy's Horseshoe Bat (Cretzschmar's Horseshoe Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 316 - 318.

Bernard, R. T. F. and M. Happold (2013b). *Hipposideros caffer Sundevall's Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 375 - 378.

Bernard, R. T. F. and M. Happold (2013c). *Nycteris thebaica Egyptian Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 457 - 460.

Bernard, R. T. F. and M. Happold (2013d). *Tadarida aegyptiaca Egyptian Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 490 - 493.

Bernard, R. T. F. and M. Happold (2013e). *Miniopterus fraterculus Lesser Long-fingered Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 712 - 714.

Bernard, R. T. F. and M. Happold (2013f). *Miniopterus natalensis Natal Long-fingered Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 718 - 720.

Bernard, R. T. F. and J. A. J. Meester (1982). Female reproduction and the female reproductive cycle of *Hipposideros caffer caffer* (Sundevall, 1846) in Natal, South Africa. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **33 (8):** 131 - 144. [Abstract]

Bernard, R. T. F., J. Paton and K. Sheppey (1988). Relative brain size and morphology of some South African bats. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **23 (1):** 52 - 58. doi: 10.1080/02541858.1988.11448077. [Abstract]

Bernard, R. T. F. and J. N. Tsita (1995). Seasonally monoestrous reproduction in the molossid bat, *Tadarida aegyptiaca* from low temperate latitudes (33°S) in South Africa. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **30 (1):** 18 - 22. [Abstract]

Best, T. L., B. A. Milam, T. D. Haas, W. S. Cvilikas and L. R. Saidak (1997). Variation in diet of the Gray bat (*Myotis grisescens*). *Journal of Mammalogy*, **78 (2):** 569 - 583. [Abstract]

Bester, G. J. and R. T. F. Bernard (1988). The population biology of bats in Maitalnd mines. *The Naturalist*, **32:** 13 - 15.

Betts, B. J. (1997). Microclimate in hell's canyon mines used by maternity colonies of *Myotis yumanensis*. *Journal of Mammalogy*, **78 (4):** 1240 - 1250.

Bhatnagar, K. P., T. D. Smith, S. N. Rai and H. D. Frahm (2016). The chiropteran brain database: volumetric survey of the hypophysis in 165 species. *The Anatomical Record*, **299:** 492 - 510. doi: 10.1002/ar.23321.

Bhatnagar, V. S. and G. Parveen (1985). Karyomorphology of an Indian rat-tailed bat, *Rhinopoma microphylum kineari* Wroughton. *National Academy Science Letters*, **8 (2):** 63 - 65. [Abstract]

Bhide, S. A. (1979). Observations on the anatomy, histology and histochemistry of the stomach of the vespertillonid bat *Miniopterus schreibersii* (Kuhl). *Proceedings of the Indian Academy of Sciences*, **88B, I (1):** 1 - 12. [Abstract]

Bianchi, V. (1916). ?? Title still needs to be checked. ?? .

Bianchi, V. (1917). Predvaritel'nyye zametki o letuchikh myshakh (Chiroptera) Rossii [Notes préliminaires sur les chauve-souries ou Chiroptères de la Russie]. *Annales du Musée zoologique de l'Académie Impériale de Sciences de St.Petersbourg*, **21:** 73 - 82 (for 1816).

Bickham, J. W. (1979). Chromosomal variation and evolutionary relationships of Vespertilionid bats. *Journal of Mammalogy*, **60 (2):** 350 - 363. [Abstract]

Bickham, J. W. and R. J. Baker (1977). Implications of chromosomal variation in *Rhogeessa* (Chiroptera: Vespertilionidae). *Journal of Mammalogy*, **58 (3):** 448 - 453.

Bickham, J. W. and J. C. Hafner (1978). A chromosomal banding study of three species of vespertilionid bats from Yugoslavia. *Genetica*, **48 (1):** 1 - 3.

Bickham, J. W., J. C. Patton, D. A. Schlitter, I. L. Rautenbach and R. L. Honeycutt (2004). Molecular phylogenetics, karyotypic diversity, and partition of the genus *Myotis* (Chiroptera: Vespertilionidae). *Molecular phylogenetics and evolution*, **33 (2):** 333 - 338. doi: 10.1016/ympev.2004.06.012.

Biek, R., P. D. Walsh, E. M. Leroy and L. A. Real (2006). Recent common ancestry of Edola Zaire virus found in a bat reservoir. *PloS Pathogens*, **2 (10):** 885 - 886. doi: 10.1371/journal.ppat.0020090.

Biesold, S. E., D. Ritz, F. Gloza-Rausch, R. , Drexler, J. F. Wollny, V. M. Corman, E. K. V. Kalko, S. Oppong, C. Drosten and M. A. Müller (2011). Type I Interferon reaction to viral infection in interferon-competent, immortalized cell lines from the African fruit bat *Eidolon helvum*. *PLoS ONE*, **6 (11) e28131:** 1 - 11. doi: 10.1371/journal.pone.0028131.

Bigalke, R. C. (1968). Evolution of mammals on southern continents. II. The contemporary mammal fauna of Africa. *The Quarterly Review of Biology*, **43:** 265 - 300. [Abstract]

Bilgin, R., K. Gürün, K. Karaman, J. Juste, P. Benda, A. Viglino, E. Çoraman, A. Karatas and A. Furman (2017). The mitochondrial phylogeography of the long-fingered bat, *Myotis capaccinii*, around the Mediterranean basin (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 56. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.

Bilgin, R., K. Gürün, H. Rebelo, S. J. Puechmaille, Ö. Maraci, P. Presetnik, P. Benda, P. Hulva, C. Ibáñez, D. Hamidovic, N. Fressel, I. Horácek, A. Karatas, A. Karatas, B. Allegrini, P. Georgiakakis, S. Gazaryan, Z. L. Nagy, M. Abi-Said, R. K. Lucan, T. Bartonicka, H. Nicolaou, D. Scaravelli, B. Karapandža, M. Uhrin, M. Paunovic and J. Juste (2016). Circum-Mediterranean phylogeography of a bat coupled with past environmental niche modeling: A new paradigm for the recolonization of Europe? *Molecular phylogenetics and evolution*, **99:** 323 - 336. doi: 10.1016/j.ympev.2016.03.024.

Bilgin, R., A. Karatas, E. Çoraman, T. Disotell and J. C. Morales (2008). Regionally and climatically restricted patterns of distribution of genetic diversity in a migratory bat species, *Miniopterus schreibersii* (Chiroptera: Vespertilionidae). *BMC Evolutionary Biology*, **8:** 209. doi: 10.1186/1471-2148-8-209.

Bilgin, R., A. Karatas, E. Çoraman, I. Pandurski, E. Papadatou and J. C. Morales (2006). Molecular taxonomy and phylogeography of *Miniopterus schreibersii* (Kuhl, 1817) (Chiroptera: Vespertilionidae), in the Eurasian transition. *Biological Journal of the Linnean Society*, **87 (4):** 577 - 582. doi: 10.1111/j.1095-8312.2006.00591.x.

Bilgin, R., A. Kesisoglu and H. Rebelo (2012). Distribution patterns of bats in the eastern Mediterranean region through a climate change perspective. *Acta Chiropterologica*, **14 (2):** 425 - 437. doi: 10.3161/150811012X661747.

Bilgin, R., Ö, Gürün, K. Maraci, H. Rebelo, S. Puechmaille, P. Presetnik, D. Hamidovic, N. Fressel, P. Hulva, I. Horácek, C. Ibañez, A. Karatas, B. Allegrini, P. Georgiakakis, S. Gazaryan, Z. Nagy, M. Abi-Said, R. Lucan, T. Bartonicka, N. Nicolaou, D. Scaravelli, B. Karapandža, M. Uhrin, M. Paunovic, P. Benda and J. Juste (2013). Circum-Mediterranean phylogeography of a bat coupled with past environmental niche modelling: a new paradigm for the recolonization of Europe? 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 21 - 22. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Billeter, S. A., D. T. S. Hayman, A. J. Peel, K. Baker, J. L. N. Wood, A. Cunningham, R. Suu-Ire, K. Dittmar and M. Y. Kosoy (2012). *Bartonella* species in bat flies (Diptera: Nycteribiidae) from western Africa. *Parasitology*, **139 (3):** 324 - 329. doi: 10.1017/S0031182011002113.

Binger, T., A. Annan, J. F. Drexler, M. A. Müller, R. Kallies, E. Adankwah, R. Wollny, A. Kopp, H. Heidemann, D. Dei, F. C. Agya-Yao, S. Junglen, T. Feldt, A. Kurth, S. Oppong, Y. Adu-Sarkodie and C. Drosten (2015). A novel rhabdovirus isolated from the Straw-Colored Fruit Bat *Eidolon helvum*, with signs of antibodies in swine and humans. *Journal of Virology*, **89 (8):** 4588 - 4597. doi: 10.1128/JVI.02932-14.

Bininda-Emonds, O. R. P., M. Cardillo, K. E. Jones, R. D. E. MacPhee, R. M. D. Beck, R. Grenyer, S. A. Price, R. A. Vos, J. L. Gittleman and A. Purvis (2007). The delayed rise of present-day mammals. *Nature*, **446:** 507 - 512. doi: 10.1038/nature05634.

Biollaz, F., N. Bruyndonckx, G. Beuneux, M. Mucedda, J. Goudet and P. Christe (2010). Genetic isolation of insular populations of the Maghrebian bat, *Myotis punicus*, in the Mediterranean Basin. *Journal of Biogeography*, **:** 1 - 11. doi: 10.1111/j.1365-2699.2010.02282.x.

Birch, J. M. (1997). Comparing wing shape of bats: the merits of principal-components analysis and relative-warp analysis. *Journal of Mammalogy*, **78 (4):** 1187 - 1198. [Abstract]

Bird, B. H., T. G. Ksiazek, S. T. Nichol and J. MacLachlan (2009). Rift Valley fever virus. *Journal of the American Veterinary Medical Association*, **234 (7):** 883 - 893.

Birdsey, G. M., J. Lewin, J. D. Holbrook, V. R. Simpson, A. A. Cunningham and C. J. Danpure (2005). A comparative analysis of the evolutionary relationship between diet and enzyme targeting in bats, marsupials and other mammals. *Proceedings of the Royal Society of London*, **B 272 (1565):** 833 - 840. doi: 10.1098/rspb.2004.3011.

Birnbaum, P., L. Granjon, P. Blanc, M.-H. Chevallier, J.-M. Duplantier, C. Duvall, J. Fahr, J. Florence, P.-M. Forget, D. Gautier, L. Gazull, J.-F. Trébuchon, E. Lecompte and B. Niagaté (2010). *Forêts de failles et forêts galeries au sud du Mali: deux voies pour la pérennité des refuges guinéens en zone soudanienne.* In Nivet, C., D. McKey and C. Legris : *Connaissance et gestion des écosystemes tropicaux. Resultats du programme de recherche "Écosystèmes Tropicaux" 2005 - 2010.* GIP Ecofor-MEEDDM, Paris. 165 - 177.

Birss, C. (2017). *9. Mammals.* In Turner, A.A. [Ed]: *Western Cape Province State of Biodiversity 2017* CapeNature Scientific Services, Stellenbosch: 191 - 230. URL: http://www.capenature.co.za/western-cape-state-biodiversity-report-2017/.

Birss, C. and N. G. Palmer (2012). *8. Mammals.* In Turner, A.A. [Ed]: *Western Cape Province State of Biodiversity 2012.* CapeNature Scientific Services, Stellenbosch: 149 - 168. URL: http://www.capenature.co.za/wp-content/uploads/2013/09/State-of-Biodiversity-2012.pdf.

Birt, P., L. S. Hall and C. G. Smith (1997). Ecomorphology of the tongues of Australian Megachiroptera (Chiroptera: Pteropodidae). *Australian Journal of Zoology*, **45:** 369-384.

Biscardi, S., D. Russo, V. Casciani, D. Cesarini, M. Mei and L. Boitani (2007). Foraging requirements of the endangered long-fingered bat: the influence of micro-habitat structure, water quality and prey type. *Journal of Zoology*, **273:** 372–381.

Bitty, E. A., B. Kadjo, S. Gonédélé, M. O. Okon and P. K. Kouassi (2013). Inventaire de la faune mammalogique d'une forêt urbaine, le Parc National du Banco, Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, **7 (4):** 1678 - 1687. doi: 10.4314/ijbcs.v7i4.23.

Bizoux, J.-P., K. Daïnou, N. Bourland, O. J. Hardy, M. Heuertz, G. Mahy and J.-L. Doucet (2009). Spatial genetic structure in *Milicia excelsa* (Moraceae) indicates extensive gene dispersal in a low-density wind-pollinated tropical tree. *Molecular Ecology*, **18 (21):** 4398 - 4408.

Black, H. L. (1979). Precision in prey selection by the trident -nosed bat (*Cloeotis percivali*). *Mammalia*, **43 (1):** 53 - 57. doi: 10.1515/mamm.1979.43.1.53. [Abstract]
Black, H. L., G. Howard and R. Stjernstedt (1979). Observations on the feeding behavior of the bat hawk (*Macheiramphus alcinus*). *Biotropica*, **11 (1):** 18 - 21. [Abstract]
Blackwell, K. (1966). A note on fruit bats in free-flight aviaries. *International zoo yearbook*, **6:** 247.
Blackwell, K. (1967). Breeding and hand-rearing of fruit bats *Epomops franqueti* and *Eidolon helvum* at Ife University Zoo. *International zoo yearbook*, **7:** 79 - 80.
Blackwell, M. (1980). Incidence, host specificity, distribution, and morphological variation in *Arthrorhynchus nycteribiae* and *A. eucampsipodae* (Laboulbeniomycetes). *Mycologia*, **72 (1):** 143 - 158. [Abstract]
Blanc, G., B. Delage and L. Ascione (1962). Etude épidémio-écologique dans la forêt du Cherrat. *Archives de l'Institut Pasteur de Maroc*, **6 (8):** 223 - 292.
Blancou, L. (1958). Notes biogéographiques sur les mammifères de l'A.E.F. *Bulletin de l'Institut de l'Etude Centrafricaine, Nouvelle Série*, **15-16:** 7 - 42.
Blanford, W. T. (1888). 7. Critical notes on the nomenclature of Indian mammals. *Proceedings of the Zoological Society of London*, **1887, IV:** 620 - 638.
Blanford, W. T. (1888-91). The Fauna of British India, including Ceylon and Burma. Part II. 617 pp.
Blasius, J. H. (1853). Beschreibung zweier neuer deutscher Fledermausarten. *Wiegmans Archiv für Naturgeschichte München*, **19 (1):** 35 - 57.
Blasius, J. H. (1857). *Fauna der Wirbelthiere Deutschlands und der angrenzenden Länder von Mitteleuropa. Erster Band. Naturgeschichte der Säugethiere.* Friedrich Vieweg und Sohn - Braunschweig: vi + 549 pp.
Blitvich, B. J. and A. E. Firth (2017). A review of flaviviruses that have no known arthropod vector. *Viruses*, **9 (6):** 154. doi: 10.3390/v9060154.
Blumenbach, J. F. (1779). *Handbuch der Naturgeschichte. Mit Kupfern. [Erster Theil].* Göttingen. (J. C. Dieterich): i - xiii; 1 - 448, tabs I - II.
Blyth, E. (1840). *Cuvier's Animal Kingdom.* .
Blyth, E. (1845). Notes. In Hutton, T. : *Rough notes on the Zoology of Canadahar and the neighbouring districts. Journal of the Asiatic Society of Bengal*, **14:** 340 - 354.
Blyth, E. (1862). Report of curator, zoological department, February, 1862, No. 1. *Journal of the Asiatic Society of Bengal*, **31:** 331 - 333.
Blyth, E. (1863). *Catalogue of the Mammals in the Museum of the Asiatic Society, Bengal.* .
Bobo, K. S. and C. B. Ntumwel (2010). Mammals and birds for cultural purposes and related conservation practices in the Korup area, Cameroon. *Life sciences Leaflets*, **9:** 226 - 233. URL: http://api.ning.com/files/gacnNrzqlnOpCQ3RQhWFKNoWo6xyGurFr6p841TnaX3hYX3pVxbRJBXNI6-SdfWL59b0rZfeeUQRWutH5HqJHB0Fn5Zc9R7e/226.MAMMALSANDBIRDSFORCULTURALPURPOSESANDRELATEDCONSERVATIONPRACTICESINTHEKORUPAREACAMEROONByK.S.BOBOandC.B.NTUMWEL.pdf .
Bobrinskoj, N. (1918). *Zametki o letuchikh myshakh dobytykh v predelakh Bukharskogo khanstva letom 1914 g. [Notes on the bats collected on the territory of the Kingdom of Bukhara in the summer 1914].* Materialy k Poznaniyu Fauny i Flory Rossii, Otdyel Zoologicheskiy, 15: 12.
Bobrinskoj, N. (1929). Bats of Central Asia. *Annuaire du Musée Zoologique de l'Academie des Sciences de l'URSS, Leningrad*, **30:** 217 - 249. [Abstract]
Bobrinskoy, N. A. (1925). Materialy dlya fauny letuchih myshey Turkestanskogo kraya. (Zapadnyy Turkestan s Semirechen - skoy i Zakaspiyskoy oblastyami, Khiva I Bukhara) [Mat - erials on the fauna of bats of Turkestan. (Eastern [sic!] Turkestan with the Regions of Semiretchie and of Trans -caspia, Khiva and Bouchara)]. *Byulletin Moskov sko go Ob she stva Izpytateley Prirody, Otdyel Biologii*, **N.S. 34:** 330-374.
Bocage, J. V. B. (1889a). Chiroptères africains nouveaux, rares ou peu connus. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 1 (1):** 1 - 7.
Bocage, J. V. B. (1889b). Mammifères d'Angola et du Congo. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 1 (1):** 8 - 32. [Abstract]
Bocage, J. V. B. (1889c). Breves considerações sobre a fauna de S. Thomé. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 1 (1):** 33 - 36.
Bocage, J. V. B. (1889d). Chiroptères de l'île St. Thomé. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 1 (3):** 197 - 199.
Bocage, J. V. B. (1891). Sur une variété de "*Phyllorrhina Commersoni*" de l'ile St. Thomé. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 2:** 88.
Bocage, J. V. B. (1892a). Subsidios para a Fauna da Guiné Portugueza. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 7:** 179 - 184.
Bocage, J. V. B (1892b). Observations sur les espèces du genre "*Cynonycteris*" recontrées en Angola par M. d'Anchieta. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **(2) 2, (7):** 173-178.
Bocage, J. V. B. (1895a). Mammiferos, aves e reptis da ilha de Anno-Bom. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser 2, 3:** 43 - 46.
Bocage, J. V. B. (1895b). Subsidios para a fauna da ilha de Fernão do Pó. Vertebrados terrestres. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser 2, 4 (8):** 1 - 15.
Bocage, J. V. B. (1896). Mammiferos, aves e reptis da Hanha, no sertao de Benguella. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 4 (14):** 105 - 109.
Bocage, J. V. B. (1897). Mamiferos, reptis e batrachios d'Africa de que existem exemplares typicos no museu de Lisboa. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser 2, 4 (16):** 187 - 206.
Bocage, J. V. B. (1898). Sur une nouvelle espèce de *Cynonycteris* d'Angola. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **ser. 2, 5 (19):** 133 - 139.
Bocage, J. V. B. (1900). A envoyé au Muséum des exemplaires de deux espèces nouvelles de chiroptères d'Angola. *Bulletin du Muséum national d'histoire naturelle de Paris*, **sér. 1, 6 (4):** 164.
Boddaert, P. (1785). *Elenchus Animalium. Volumen I. Sistens Quatrupedia huc usque nota, eorumque varietates. As ductum Nature, quantum fiery potuit disposita.* C.R. Hake, Roterodami [Rotterdam], I - XXXVIII; 1 - 174.
Bogan, M. A., H. W. Setzer, J. S. Findley and D. E. Wilson (1978). *Phenetics of Myotis blythi in Morocco.* Proceedings of the Fourth International Bat Research Conference - Nairobi: 217 - 230.
Bogdanov (1882). ?? Title still needs to be checked. ?? *Outline nat. Hist. Khibinskoyo.*

Bogdanowicz, W. (1990). Phenetic relationships among bats of the family Rhinolophidae. Abstract. Fifth European Bat Research Symposium: 20 - 25 august 1990 - Nyborg Strand, Denmark: no 32. [Abstract]
Bogdanowicz, W. (1992). Phenetic relationships among bats of the family Rhinolophidae. *Acta Theriologica*, **37 (3):** 213 - 240. [Abstract]
Bogdanowicz, W. (1994). *Myotis daubentonii*. *Mammalian Species*, **475:** 1 - 9, 3 figs.
Bogdanowicz, W., M. B. Fenton and K. Daleszczyk (1999). The relationships between echolocation calls, morphology and diet in insectivorous bats. *Journal of Zoology*, **247 (3):** 381 - 393.
Bogdanowicz, W., P. Hulva, B. C. Bolfíková, M. M. Bus, E. Rychlicka, A. Sztencel-Jablonka, L. Cistrone and D. Russo (2015). Cryptic diversity of Italian bats and the role of the Apennine refugium in the phylogeography of the western Palaearctic. *Zoological Journal of the Linnean Society*, **174 (3):** 635 - 648. doi: 10.1111/zoj.12248.
Bogdanowicz, W., J. Juste, R. D. Owen and A. Sztencel (2005). Geometric morphometrics and cladistics: testing evolutionary relationships in mega- and microbats. *Acta Chiropterologica*, **7 (1):** 39 - 49.
Bogdanowicz, W., S. Kasper and R. D. Owen (1998). Phylogeny of Plecotine bats: reevaluation of morphological and chromosomal data. *Journal of Mammalogy*, **79 (1):** 78 - 90. [Abstract]
Bogdanowicz, W. and D. Kock (1998). Quoting and spelling names of species from H. Kuhl's "Die deutschen Fledermäuse". *Bat Research News*, **39 (1):** 4 - 5.
Bogdanowicz, W. and R. D. Owen (1990). Phylogenetic analyses of the bat family Rhinolophidae. 1. Metrical characters. Abstract. Fifth European Bat Research Symposium: 20 - 25 august 1990 - Nyborg Strand, Denmark: no 91. [Abstract]
Bogdanowicz, W. and R. D. Owen (1992). Phylogenetic analyses of the bat family Rhinolophidae. *Zeitschrift für zoologischen Systematik und Evolutions-forschung*, **30:** 142 - 160. [Abstract]
Bogdanowicz, W. and R. D. Owen (1996). *Landmark-based size and shape analysis in the Plecotine bats.* In Marcus, L.F., M. Corti, A. Loy, G.J.P. Naylor and D. Slice : *Advances in morphometrics.* Plenum Press - New York: 489 - 501. URL: http://www.faunaparaguay.com/plenum2.pdf. [Abstract]
Bogdanowicz, W. and R. D. Owen (1998). *2. In the Minotaur's labyrinth. Phylogeny of the bat family Hipposideridae.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 27 - 42.
Bohmann, K., A. Monadjem, C. Lehmkuhl Noer, M. Rasmussen, M. R. K. Zeale, E. Clare, G. Jones, E. Willerslev and M. T. P. Gilbert (2011). Molecular diet analysis of two african free-tailed bats (Molossidae) using high throughput sequencing. *PLoS ONE*, **6 (6) e21441:** 1 - 11. doi: 10.1371/journal.pone.0021441.
Böhme, W. and R. Hutterer (1979). Kommentierte Liste einer Säugetier Aufsammlung aus dem Senegal. *Bonner zoologische Beitrage*, **29 (4):** 303 - 322 (fir 1978). [Abstract]
Boie, F. (1830). Naturgeschichtliche Beytrage vermischten Inhalts. II. *Leuconoe* Boie, eine neue Fledermausgattung. *Isis oder Encyclopädische Zeitung von Oken*, **1830:** 256 - 257.
Bojarski, C. (1990). Immunolocalisation of, and ultrastructural changes in the LH gonadotropes of *Miniopterus schreibersii* and *Rhinolophus capensis* (Mammalia: Chiroptera) in relation to their reproductive cycles. MS thesis - Rhodes University: i - viii; 1 - 109. URL: http://contentpro.seals.ac.za/iii/cpro/DigitalItemViewPage.external?sp=1002039. [Abstract]
Bojarski, C. (1993). Seasonal changes in pituitary and plasma prolactin concentrations, and the role of prolactin in the control of delayed implantation in female *Miniopterus schreibersii*. PhD thesis - Rhodes University: i - ix; 1 - 95. URL: http://eprints.ru.ac.za/3694/1/BOJARSKI-PhD-TR94-06.pdf. [Abstract]
Bojarski, C. and R. T. F. Bernard (1988). Comparison of the morphology of the megachiropteran and microchiropteran eye. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **23 (3):** 155 - 160. doi: 10.1080/02541858.1988.11448095. [Abstract]
Bojarski, C. and R. T. F. Bernard (1992). Immunolocalization and ultrastructural changes of LH gonadotropes in relation to testicular activity and sperm storage in the male Cape horseshoe bat, *Rhinolophus capensis*. *South African Journal of Sciences*, **88:** 234 - 236.
Bol A Anong, A., B. B. Guieke and B. D. Tsala (2011). Introduction à l'inventaire des Chauves-souris (Chiroptères) de la ville de Maroua, Extrême-Nord Cameroun. Mémoire présenté en vu de l'obtention du Diplôme de Professeur de l'Enseignement Secondaire de Deuxième Grade (DIPESS II) en Sciences de la Vie et de la Terre (Option : Unique). Université de Maroua: 96 pp. URL: http://www.le-vespere.org/docs/telechargements/Bol-Guieke&Tsala_2011_Chauves-sourisMaroua_NordCameroun.pdf.
Bol A Anong, A. G. (2013). Investigations sur le régime alimentaire de trois chauves-souris insectivores de la région de l'Extrême-Nord Cameroun. Master's thesis - University of Maroua, Cameroon: i - xiii; 1 - 66. URL: http://le-vespere.org/wp-content/uploads/2015/02/telechargements/Bol%20A%20Anong_2013_RegimeAlimentaireInsectivoresCameroun.pdf.
Bollen, A. (2003). Fruit-frugivore interactions in a Malagasy littoral forest: a community-wide approach of seed dispersal. PhD Thesis - University of Antwerp, Belgium: 165 pp.
Bollen, A. (2007). *Chapter 3.4. Fruit characteristics: fruit selection, animal seed dispersal and conservation matters in the Sainte Luce Forests.* In Ganzhorn, J.U., S.M. Goodman and M. Vincelette : *Biodiversity, Ecology and Conservation of Littoral Ecosystems in Southeastern Madagascar, Tolagnaro* SI/MAB Series #11, Smithsonian Institution, Washington DC, USA= 127 - 145. URL: http://www.riotintomadagascar.com/pdf/biodiversityBook/Madagascar_3.4.pdf.
Bollen, A. and G. Donati (2006). Conservation status of the littoral forest of south-eastern Madagascar: A review. *Oryx*, **40 (1):** 57 - 66. doi: 10.1017/S0030605306000111.
Bollen, A. and L. Van Elsacker (2002). Feeding ecology of *Pteropus rufus* (Pteropodidae) in the littoral forest of Sainte Luce, SE Madagascar. *Acta Chiropterologica*, **4 (1):** 33 - 47. doi: 10.3161/001.004.0105.
Bollen, A., L. Van Elsacker and J. U. Ganzhorn (2004a). Relations between fruits and disperser assemblages in a Malagasy littoral forest: A community-level approach. *Journal of Tropical Ecology*, **20 (6):** 599 - 612. doi: 10.1017/S0266467404001853.
Bollen, A., L. Van Elsacker and J. U. Ganzhorn (2004b). Tree dispersal strategies in the littoral forest of Sainte Luce (SE-Madagascar). *Oecologia*, **139 (4):** 604 - 616. doi: 10.1007/s00442-004-1544-0.
Bonaccorso, F. J., J. R. Winkelmann, A. Deacon and S. Macfadyen (2004). On the distribution of *Ficus sycomorus* and movements of *Epomophorus* fruit bats in Kruger National Park, South Africa. *Bat Research News*, **45 (4):** 205 - 206.
Bonaccorso, F. J., J. R. Winkelmann, C. M. Todd and A. C. Miles (2014). Foraging movements of epauletted fruit bats (Pteropodidae) in relation to the distribution of sycamore figs (Moraceae) in Kruger National Park, South Africa. *Acta Chiropterologica*, **16 (1):** 41 - 52. doi: 10.3161/150811014X683255.
Bonaparte, C. L. (1837-41). *Iconografia della Fauna Italica per le quattro classi degli Animali Vertebrati. Tomo I. Mammiferi e uccelli.* Tipografia Salviucci, Roma, Italy.
Bonaparte, C. L. (1841). *Iconogr.Fauna ital.* .

Bonaparte, C. L. (1845). ?? Title still needs to be checked. ?? *Atti della sesta Ruin. degli Scienze Italiano, Milano*.
Bondarenko, A. M. (2007). Fauna of bats of the Kitskansky wood (Moldova, Transdniester Region) (In Russian with English summary). *Plecotus et al.*, **9 :** 18 - 24.
Bonhote, J. L. (1910). On a small collection of mammals from Egypt. *Proceedings of the Zoological Society of London*, **1909, IV:** 788 - 798. [Abstract]
Bonhote, J. L. (1912). 15. On a further collection of mammals from Egypt and Sinai. *Proceedings of the Zoological Society of London*, **1912, I:** 224 - 231.
Bonvicino, C. R., M. A. Moreira and M. A. Soares (2014). Hepatitis B virus lineages in mammalian hosts: Potential for bidirectional cross-species transmission. *World Journal of Gastroenterology*, **20 (24):** 7665 - 7674. doi: 10.3748/wjg.v20.i24.7665.
Boonman, A., Y. Bar-On, N. Cvikel and Y. Yovel (2013b). It's not black or white - on the range of vision and echolocation in echolocating bats. *Frontiers in Physiology*, **4:** 248. doi: 10.3389/fphys.2013.00248.
Boonman, A., S. Bumrungsri and Y. Yovel (2014). Nonecholocating fruit bats produce biosonar clicks with their wings. *Current Biology*, **24 (24):** 2962 - 2967. doi: 10.1016/j.cub.2014.10.077.
Boonman, A., Y. Yovel and S. Bumrungsri (2013a). Echolocation in non-echolocating bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 23 - 24. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Boot (1837). II. Orbituary. *Magazine of Natural History and Journal of Zoology, Botany, Mineralogy, Geology, and Meteorology*, **n.s. 1, 1 (7):** 388 - 392.
Booth, A. H. (1956). Some Gold Coast mammals not included in Cansdale's "Provisional Checklist". *Journal of the West African Science Association*, **2 (2):** 137 - 138. [Abstract]
Booth, A. H. (1958). The Niger, the Volta and the Dahomey Gap as geographic Barriers. *Evolution*, **12:** 48 - 62. [Abstract]
Booth, A. H. (1959). On the mammalian fauna of the Accra Plain. *Journal of the West African Science Association*, **5 (1):** 26 - 36. [Abstract]
Borchert, M., S. Mulangu, R. Swanepoel, A. Tshomba, A. Afounde, A. Kulidri, J.-J. Muyembe-Tamfum and P. Van der Stuyft (2005). Pygmy populations seronegative for Marburg virus. *Emerging Infectious Diseases*, **11 (1):** 174 - 177.
Borg, J. J. (2002). *Bat Data Sheets for the Maltese Islands.* Environment Protection Directorate/ MEPA.
Borquin, O., J. Vincent and P. M. Hitchins (1971). The vertebrates of the Hluhluwe Game Reserve-Corridor (State-Land)-Umfolozi Game Reserve Complex. *The Lammergeyer: the journal of the Natal Parks, Game & Fish Preservation Board*, **14:** 5 - 58, 61 figs.
Boston, E. (S. M.), I. Montgomery and P. A. Prodöhl (2008). Development and characterization of 11 polymorphic compound tetranucleotide microsatellite loci for the Leisler's bat, *Nyctalus leisleri* (Vespertilionidae, Chiroptera). *Conservation Genetics*, **10 (5):** 1501 - 1504 (for 2009). doi: 10.1007/s10592-008-9768-x.
Boston, E. S. M., W. I. Montgomery, R. Hynes and P. A. Prodöhl (2015). New insights on postglacial colonization in western Europe: the phylogeography of the Leisler's bat (*Nyctalus leisleri*). *Proceedings of the Royal Society of London*, **B 282 (1804):** 20142605. doi: 10.1098/rspb.2014.2605.
Boston, E. (S. M.), P. Prodöhl and I. Montgomery (2007). Mitochondrial phylogeography of the Leisler's bat (*Nyctalus leisleri*) in Ireland and across Europe: new perspectives. XIV International Bat Research Conference & 37th NASBR, Merida, Yucatan, Mexico, 19-23 August 2007: 120.
Boston, E. S. M., S. J. Puechmaille, F. Clissmann and E. C. Teeling (2014). Further evidence for cryptic north-western refugia in Europe? Mitochondrial phylogeography of the sibling species *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus*. *Acta Chiropterologica*, **16(2):** 263 - 277. doi: 10.3161/150811011014X687233.
Botero-Castro, F., F. Delsuc and E. J. P. Douzery (2014). Thrice better than once: quality control guidelines to validate new mitogenomes. *Mitochondrial DNA*, **27 (1):** 449 - 454 (for 2016). doi: 10.3109/19401736.2014.900666.
Botnariuc, N. and V. Tatole (2005). *Cartea Rosie a vertebratelor din România.* Museul National de Istorie Naturala "Grigore antipa".
Bouchard, S. (1998). *Chaerephon pumilus*. *Mammalian Species*, **574:** 1 - 6, 3 figs.
Bouchard, S. (2001a). *Chaerephon ansorgei*. *Mammalian Species*, **660:** 1 - 3, 3 figs.
Bouchard, S. (2001b). Sex discrimination and roostmate recognition by olfactory cues in the African bats, *Mops condylurus* and *Chaerephon pumilus* (Chiroptera: Molossidae). *Journal of Zoology*, **254 (1):** 109 - 117. doi: 10.1017/S0952836901000607.
Boulard, Y. (1975). Etude morphologique des coccidies (Adeleidea) *Klossiella killicki* n. sp. chez des microchiropteres africains et *Klossiella tejerai* Scorza, 1957, chez un marsupial sud-americain [with English summary]. *Bulletin du Muséum national d'histoire naturelle de Paris*, **Sér. 3 (284), Zool. (194):** 83 - 89.
Boulay, M. C. and C. B. Robbins (1989). *Epomophorus gambianus*. *Mammalian Species*, **344:** 1 - 5, 3 figs.
Boulger, L. R. and J. S. Porterfield (1958). Isolation of a virus from Nigerian fruit bats. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **52 (5):** 421 - 424. doi: 10.1016/0035-9203(58)90127-5. [Abstract]
Boundenga, L., B. Makanga, B. Ollomo, A. Gilabert, V. Rougeron, B. Mve-Ondo, C. Arnathau, P. Durand, N. D. Moukodoum, A.-P. Okouga, L. Delicat-Loembet, L. Yacka-Mouele, N. Rahola, E. Leroy, C. Tidiane, F. Renaud, F. Prugnolle and C. Paupy (2016). Haemosporidian parasites of antelopes and other vertebrates from Gabon, Central Africa. *PLoS ONE*, **11 (2):** e0148958. doi: 10.1371/journal.pone.0148958.
Boundenga, L., B. Ngoubangoye, I. M. Mombo, T. A. Tsoubmou, F. Renaud, V. Rougeron and F. Prugnolle (2018). Extensive diversity of malaria parasites circulating in Central African bats and monkeys. *Ecology and Evolution*, **8:** 10578 - 10586. doi: 10.1002/ece3.4539.
Bourgarel, M., D. M. Pfukenyi, V. Boué, L. Talignani, N. Chiweshe, F. Diop, A. Caron, G. Matope, D. Missé and F. Liégeois (2018). Circulation of *Alphacoronavirus, Betacoronavirus* and *Paramyxovirus* in *Hipposideros* bat species in Zimbabwe. *Infection, Genetics and Evolution*, **58:** 253 - 257. doi: 10.1016/j.meegid.2018.01.007.
Bourgarel, M., N. Wauquier and J.-P. Gonzalez (2010). Emerging viral threats in Gabon: health capacities and response to the risk of emerging zoonotic diseases in Central Africa. *Emerging Health Threats Journal*, **3 (e7):** 1 - 11. doi: 10.3134/ehtj.10.163.
Bourne, S. (2009). Bats of the Mascerene Islands. *The Australasian Bat Society Newsletter*, **32:** 21 - 22.
Bourquin, O. and S. G. Sowler (1980). The vertebrates of Vernon Crookes Nature Reserve: 1. *The Lammergeyer: the journal of the Natal Parks, Game & Fish Preservation Board*, **28:** 20 - 32.
Bourret, R. (1951). Une nouvelle chauve-souris du Tonkin, *Rhinomegalophus paradoxolophus*. *Bulletin du Muséum national d'histoire naturelle de Paris*, **ser. 2, 33 (6):** 607 - 609.
Bovey, R. (1949). Les chromosomes des Chiroptères et des Insectivores. *Revue suisse de zoologie*, **56:** 371 - 460.

Bowdich, T. E. (1821). *An analysis of the natural classification of mammalia, for the use of students and travellers.* J. Smith - Paris.

Bowdich, T. E. (1825). *Excursions in Madeira and Poto Santo, during the autumn of 1823, while on his third voyage to Africa.* George B. Whittaker, London: i - xii; 1 - 278.

Bowie, R. C. K., D. S. Jacobs and P. J. Taylor (1999). Resource use by two morphologically similar insectivorous bats (*Nycteris thebaica* and *Hipposideros caffer*). *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **34 (1):** 27 - 33.

Bown, T. M., M. Kraus, S. Wing, J. Fleagle, B. H. Tiffney, E. Simons and C. F. Vondra (1982). The Fayum Primate Forest revisited. *Journal of Human Evolution*, **11:** 603 - 632. doi: http://digitalcommons.unl.edu/usgsstaffpub/245. [Abstract]

Braack, L. E. O. (1989). Arthropod inhabitants of a tropical cave 'island' environment provisioned by bats. *Biological Conservation*, **48 (2):** 77 - 84. [Abstract]

Bracebridge C., E. Fanning and K. M. Howell [Eds] (2004). Nawenge Forest Reserve: A biodiversity survey. Frontier-Tanzania Enviromental Research Report 109. Society for Environmental Exploration UK, University of Dar es Salaam, Forest and Beekeeping Division, Dar es Salaam, Tanzania: i - vi; 1 - 46. URL: http://easternarc.or.tz/downloads/Mahenge/FTER%20109%20Nawenge%20FR%20-%20final.pdf.

Bradbury, J. W. (1977). Lek mating behavior in the hammer-headed bat. *Zeitschrift für Tierpsychologie - Journal of Comparative Ethology*, **45 (3):** 225 - 255. doi: 10.1111/j.1439-0310.1977.tb02120.x. [Abstract]

Bradbury, J. W. (1981). *The evolution of leks.* In Alexander, R. D. and D. W. Tinkle [Eds]: *Natural selection and social behaviour: Recent research and new theory.* Chiron Press, New York; 138 - 169.

Bradford, C., R. Jennings and J. Ramos-Vara (2010). Gastrointestinal leiomyosarcoma in an Egyptian fruit bat (*Rousettus aegyptiacus*). *Journal of Veterinary Diagnosis and Investigation*, **22 (3):** 462 - 265. doi: 10.1177/104063871002200324.

Bradley, L. C., B. R. Amman, J. G. Brant, L. R. McAuley, F. Mendez-Harclerode, J. R. Suchecki, C. Jones, H. H. Genoways, R. J. Baker and R. D. Bradley (2005). Mammalogy at Texas Tech University: a historical perspective. *Occasional Papers of the Museum, Texas Tech University*, **243:** 1 - 30.

Bradley, R. D. and R. J. Baker (2001). A test of the genetic species concept: cytochrome-*b* sequences and mammals. *Journal of Mammalogy*, **82 (4):** 960 - 973. doi: 10.1644/1545-1542(2001)082<0960:ATOTGS>2.0.CO;2.

Bradley, R. D., L. C. Bradley, H. J. Garner and R. J. Baker (2012). Cost of collecting and preparing mammal voucher specimens for natural history collections. *Occasional Papers of the Museum, Texas Tech University*, **313:** 1 - 14.

Bræstrup, F. W. (1933). On the taxonomic value of the subgenus *Lophomops* (Nyctinomine bats), with remarks on the breeding times of African bats. *Annals and Magazine of Natural History*, **ser. 10, 11 (63):** 269 - 274. doi: 10.1080/00222933308673658.

Bræstrup, F. W. (1935a). Remarks on climatic change and faunal evolution in Africa. *Zoogeografica*, **2:** 484 - 494. [Abstract]

Bræstrup, F. W. (1935b). Report on the mammals collected by Mr. Harry Madsen during professor O. Olufsen's expedition to French Sudan and Nigeria in the years 1927-28. (with zoogeographical remarks.). *Videnskabelige Meddelelser fra dansk naturhistorisk Forening in Kobenhavn*, **99:** 73 - 130.

Bræstrup, F. W. (1947). Remarks on faunal exchange through the Sahara. *Videnskabelige Meddelelser fra dansk naturhistorisk Forening in Kobenhavn*, **110:** 1 - 15. [Abstract]

Brainard, J. (2019). West African bats hosts Ebola. *Science*, **363 (6426):** 434. doi: 10.1126/science.363.6426.434.

Branch, W. R. (2008). Proposed Kalukundi Mine (Democratic Republic of the Congo) terrestrial fauna environmental impact assessment report. Final report. Envirolution Consulting (Pty) Ltd, PO Box 1898, Sunninghill 2157: 83 pp. URL: http://www.africoresources.com/r/files/appendix5_terrestrial_fauna_assessment.pdf.

Braun, J. K. and M. A. Mares (1995). The mammals of Argentina: an etymology. *Mastozoología Neotropical*, **2 (2):** 173 - 206.

Braun, M. and U. Häussler (1999). Funde der Zwergfledermaus-Zwillingsart *Pipistrellus pygmaeus* (Leach, 1825) in Nordbaden. *Carolinea*, **57:** 111 - 120.

Bray, R. S. (1958). On the parasitic Protozoa of Liberia. I. Coccidia of some small mammals. *Journal of Protozoology*, **5 (1):** 81 - 83. doi: 10.1111/j.1550-7408.1958.tb02530.x. [Abstract]

Bray, T. C. and P. Benda (2016). Distribution of *Asellia tridens* (Chiroptera: Hipposideridae) lineages including representatives from Saudi Arabia. *Zoology in the Middle East*, **62(4):** 283 - 287. doi: 10.1080/09397140.2016.1250708.

Bray, T. C., O. B. Mohammed and A. N. Alagaili (2013). Phylogenetic and demographic insights into Kuhl's pipistrelle, *Pipistrellus kuhlii*, in the Middle East. *PLoS ONE*, **8 (2):** e57306. doi: 10.1371/journal.pone.0057306.

Brehm, C. L. (1827). ?? Title still needs to be checked. ?? *Ornis*3.

Breitwisch, R. (1983). Fructivores at a fruiting *Ficus* vine in a southern Cameroon tropical wet forest. *Biotropica*, **15 (2):** 125 - 128. [Abstract]

Breman, J. G., K. M. Johnson, G. Van der Groen, C. B. Robbins, M. V. Szczeniowski, K. Ruti, P. A. Webb, F. Meier, D. L. Heymann and Ebola Virus Study Team (1999). A search for Ebola virus in animals in the Democratic Republic of the Congo and Cameroon: Ecologic, virologic, and seriologic surveys, 1979 - 1980. *The Journal of Infectious Diseases*, **179 (2 - Suppl 1):** 139 - 147. doi: 10.1086/514278.

Brennan, R. E. Jr., W. Caire, N. Pugh, S. Chapman, A. H. Robbins and D. E. Akiyoshi (2015). Examination of bats in western Oklahoma for antibodies against *Pseudogymnoascus destructans*, the causative agent of white-nose syndrome. *The Southwestern Naturalist*, **60 (2-3):** 145 - 150.

Bres, P. and L. Chambon (1963). Isolation at Dakar of a strain of arborvirus from the salivary glands of the bat. Ann. Inst. Pasteur (Paris). 104.

Bretschner (1904). ?? Title still needs to be checked. ?? .

Brierley, L., M. J. Vonhof, K. J. Olival, P. Daszak and K. E. Jones (2016). Quantifying global drivers of zoonotic bat viruses: a process-based perspective. *American Naturalist*, **187 (2):** xxx - xxx. doi: 10.1086/684391 (?).

Briggs, D. J., H. Wilde, T. Hemachuda, Shantavasinkul, B. Quiambao, M. K. Sudarshan and S. N. Madhusudana (2011). Commenton: 'Rabies and African bat lyssavirus encephalitis and its prevention'. *International Journal of Antimicrobial Agents*, **37:** 182 - 183. doi: 10.1016/j.ijantimicag.2010.10.019.

Brigham, R. M., E. K. V. Kalko, G. Jones, S. Parsons and H. J. G. A. Limpens [Eds] (2004). *Bat Echolocation Research. Tools, techniques and analysis.* Bat Conservation International - Austin, Texas: i - vii; 1 - 167. URL: http://www.batcon.org/pdfs/stories/BatEcholocationResearch.pdf.

Brito, J. C., F. Álvares, F. Martínez-Freirá, P. Sierra, N. Sillero and P. Tarroso (2010). Data on the distribution of mammals from Mauritania, West Africa. *Mammalia*, **74 (4):** 449 - 455. doi: 10.1515/MAMM.2010.05.

Broadley, D. G. (1982). Predation on termites by African Caenophidian snakes. *Journal of the Herpetological Association of Africa*, **27 (1):** 8.

Bronner, G. N. (1990). New distribution records for four mammal species, with notes on their taxonomy and ecology. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **33 (2):** 1 - 7. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/435. [Abstract]
Bronner, G. N., M. Hoffmann, P. J. Taylor, C. T. Chimimba, P. B. Best, C. A. Matthee and T. J. Robinson (2003). A revised systematic checklist of the extant mammals of the southern African subregion. *Durban Museum Novitates*, **28:** 56 - 106.
Bronner, G. N., S. K. Maloney and R. Buffenstein (1999). Survival tactics within thermally-challenging roosts: heat tolerance and cold sensitivity in the Angolan free-tailed bat, *Mops condylurus*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **34 (1):** 1 - 10.
Bronner, G. N. and J. A. J. Meester (1987). Mammals of Bluff Nature Reserve. *The Lammergeyer: the journal of the Natal Parks, Game & Fish Preservation Board*1 - 7.
Brook, C. E., Y. Bai, A. P. Dobson, L. M. Osikowicz, H. C. Ranaivoson, Q. Zhu, M. Y. Kosoy and K. Dittmar (2015). *Bartonella* spp. in fruit bats and blood-feeding ectoparasites in Madagascar. *PLoS Neglected Tropical Diseases*, **10 (2):** e0003532. doi: 10.1371/journal.pntd.0003532.
Brook, C. E., H. C. Ranaivoson, D. Andriafidison, M. Ralisata, J. Razafimanahaka, J.-M. Héraud, A. P. Dobson and C. J. Metcalf (2019). Population trends for two Malagasy fruit bats. *Biological Conservation*, **234:** 165 - 171. doi: 10.1016/j.biocon.2019.03.032.
Brooks, D. M. and J. W. Bickham (2014). New species of *Scotophilus* (Chiroptera: Vespertilionidae) from sub-Saharan Africa. *Occasional Papers of the Museum, Texas Tech University*, **326:** 1 - 21.
Broom, R. (1948). Some South African Pliocene and Pleistocene mammals. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **21:** 1 - 38.
Brosset, A. (1955). Observations sur la biologie des chiroptères du Maroc oriental. *Bulletin de la Société des sciences naturelles et physiques du Maroc*, **35 (4):** 295 - 306.
Brosset, A. (1961). L'hibernation chez les chiroptères tropicaux. *Mammalia*, **25 (4):** 413 - 452. [Abstract]
Brosset, A. (1963). *Myotis nattereri*, chiroptère nouveau pour l'Afrique du Nord. *Mammalia*, **27 (3):** 440 - 443.
Brosset, A. (1966a). Contribution à la faune du Congo (Brazzaville). Mission A. Villiers et A. Descarpentries. XX. Chiroptères. *Bulletin de l'Institut fondamental d'Afrique noire: sciences naturelles*, **28A (1):** 362 - 370.
Brosset, A. (1966b). *La Biologie des chiroptères.* Paris: 240 pp.
Brosset, A. (1966c). Les chiroptères du Haut-Ivindo (Gabon). *Biologica Gabonica*, **2 (1):** 47 - 86.
Brosset, A. (1968). La permutation du cycle sexuel saisonnier chez le chiroptère *Hipposideros caffer*, au voisinage de l'équateur. *Biologica Gabonica*, **4 (4):** 325 - 341. [Abstract]
Brosset, A. (1976). Social organization in the African bat, *Myotis boccagei*. *Zeitschrift für Tierpsychologie - Journal of Comparative Ethology*, **42 (1):** 50 - 56. doi: 10.1111/j.1439-0310.1976.tb00955.x. [Abstract]
Brosset, A. (1982). Structure sociale du chiroptère *Hipposideros beatus*. *Mammalia*, **46 (1):** 3 - 9. doi: 10.1515/mamm.1982.46.1.3. [Abstract]
Brosset, A. (1985). Chiroptères d'altitude du Mont Nimba (Guinée). Description d'une espèce nouvelle, *Hipposideros lamottei*. *Mammalia*, **48 (for 1984) (4):** 545 - 555. [Abstract]
Brosset, A. (2003). *Les chiroptères du mont Nimba.* In Lamotte, M. and R. Roy : *Le Peuplement Animal du Mout Nimba (Guinée, Côte d'Ivoire, Liberia).* Mémoires du Museum national d'Histoire naturelle: 687 - 693.
Brosset, A., L. Barbe, J.-C. Beaucournu, C. Faugier, H. Salvayre and Y. Tupinier (1988). La raréfaction du rhinolophe euryale (*Rhinolophus euryale* Blasius) en France. *Mammalia*, **52 (1):** 101 - 122. doi: 10.1515/mamm.1988.52.1.101. [Abstract]
Brosset, A. and B. Caubère (1960). La colonie d'*Asellia tridens* de l'oasis de Figuig (Chiroptères). *Mammalia*, **24 (2):** 222 - 227. [Abstract]
Brosset, A. and H. Saint Girons (1980). Cycles de reproduction des microchiroptères troglophiles du nord-est du Gabon. *Mammalia*, **44 (2):** 225 - 232. doi: 10.1515/mamm.1980.44.2.225. [Abstract]
Brosset, A. and R. Vuattoux (1968). Redécouverte du "rat volant" de Daubenton *Myopterus senegalensis* Oken (Chiroptera), en Cote-d'Ivoire. *Mammalia*, **32 (1):** 82 - 85. doi: 10.1515/mamm.1968.32.1.82. [Abstract]
Brown, C. R. (1999). Metabolism and thermoregulation of individual and clustered long-fingered bats, *Miniopterus schreibersii*, and the implications for roosting. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **34 (4):** 166 - 172.
Brown, C. R. and R. T. F. Bernard (1994). Thermal preference of Schreiber's long-fingered (*Miniopterus schreibersii*) and Cape horseshoe (*Rhinolophus capensis*) bats. *Comparative Biochemistry and Physiology*, **107A:** 439 - 449.
Brown, K. M. and J. Dunlop (1997). *Rhinolophus landeri*. *Mammalian Species*, **567:** 1 - 4, 4 figs.
Brown, R. W. (1991). *Composition of scientific words.* Smithsonian Institution Press, Washington D.C.
Brugière, D. and A. Penelon (1999). Proposition au gouvernement de la République Centrafricaine de classement du site de Mbaere-Bodingue comme zone humide d'importance internationale au titre de la convention de Ramsar. Projet ECOFAC, Bangui, République Centraficaine & UMR, Université de Rennes, France: 22 pp.
Brunet, A. K. and R. A. Medellin (2001). The species-area relationship in bat assemblages of tropical caves. *Journal of Mammalogy*, **82 (4):** 1114 - 1122.
Brünnich, M. T. (1782). *Dyrenes Historie og Dyre-Samlingen udi Universitetets Natur-Theater. 4. Bind.* Kobenhavn: i - xxxvii; 1 - 76.
Brunotte, L., M. Beer, M. Horie and M. Schwemmle (2016). Chiropteran influenza viruses: flu from bats or a relic from the past? *Current Opinion in Virology*, **16:** 114 - 119. doi: 10.1016/j.coviro.2016.02.003.
Bruton, M. N. (1978). Recent mammal records from eastern Tongaland in Kwazulu, with notes on Hippopotamus in Lake Sibaya. *The Lammergeyer: the journal of the Natal Parks, Game & Fish Preservation Board*, **24:** 19 - 27. [Abstract]
Bruyndonckx, N., F. Biollaz, S. Dubey, J. Goudet and P. Christe (2010). Mites as biological tags of their hosts. *Molecular Ecology*, **19:** 2770 - 2778. doi: 10.1111/j.1365-294X.2010.04699.x.
Buceta, J. and K. Johnson (2017). Modeling the Ebola zoonotic dynamics: Interplay between enviroclimatic factors and bat ecology. *PLoS ONE*, **12 (6):** e0179559. doi: 10.1371/journal.pone.0179559.
Buffenstein, R., S. K. Maloney and G. N. Bronner (1999). Seasonal and daily variation in blood and urine concentrations of free-ranging Angolan free-tailed bats (*Mops condylurus*) in hot roosts in southern Africa. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **34 (1):** 11 - 18.
Bulatova, N., L. Lavrenchenko, V. Orlov and A. Milishnikov (1999). Chromosome identification of mammalian species in western Ethiopia. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 18.
Burchardt, L. S., P. Norton, O. Behr, C. Scharff and M. Knörnschild (2019). General isochronous rhythm in echolocation calls and social vocalizations of the bat *Saccopteryx bilineata*. *Royal Society Open Science*, **6 (1):** 181076. doi: 10.1098/rsos.181076.

Burgess, H. N. L. (2004). A behavioural study of the Silhouette sheath-tailed bat (*Coleura seychellensis*). *Phelsuma*, **12:** 69 - 77.
Burgess, H. (N. L.) and N. Lee (2004). A behavioural study of the Silhouette sheath-tailed bat (*Coleura seychellensis*). *Phelsuma*, **12:** 69 - 77. URL: http://islandbiodiversity.com/Phelsuma%2012-3.pdf.
Burgess, N. D., D. Kock, A. Cockle, C. FitzGibbon, P. Jenkins and P. Honess (2000). *Mammals.* In Burgess, N. D. and G. P. Clarke : *Coastal forests of Eastern Africa. IUCN Forest Conservation Program.* IUCN - The World Conservation Union - Gland & Cambridge: 173 - 190; App. 5: 401 - 406.
Burgess, N. D., L. B. Mwasumbi, W. J. Hawthorne, A. Dickinson and R. A. Doggett (1992). Preliminary assessment of the distribution, status and biological importance of coastal forests in Tanzania. *Biodiversity and conservation*, **62 (3):** 205 - 218. [Abstract]
Burland, T. M. and J. W. Wilmer (2001). Seeing in the dark: molecular approaches to the study of bat populations. *Biological Reviews*, **76:** 389 - 409.
Burnett, G. T. (1829). Illustrations of the Alipeda (Alipeds), or bats and their allies; being the arrangement of the Cheiroptera, Volitantia, or wing-footed beasts, indicated in outline. *Quarterly Journal of Science, Literature and Art*, **1 (5):** 262 - 269.
Burney, D. A., N. Vasey, L. R. Godfrey, Ramilisonina, W. L. Jungers, M. Ramarolahy and L. Raharivony (2008). New findings at Andrahomana cave, southeastern Madagascar. *Journal of Cave and Karst Studies*, **70 (1):** 13 - 24. URL: http://www.caves.org/pub/journal/PDF/v70/cave-70-01-13.pdf.
Butenko, A. M. (1996). Study of arboviruses in the republic of Guinea. *Med. Parazitol. (Mosk).*, **2:** 40 – 45.
Butinsky, T. M. (1984). Ecological survey of the Impenetrable (Bwindi) Forest, Uganda, and recommendations for its conservation and management. Wildlife Conservation International - New York Zoological Society: i - vi; 1 - 150. URL: http://wildsolutions.nl/Publications/Ecological%20Survey%20of%20the%20Impenetrable%20(Bwindi)%20Forest%20-%20Butynski%20-%201984.pdf. [Abstract]
Butler, C. and R. MacFarlane (2011). Beware of pigs near wings: piggeries, birds, bats and human health. In Anonymus : *1st International One Health Congress. EcoHealth*, **7 (Suppl. 1):** S77 - S78. doi: 10.1007/s10393-010-0376-0. URL: http://www.springerlink.com/content/fk7568613802u117/fulltext.pdf.
Butler, J. E., N. Wertz, Y. Zhao, S. Zhang, Y. Bao, S. Bratsch, T. H. Kunz, J. O. Jr. Whitaker and T. Schountz (2010). The two suborders of chiropterans have the canonical heavy-chain immunoglobulin (Ig) gene repertoire of eutherian mammals. *Developmental and Comparative Immunology*, **35:** 273 - 284 (for 2011). doi: 10.1016/j.dci.2010.08.011.
Butler, P. M. (1969). *Insectivores and bats from the Miocene of East Africa: new material.* In Leakey, L. S. B. : *Fossil vertebrates of Africa, vol 1.* Academic Press - New York & London: 1 - 38.
Butler, P. M. (1978). *Insectivora and Chiroptera.* In Maglio, V. J. and H. B. S. Cooke : *Evolution of African Mammals.* Harvard University Press - Cambridge, Mass.: 56 - 68.
Butler, P. M. (1984). Macroscelidea, Insectivora and Chiroptera from the Miocene of East Africa. *Palaeovertebrata, Montpelier*, **14 (3):** 177 - 200. [Abstract]
Butler, P. M. and M. Greenwood (1965). *Insectivora and Chiroptera.* In Leakey, L. S. B. : *Olduvai Gorge 1951-1961. Vol. 1: Fauna and background.* Cambridge University Press - Cambridge, U.K.: 13 - 15.
Butler, P. M. and A. T. Hopwood (1957). Insectivora and Chiroptera from the Miocene rocks of Kenya Colony. *Fossil Mammals of Africa*, **13:** 1 - 35.
Byng, J. W., P. A. Racey and M. D. Swaine (2009). The ecological impacts of a migratory bat aggregation on its seasonal roost in Kasanka National Park, Zambia. *African Journal of Ecology*, **48:** 29 - 36. doi: 10.1111/j.1365-2028.2009.01074.x.
Cabral, M. J., J. Almeida, P. R. Almeida, T. Dellinger, N. Ferrand de Almeida, M. E. Oliveira, J. M. Palmeirim, A. I. Queiroz, L. Rogado and M. Santos-Reis (2005). *Livro Vermelho dos Vertebrados de Portugal.* Vermelho dos Vertebrados de Portugal.
Cabrera, A. (1908). Lista de los mamiferos de las Posesiones españolas del Golfo de Guinea. *Memorias de la Sociedad Español de Historia natural*, **1 (25):** 435 - 456.
Cabrera, A. (1914). *Fauna Ibérica. Mamíferos.* Museum Nacional de Ciencias Naturales - Madrid.
Cabrera, A. (1920). Dos nuevos murciélagos fugivoros. *Boletin de la Real Sociedad Española de Historia Natural*, **20 (1-2):** 106 - 108.
Cabrera, A. (1929). Catalogo descriptivo de los Mamiferos de la Guinea Española. *Memorias de la Sociedad Español de Historia natural*, **16:** 1 - 121.
Cabrera, A. (1958). Catálogo de los mamíferos de América del Sur. *Revista do Museu Argentina de Ciencias Naturales, Zoologica*, **4 (1):** i - xvi; 1 - 307.
Cabrera, A. and A. E. Ruxton (1926). On mammals from Luluabourg, Southern Congo. *Annals and Magazine of Natural History*, **ser. 9, 17 (103):** 591 - 602. doi: 10.1080/00222932608633448. [Abstract]
Cabrera Latorre, A. (1903). Mamiferos de la Guinea Española. *Memorias de la Sociedad Español de Historia natural*, **1:** 1 - 60.
Cabrera Latorre, A. (1904). Ensayo monográfico sobre los quirópteros de España. *Memorias de la Sociedad Español de Historia natural*, **2 (5):** 249 - 287, 24 figs. on 5 pls.
Cabrera Latorre, A. (1906). Mamiferos de Mogador. *Boletin de la Real Sociedad Española de Historia Natural*, **6:** 357 - 368.
Caceres, S. [Ed] (2010). Plan de conservation de la roussette noire (*Pteropus niger*) dans l'île de La Réunion. Direction Régionale de l'Environnement de La Réunion (DIREN). ONCFS, 71 pp. URL: http://www.reunion.developpement-durable.gouv.fr/IMG/pdf/PDC_Roussette_cle0b11cd.pdf.
Cagnolaro, L. (1976). Catalogo dei tipi del Museo civico di Storia naturale di Milano. III. I tipi dei mammiferi, con un profilo storico sulla collezione mammalogica. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **117 (3-4):** 85 - 108. [Abstract]
Calderon, A., C. Guzman, J. Salazar-Bravo, L. T. Figueiredo, S. Mattar and G. Arrieta (2016). Viral zoonoses that fly with bats: a review. *Manter: Journal of Parasite Biodiversity*Suppl. 6. doi: 10.13014/K2BG2KWF.
Calisher, C. H., J. E. Childs, H. E. Field, K. V. Holmes and T. Schountz (2006). Bats: Important reservoir hosts of emerging viruses. *Clinical Microbiology Reviews*, **19 (3):** 531 - 545. doi: 10.1128/CMR.00017-06.
Canaris, A. G. and S. L. Gardner (1967). A guide to Helminth species described from African Vertebrates. West Virginia University Library - Morgantown: 99 pp.
Cantrell, M. A., L. Scott, C. J. Brown, A. R. Martinez and H. A. Wichman (2008). Loss of LINE-1 activity in the Megabats. *Genetics: a periodical record of investigations bearing on heredity and variation*, **178 (1):** 393 - 404. doi: 10.1534/genetics.107.080275.
Canuti, M., A. M. Eis-Huebinger, M. Deijs, M. de Vries, J. F. Drexler, S. K. Oppong, M. A. Müller, S. M. Klose, N. Wellinghausen, V. M. Cottontail, E. K. V. Kalko, C. Drosten and L. van der Hoek (2011). Two novel parvoviruses in frugivorous new and old world bats. *PLoS ONE*, **6 (12) e29140:** 1 - 9. doi: 10.1371/journal.pone.0029140.

Capanna, E. (1968). Some considerations on the evolution of the karyotype of Microchiroptera. *Experientia*, **24 (6):** 624 - 626. doi: 10.1007/BF02153815. URL: http://www.springerlink.com/content/k288l522262037l6/fulltext.pdf.
Capanna, E. and M. V. Civitelli (1964a). Contributo alla conoscenza della cariologia dei rinolofidi (Mammalia - Chiroptera). *Caryologia*, **17 (2):** 361 - 371. doi: 10.1080/00087114.1964.10796132. [Abstract]
Capanna, E. and M. V. Civitelli (1964b). I cromosomi di alcune specie di microchirotteri italiani. *Bolletino Zoologico Italiana*, **31:** 535 - 540.
Capanna, E. and M. V. Civitelli (1965). Cariologia e cariometria del miniottero (Mammalia - Chiroptera). *Caryologia*, **18 (3):** 541 - 546. doi: 10.1080/00087114.1965.10796188. [Abstract]
Capanna, E. and M. V. Civitelli (1966). I cromosomi del pipistrello abolimbato. *Caryologia*, **19:** 231 - 240. [Abstract]
Capanna, E., M. V. Civitelli and L. Conti (1967). I cromosomi somatici del pipistrello Ferro di cavallo minore' (Mammalia-Chiroptera). *Rendiconti Accademia Nazionale Lincei*, **42:** 125 - 128.
Capanna, E., M. V. Civitelli and C. Spagnuolo (1968). Contributo alla cariologia del genere Myotis. Considerazioni sulla evoluzione del cariotipo dei Vespertilionidi (Mammalia-Chiroptera). *Caryologia*, **21 (3):** 225 - 240. doi: 10.1080/00087114.1968.10796301. [Abstract]
Capanna, E. and M. G. Manfredi Romanini (1971). Nuclear DNA content and morphology of karyotype in certain Paleartic Microchiroptera. *Caryologia*, **24 (4):** 471 - 482. doi: 10.1080/00087114.1971.10796455. [Abstract]
Capo-Chichi, B., S. Tchibozo, W. Bergmans and G. A. Mensah (2004). *Observations préliminaires sur les chauves-souris du Bénin.* In Mensah, G. A., B. Sinsin and E. Thomassen [Eds]: *Actes du seminaire-atelier sur la mammalogie et la biodiversité Abomey-Calavi/Bénin, 30/10 - 18/11/2002 - Proceedings of symposium-workshop on mammal study and biodiversity Abomey-Calavi/Bénin, 30/10 - 18/11/2002.* VZZ Rapport 2004-13: 159 - 164.
Cardiff, S. G. (2006). Bat Cave Selection and Conservation in Ankarana, Northern Madagascar. Graduate School of Arts and Sciences, Columbia University: 65 pp. URL: https://mywebspace.wisc.edu/scardiff/web/cardiff2006ma-thesis.pdf.
Cardiff, S. G., S. M. Goodman and N. B. Simmons (2004). Cave selection by bats in Ankarana, northern Madagascar. *Bat Research News*, **45 (4):** 209 - 210.
Cardiff, S. G. and R. K. B. Jenkins (2016). The bats of Madagascar: a conservation challenge. *Lessons in Conservation*, **6:** 80 - 108.
Cardiff, S. G., F. H. Ratrimomanarivo and S. M. Goodman (2012). The effect of tourist visits on the behavior of *Rousettus madagascariensis* (Chiroptera: Pteropodidae) in the Caves of Ankarana, Northern Madagascar. *Acta Chiropterologica*, **14 (2):** 479 - 490. doi: 10.3161/150811012X661783.
Cardiff, S. G., F. H. Ratrimomanarivo, G. Rembert and S. M. Goodman (2009). Hunting, disturbance and roost persistence of bats in caves at Ankarana, northern Madagascar. *African Journal of Ecology*, **:** e10. doi: 10.1111/j.1365-2028.2008.01015.x.
Cardinal, B. R. and L. Christidis (2000). Mitochondrial DNA and morphology reveal three geographically distinct lineages of the large bentwing bat (*Miniopterus schreibersii*) in Australia. *Australian Journal of Zoology*, **48:** 1 - 19.
Caron, A., M. Bourgarel, J. Cappelle, F. Liégeois, H. M. De Nys and F. Roger (2018). Ebola virus maintenance: if not (only) bats, what else? *Viruses*, **10 (10):** 549. doi: 10.3390/v10100549.
Carpenter, J., Z. Hegyeli, S. Bugariu and I. Moldován (2014). First confirmed records of Lesser Mouse-tailed Bat, *Rhinopoma cystops* Thomas, 1903, for Sinai, Egypt (Mammalia: Chiroptera). *Zoology in the Middle East*, **60 (2):** 180 - 182. doi: 10.1080/09397140.2014.914750.
Carpenter, R. E (1986). Flight physiology of intermediate-sized fruit bats (Pteropodidae). *Journal of experimental biology*, **120 (1):** 79 - 103. [Abstract]
Carpentier, C.-J. (1932). Les mammifères du pays Zaïan. *Bulletin de la Société des Sciences Naturelles du Maroc*, **12:** 11 - 22.
Carr, J., A. Adeleke, K. Angu Angu, E. Belle, N. Burgess, S. Carrizo, A. Choimes, N. Coulthard, W. Darwall, W. Foden, J.-M. Garreau, W. Gatarabirwa, C. Hicks, D. Ramløse Kapijimpanga, E. King, K. Koenig, S. Martinez, H. Meng, S. Kofi Nyame, B. Polidoro, S. Regnaut, Y. Shennan-Farpon, G. Shepherd, K. Smith, A. van Soesbergen, J. Somda and G. Walters (2015). Ecosystem Profile: Guinean forests of West Africa biodiversity hotspot. International Union for Conservation of Nature - Technical Report: 403 pp. doi: 10.13140/RG.2.1.1724.8889.
Carr, M., G. Gonzalez, M. Sasaki, S. E. Dool, K. Ito, A. Ishii, B. M. Hang'ombe, A. S. Mweene, E. C. Teeling, W. W. Hall, Y. Orba and H. Sawa (2017). Identification of the same polyomavirus species in different African horseshoe bat species is indicative of short-range host-switching events. *Journal of general virology*, **98:** 2771 - 2785. doi: 10.1099/jgv.0.000935.
Carroll, J. B. (1985). The flying foxes (*Pteropus* spp.) of the western Indian Ocean islands (and a footnote on *Rousettus obliviosus*). *Bat News*, **4:** 4 - 5.
Carroll, J. B. and A. T. C. Feistner (1996). *Conservation of western Indian Ocean fruit bats.* In Lourenço, W.R. : *Biogéographie de Madagascar.* ORSTOM, Paris: 329 - 335. [Abstract]
Carroll, J. B. and G. M. Mace (1988). Population management of the Rodrigues fruit bat (*Pteropus rodricensis*) in captivity. *International zoo yearbook*, **27 (1):** 70 - 78. doi: 10.1111/j.1748-1090.1988.tb03198.x.
Carroll, J. B. and I. C. Thorpe (1991). The conservation of Livingstone's fruit bat *Pteropus livingstonii* Gray 1866: a report on an expedition to the Comores in 1990. *Dodo*, **33:** 20-35.
Carroll, S. A., J. S. Towner, T. K. Sealy, L. K. McMullan, M. L. Khristova, F. J. Burt, R. Swanepoel, P. E. Rollin and S. T. Nichol (2012). Molecular evolution of viruses of the family Filoviridae based on 97 whole-genome sequences. *Journal of Virology*, **87 (5):** 2608 - 2616 (for 2013). doi: 10.1128/JVI.03118-12.
Carter, A. M. and A. C. Enders (2016). Placentation in mammals: Definitive placenta, yolk sac, and paraplacenta. *Theriogenology*, **86 (1):** 278 - 287. doi: 10.1016/j.theriogenology.2016.04.041.
Carter, A. M., S. M. Goodman and A. C. Enders (2008). Female reproductive tract and placentation in Sucker-footed bats (Chiroptera: Myzopoda) endemic to Madagascar. *Placenta*, **29:** 484 - 491. doi: 10.1016/j.placenta.2008.02.009.
Carter, G. (G.) and L. Leffer (2015). Social grooming in bats: are vampire bats exceptional? *PLoS ONE*, **10 (10):** e0138430. doi: 10.1371/journal.pone.0138430.
Carter, G. G. and G. S. Wilkinson (2013). *Cooperation and conflict in the social lives of bats.* In Adams, R. A. and S. C. Pedersen [Eds]: *Bat evolution, ecology, and conservation.* Springer - New York, Heidelberg, Dordrecht, London: 225 - 242. doi: 10.1007/978-1-4614-7397-8_12.
Carter, R. and R. (A.) Adams (2013). Tracheal calcification in birds, bats, shrews, and mice. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 33. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Carvalho, M., J. M. Palmeirim, F. C. Rego, N. Sole, A. Santana and J. E. Fa (2014). What motivates hunters to target exotic or endemic species on the island of São Tomé, Gulf of Guinea? *Oryx*, **49 (2):** 278 - 286 (for 2015). doi: 10.1017/S0030605313000550.

Carvalho, M., F. Rego, J. Palmeirim and J. Fa (2015). Wild meat consumption on São Tomé Island, West Africa: implications for conservation and local livelihoods. *Ecology and Society*, **20 (3):** 27. doi: 10.5751/ES-07831-200327.
Cassel-Beraud, A. M., D. Fontenille and L. Rabetafika (1989). Etude bactérienne, virale et parasitaire d'une population de chauves-souris *Chaerophon pumila* à Ahjiro, Madagascar. *Archives de l'Institut Pasteur de Madagascar.*, **56 (1):** 233 - 239. [Abstract]
Cassel-Béraud, A. M. and C. Richard (1988). Étude de la flore intestinale a,robie de Microch,iroptŠres *Chaerephon pumila* a Madagascar. *Bulletin de la Société de Pathologie exotique et ses filiales*, **(81):** 806 - 810.
Castella, V., M. Ruedi, L. Excoffier, C. Ibáñez, R. Arlettaz and J. Hausser (2000). Is the Gibraltar Strait a barrier to gene flow for the bat *Myotis myotis* (Chiroptera: Vespertilionidae)?. *Molecular Ecology*, **9 (11):** 1761 - 1772.
Cavaleros, M., R. Buffenstein, F. P. Ross and J. M. Pettifor (2003). Vitamin D metabolism in a frugivorous nocturnal mammal, the Egyptian fruit bat (*Rousettus aegyptiacus*). *General & Comparative Endocrinology*, **133 (1):** 109 - 117. doi: 10.1016/S0016-6480(03)00150-3.
Cazurro, M. (1894). Datos para la fauna de la provincia de Madrid. Mamíferos. *Acta Soc. Esp. Hist. Nat.*, **(2) 23 (1):** 6 - 19.
Cebesoy, S. and M. Karakas (2013). Histochemical determination of muscle fiber types in primary flight muscles of *Miniopterus schreibersi*. *Journal of Animal and Veterinary Advances*, **12 (3):** 382 - 386.
Centeno-Cuadros, A., P. Hulva, D. Romportl, S. Santoro, T. Stríbná, D. Shohami, A. Evin, A. Tsoar, P. Benda, I. Horácek and R. Nathan (2017). Habitat use, but not gene flow, is influenced by human activities in two ecotypes of Egyptian fruit bat (*Rousettus aegyptiacus*). *Molecular Ecology*, **26 (22):** 6224 - 6237. doi: 10.1111/mec.14365.
Cerná, Z. and B. Ryšavý (1976). Notes on the distribution of *Eimeria dukei* Lavier, 1927 in African bats. *Folia parasitologica*, **23:** 286.
Cervený, J. and P. Koubek (2008). Four new bat species from the "territory of the Czech Republic". *Vespertilio*, **12:** 11 - 14.
Chakraborty, S., T. P. Bhattacharyya, J. K. Dey, M. K. Ghosh, T. K. Chakraborty and A. K. Poddar (2004). *Mammals.* Zoological Survey of India, Kolkata, India.
Chan, L. M., S. M. Goodman, M. D. Nowak, D. W. Weisrock and A. D. Yoder (2011). Increased population sampling confirms low genetic divergence among *Pteropus* (Chiroptera: Pteropodidae) fruit bats of Madagascar and other western Indian Ocean islands. *PLoS Currents: Tree of Life*, **3:** RRN1226. doi: 10.1371/currents.RRN1226. URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3064450/ .
Changula, K., M. Kajihara, A. Mori-Kajihara, Y. Eto, H. Miyamoto, R. Yoshida, A. Shigeno, B. Hang'ombe, Y. Qiu, D. Mwizabi, D. Squarre, J. Ndebe, H. Ogawa, H. Harima, E. Simulundu, L. Moonga, P. Kapila, W. Furuyama, T. Kondoh, M. Sato, Y. Takadate, C. Kaneko, R. Nakao, V. Mukonka, A. Mweene and A. Takada (2018). Seroprevalence of filovirus infection of *Rousettus aegyptiacus* bats in Zambia. *The Journal of Infectious Diseases*, **218 (Suppl. 5):** S312 - S317. doi: 10.1093/infdis/jiy266.
Changula, K., M. Kajihara, A. S. Mweene and A. Takada (2014). Ebola and Marburg virus diseases in Africa: Increased risk of outbreaks in previously unaffected areas? *Microbiology and Immunology*, **58 (9):** 483 - 491. doi: 10.1111/1348-0421.12181.
Chapman, R. F. (1958). Some observations on the food of a bat. *Annals and Magazine of Natural History*, **ser. 13, 1 (3):** 188 - 192. [Abstract]
Chari, G. C. and A. Gopalakrishna (1984). Morphogenesis of the foetal membranes and placentation in the bat, *Miniopterus schreibersii fuliginosus* (Hodgson). *Proceedings of the Indian Academy of Sciences*, **(Anim, Sci.), 93 (5):** 463 - 483. [Abstract]
Chasen, F. N. (1939). Four new mammals from Java. *Treubia*, **17 (3):** 185 - 188.
Chastel, C., H. Launay, G. Le Lay, H. Bailly-Choumara, H. Hellal, M. Valle, D. Bach-Hamba and J.-C. Beaucournu (1986). Petits mammifères sauvages et arbovirus dans la région du bassin méditerranéen occidental. *Cahiers de l'ORSTOM, série Entomologie, Médicine et Parasitologie*, **24 (1):** 69 - 76. [Abstract]
Chatelain, C. and D. Brugière (1999). Proposition de classement du parc national Mbaere-Bodingue et de l'aire d'utilisation durable des écosystèmes de la Mbaere dans la zone d'intervention du projet ECOFAC-RCA. Projet ECOFAC - Composante République Centrafricaine: 73 pp.
Chaverri, G., L. Ancillotto and D. Russo (2018). Social communication in bats. *Biological Reviews*, **93 (4):** 1938 - 1954. doi: 10.1111/brv.12427.
Chawana, R., A. Alagaili, N. Patzke, M. A. Spocter, O. B. Mohammed, C. Kaswera, E. Gilissen, N. C. Bennett, A. O. Ihunwo and P. R. Manger (2014). Microbats appear to have adult hippocampal neurogenesis, but post-capture stress causes a rapid decline in the number of neurons expressing doublecortin. *Neuroscience*, **277:** 724 - 733. doi: 10.1016/j.neuroscience.2014.07.063.
Chawana, R., N. Patzke, C. Kaswera, E. Gilissen, A. O. Ihunwo and P. R. Manger (2013). Adult neurogenesis in eight Megachiropteran species. *Neuroscience*, **244:** 159 - 172. doi: 10.1016/j.neuroscience.2013.04.020.
Chawana, R., N. Patzke, A. N. Alagaili, N. C. Bennett, O. B. Mohammed, C. Kaswera-Kyamakya, E. Gilissen, A. O. Ihunwo, J. D. Pettigrew and P. R. Manger (2016). The distribution of Ki-67 and doublecortin immunopositive cells in the brains of three Microchiropteran species, *Hipposideros fuliginosus*, *Triaenops persicus*, and *Asellia tridens*. *The Anatomical Record*, **299 (11):** 1548 - 1560. doi: 10.1002/ar.23460.
Cheesman, R. E. and M. A. C. Hinton (1924). LXII. On the mammals collected in the desert of Central Arabia by Major R.E. Cheesman. *Annals and Magazine of Natural History*, **ser. 9, 14 (85):** 548 - 558. [Abstract]
Chege, H. N., C. Schepers and G. J. J. Wolfaardt (2015). Documenting the bat species assemblages of the Meletse Bat Research and Conservation Training Centre in Limpopo Province, Thabazimbi, South Africa. *African Bat Conservation News*, **38:** 5 - 8.
Cheke, A. S. (2009a). Data sources for 18th century French encyclopaedists - what they used and omitted: evidence of data lost and ignored from the Mascarene Islands, Indian Ocean. *Journal of the National Museum (Prague), Natural History Series*, **177 (9):** 91 - 117.
Cheke, A. S. (2009b). Not lost but hiding - type material of the endemic Mauritian bat *Mormopterus acetabulosus* (Hermann, 1804) (Chiroptera: Molossidae). *Journal of the National Museum (Prague), Natural History Series*, **178 (1):** 1 - 3.
Cheke, A. S. (2011). Was the flying-fox *Pteropus comorensis* on Mafia Island (Tanzania) introduced by humans? *Journal of East African Natural History*, **100 (1 - 2):** 59 - 68. doi: 10.2982/028.100.0104.
Cheke, A. S. and J. F. Dahl (1981). The status of bats on western Indian Ocean islands with special reference to *Pteropus*. *Mammalia*, **45 (2):** 205 - 238. [Abstract]
Chen, L., B. Liu, J. Yang and Q. Jin (2014). DBatVir: the database of bat-associated viruses. *Database*, **2014:** bau021. doi: 10.1093/database/bau021.

Chen, M.-Y., D. Liang and P. Zhang (2017). Phylogenomic resolution of the phylogeny of Laurasiatherian mammals: exploring phylogenetic signals within coding and noncoding sequences. *Genome Biology and Evolution*, **9 (8):** 1998 - 2012. doi: 10.1093/gbe/evx147.

Chernova, O. F. (2002). The structure of the cuticle of guard hair in fruit-eating bats (Chiroptera, Pteropodidae). *Doklady Biological Sciences*, **382:** 34 - 37.

Child, G. S. (1965). Some notes on the mammals of Kilimanjaro. *Tanganyika Notes and Records*, **64:** 77 - 89. [Abstract]

Childs-Sanford, S. E., G. V. Kollias, N. Abou-Madi, P. L. McDonough, M. M. Garner and H. O. Mohammed (2009). *Yersinia pseudotuberculosis* in a closed colony of egyptian fruit bats (*Rousettus aegyptiacus*). *Journal of Zoo and Wildlife Medicine*, **40 (1):** 4 - 14. doi: 10.1638/2007-0033.1.

Chimimba, C. T. and D. J. Kitchener (1991). A systematic revision of Australian Emballonuridae. *Records of the Western Australian Museum, Perth*, **15:** 203-265.

Chippaux, J.-P. (2014). Outbreaks of Ebola virus disease in Africa: the beginnings of a tragic saga. *Journal of Venomous Animals and Toxins including Tropical Diseases*, **20:** 44. doi: 10.1186/1678-9199-20-44.

Chitaukali, W. N., H. Burda and D. Kock (1999). Small mammals of the Nyika Plateau, Malawi. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 99.

Chitaukali, W. N., H. Burda and D. Kock (2001). *On small mammals of the Nyika Plateau, Malawi.* In Denys, C., L. Granjon and A. Poulet : *African Small Mammals / Petits mammifères africains.* Institut de Recherche pour le Développement collection - Colloques et séminaires Paris: 415 - 426.

Christidis, L., S. M. Goodman, K. Naughton and B. Appleton (2014). Insights into the evolution of a cryptic radiation of bats: Dispersal and ecological radiation of malagasy *Miniopterus* (Chiroptera: Miniopteridae). *PLoS ONE*, **9 (3):** e92440. doi: 10.1371/journal.pone.0092440.

Chubb, E. C. (1908). *5. On some little-known South African mammals recently obtained in Rhodesia.* Report of the South African Association for the Advancement of Science, 6th meeting: 171 - 174. [Abstract]

Chubb, E. C. (1909). 2. The mammals of Matabeleland. *Proceedings of the Zoological Society of London*, **1909, I (8):** 113 - 125.

Chubb, E. C. (1910). A revised list of the mammals of South Africa. *South African Journal of Sciences*, **6 (4):** 129 - 142. [Abstract]

Chubb, E. C. (1911). On the re=discovery of the bat *Kerivoula brunnea*, Dobs. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **3 (1):** 56 - 57.

Chubb, E. C. (1917). A new bat of the genus *Otomops*, obtained at Durban. *Annals of the Durban Museum*, **1 (4):** 433 - 434.

Church, J. C. T. and D. J. Warren (1968). Wound healing in the web membrane of the fruit bat. *British Journal of Surgery*, **55 (1):** 26 - 31. doi: 10.1002/bjs.1800550108.

Churcher, C. S. (1991). The Egyptian fruit bat *Rousettus aegyptiacus* in Dakhleh Oasis, Western Desert of Egypt. *Mammalia*, **55 (1):** 139 - 142.

Churchill, S. (K.), R. Draper and E. Marais (1997). Cave utilisation by Namibian bats: population, microclimate and roost selection. *South African Journal of Wildlife Research*, **27 (2):** 44 - 50. [Abstract]

Ciechanowski, M., T. Zajac, A. Bilas and R. Dunajski (2007). Spatiotemporal variation in activity of bat species differing in hunting tactics: effects of weather, moonlight, food abundance, and structural clutter. *Canadian journal of zoology*, **85:** 1249 - 1263. doi: 10.1139/S07-090.

Claessen, C. J. and F. De Vree (1990). *Systematic and distributional notes on the larger species of the genus Epomophorus Bennet, 1836 (Chiroptera: Pteropodidae).* In Peters, G. and R. Hutterer : *Vertrebrates in the Tropics. Proceedings of the International Symposium on Vertebrate Biogeography and Systememattics in the Tropics, Bonn, June 5-8, 1989.* Museum Alexander Koenig - Bonn: 177 - 186. [Abstract]

Claessen, C. J. and F. De Vree (1991). Systematic and taxonomic notes on the *Epomophorus anurus-labiatus-minor* complex with the description of a new species (Mammalia: Chiroptera: Pteropodidae). *Senckenbergiana biologica*, **71 (for 1990) (4/6):** 209 - 238. [Abstract]

Clark, K. M., J. B. Carroll, M. Clark, S. R. T. Garrett, S. Pinkus and R. Saw (1997). Capture and survey of Livingstone's fruit bats *Pteropus livingstonii* in the Comoros Islands: the 1995 expedition. *Dodo*, **33:** 20 - 35.

Clark, N. (2004). Appendix 1. Summary of observations on the sheath-tailed bat (August 2001). In Burgess, H., Lee, N. : *A behavioural study of the Silhouette sheath-tailed bat (Coleura seychellensis). Phelsuma*, **12:** 76 - 77. URL: http://islandbiodiversity.com/Phelsuma%2012-3.pdf.

Clauss, M. and D. E. Paglia (2012). Iron storage disorders in captive wild mammals: the comparative evidence. *Journal of Zoo and Wildlife Medicine*, **43 (3 Suppl.):** S6 - S18. doi: 10.1638/2011-0152.1.

Coastal Resources Center and Friends of the Nation (2011). Assessment of critical coastal habitats of the Western Region, Ghana. Integrated Coastal and Fisheries Governance Initiative for the Western Region of Ghana. Coastal Resources Center, University of Rhode Island: 132 pp. URL: http://www.crc.uri.edu/download/Critical_Habitats_FINAL_508.pdf.

Cockle, A., D. Kock, L. Stublefield, K. M. Howell and N. D. Burgess (1998). Bat assemblages in Tanzanian coastal forests. *Mammalia*, **62 (1):** 53 - 68. [Abstract]

Cockrum, E. L. (1976). Status of the name of a rhinolophid bat, *Rhinolophus euryale tuneti* Deleuil and Labbe, 1955. *Mammalia*, **40 (4):** 685 - 686. doi: 10.1515/mamm.1976.40.4.683.

Coe, M. (1972). The South Turkana Expedition. Scientific Papers IX. Ecological studies of small mammals of South Turkana. *The Geographical Journal*, **138:** 316 - 338. [Abstract]

Coe, M. (1976). Mammalian ecological studies on Mount Nimba, Liberia. *Mammalia*, **39 (for 1975) (4):** 523 - 588. [Abstract]

Coertse, J., L. H. Nel, C. T. Sabeta, J. Weyer, A. Grobler, J. Walters and W. Markotter (2011). A case study of rabies diagnosis from formalin-fixed brain material. *Journal of the South African Veterinary Association*, **82 (4):** 250 - 253.

Coetzee, C. G. (1963). The prey of owls in the Kruger National Park as indicated by owl pellets collected during 1960-61. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **6 (1):** 115 - 125. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/818.

Coetzee, C. G. (1965). Bat banding in Southern Africa. *News Bulletin of the zoological Society of South Africa*, **7:** 8 - 10.

Coetzee, C. G. (1981). Distribution patterns of terrestrial mammals in South West Africa / Namibia. Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 36. [Abstract]

Cohen, L., P. J. Taylor, D. (S.) Jacobs, T. (C.) Kearney, K. (L.) MacEwan, A. Monadjem, L. R. Richards, (M.) C. Schoeman and T. Sethusa (2016). *A conservation assessment of Rhinolophus cohenae.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Coimbra, J. P., J. D. Pettigrew, C. Kaswera-Kyamakya, E. Gilissen, S. P. Collin and P. R. Manger (2016). Retinal ganglion cell topography and spatial resolving power in African megachiropterans: Influence of roosting microhabitat and foraging. *The Journal of Comparative Neurology*, **525 (1):** 186 - 203 (for 2017). doi: 10.1002/cne.24055.

Coleman, J. C. and C. T. Downs (2012). The sweet side of life: Nectar sugar type and concentration preference in Wahlberg's epauletted fruit bat. *Comparative Biochemistry and Physiology*, **A 162 (4):** 431 - 436. doi: 10.1016/j.cbpa.2012.04.024.

Colgan, D. J. and P. da Costa (2002). Megachiropteran evolution studied with 12S rDNA and *c*-mos DNA sequences. *Journal of Mammalian Evolution*, **9 (1/2):** 3 - 22.

Colket, E. and D. E. Wilson (1998). *Taphozous hildegardeae*. *Mammalian Species*, **597:** 1 - 3, 3 figs.

Collen, B., S. T. Turvey, C. Waterman, H. M. R. Meredith, T. S. Kuhn, J. E. M. Baillie and N. J. B. Isaac (2011). Investing in evolutionary history: implementing a phylogenetic approach for mammal conservation. *Philosophical transactions of the Royal Society of London*, **366 (1578):** 2611 - 2622. doi: 10.1098/rstb.2011.0109.

Collinson, W. J., D. M. Parker, R. T. F. Bernard, B. K. Reilly and H. T. Davies-Mostert (2015). An inventory of Vertebrate roadkill in the Greater Mapungubwe Transfrontier Conservation Area, South Africa. *African Journal of Wildlife Research*, **45 (3):** 301 - 311. doi: 10.3957/056.045.0301.

Conenna, I., R. Rocha, D. Russo and M. Cabeza (2017). Insular bats and research effort: a review of global patterns and priorities. *Mammal Review*, **47 (3):** 169 - 182. doi: 10.1111/mam.12090.

Conrardy, C., Y. Tao, I. V. Kuzmin, M. Niezgoda, B. Agwanda, R. F. Breiman, L. J. Anderson, C. E. Rupprecht and S. Tong (2014). Short Report: Molecular detection of adenoviruses, rhabdoviruses, and paramyxoviruses in bats from Kenya. *The American Journal of Tropical Medicine and Hygiene*, **91 (2):** 258 - 266. doi: 10.4269/ajtmh.13-0664.

Constantine, D. G. (1998). An overlooked external character to differentiate *Myotis californicus* and *Myotis ciliolabrum* (Vespertilionidae). *Journal of Mammalogy*, **79 (2):** 624 - 630. [Abstract]

Cooper-Bohannon, R., H. Rebelo, G. Jones, F. Cotterill, A. Monadjem, C. Schoeman, P. Taylor and K. Park (2013). Bats without borders - the distribution and conservation of cave-dwelling bats in southern Africa. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 39 - 40. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Cooper-Bohannon, R., H. Rebelo, G. Jones, F. (W.), Monadjem, A. Cotterill, M. C. Schoeman, P. Taylor and K. Park (2016). Predicting bat distributions and diversity hotspots in southern Africa. *Hystrix, Italian Journal of Mammalogy*, **Xxx (xx):** xxx - xxx. doi: 10.4404/hystrix-27.1-11722.

Copeland, R. S., A. H. Kirk-Spriggs, S. Muteti, W. Booth and B. M. Wiegmann (2011). Rediscovery of the "terrible hairy fly", *Mormotomyia hirsuta* Austen (Diptera: Mormotomyiidae), in eastern Kenya, with notes on biology, natural history, and genetic variation of the Ukasi Hill population. *African Invertebrates*, **52 (2):** 363 - 390.

Copley, H. (1950). *Small mammals of Kenya.* Highway Press, Nairobi & Longmans, Green and Co., London etc.: i-viii; 1 - 96.

Çoraman, E., C. Dietz, E. Hempel, A. Ghazaryan, E. Levin, P. Presetnik, M. Zagmajster and F. Mayer (2019). Reticulate evolutionary history of a western Palaearctic bat complex explained by multiple mtDNA introgressions in secondary contacts. *Journal of Biogeography*, **46 (2):** 343 - 354. doi: 10.1111/jbi.13509.

Çoraman, E., A. Furman, A. Karatas and R. Bilgin (2013). Phylogeographic analysis of Anatolian bats highlights the importance of the region for preserving the Chiropteran mitochondrial genetic diversity in the Western Palaearctic. *Conservation Genetics*, **14 (6):** 1205 - 1216. doi: 10.1007/s10592-013-0509-4.

Corbet, G. B. (1978). *The mammals of the Palaearctic region: a taxonomic review.* British Museum (Natural History) - Cornell University Press - London & Ithaca: i - vi; 1 - 314.

Corbet, G. B. (1984). *The mammals of the Palaearctic region: a taxonomic review. Supplement.* British Museum (Natural History) - London: 1 - 45. [Abstract]

Corbet, G. B. and J. E. Hill (1980). *A world list of mammalian species.* Comstock Cornell University Press - London & Ithaca: 1 - 226.

Corbet, G. B. and J. E. Hill (1991). *A world list of mammalian species. 3rd edition.* Natural History Museum Publications, Oxford University Press - Oxford.

Corbet, G. B. and J. E. Hill (1992). *The mammals of the Indomalayan Region: A systematic review.* Natural History Museum Publications, Oxford University Press - Oxford: 1 - 488. [Abstract]

Corcoran, A. J. and C. F. Moss (2017). Sensing in a noisy world: lessons from auditory specialists, echolocating bats. *Journal of experimental biology*, **220 (24):** 4554 - 4566. doi: 10.1242/jeb.163063.

Cordeiro, N. J., J. C. Lovett, E. Mulungu, G. G. Maina and J. H. Gerstle (2006). Initial trends of bird assemblages before and after river diversion in an endemic-rich African forest. *Biodiversity and conservation*, **15 (3):** 971 - 983.

Corlett, R. T. (2017). Frugivory and seed dispersal by vertebrates in tropical and subtropical Asia: An update. *Global Ecology and Conservation*, **11:** 1 - 22. doi: 10.1016/j.gecco.2017.04.007.

Corman, V. M., H. J. Baldwin, A. F. Tateno, R. M. Zerbinati, A. Annan, M. Owusu, E. E. Nkrumah, G. D. Maganga, S. Oppong, Y. Adu-Sarkodie, P. Vallo, L. V. R. F. d. S. Filho, E. M. Leroy, V. Thiel, L. van der Hoek, L. L. M. Poon, M. Tschapka, C. Drosten and J. F. Drexler (2015). Evidence for an ancestral association of human coronavirus 229E with bats. *Journal of Virology*, **89 (23):** 11858 - 11870. doi: 10.1128/JVI.01755-15..

Corman, V. M., N. L. Ithete, L. R. Richards, M. C. Schoeman, W. Preiser, C. Drosten and J. F. Drexler (2014). Rooting the phylogenetic tree of MERS-Coronavirus by characterization of a conspecific virus from an African bat. *Journal of Virology*, **88 (19):** 11297 - 11303. doi: 10.1128/JVI.01498-14.

Cornette, R., G. Dobigny, S. Moulin and A. M. Drieux-Dumont (1999). Inventaire des micromammifères de l'Adrar des Iforas, Mali: Implications systématiques et biogéographiques. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 113.

Cosson, J. F. (1995). Captures of *Myonycteris torquata* (Chiroptera: Pteropodidae) in forest canopy in South Cameroon. *Biotropica*, **27 (3):** 395 - 396.

Cosson, J. F., M. Tranier and F. Colas (1996). On the occurrence and possible migratory behaviour of the fruit bat *Eidolon helvum* in Mauritania, Africa. *Journal of African Zoology*, **110 (5):** 369 - 371. [Abstract]

Cotterill, F. P. D. (1995). *New fruit bat species for Southern Africa.* Zimbabwe Wildlife, January - March 1995: 11. URL: https://sites.google.com/site/fpdcotterill/natural-history/2000-km-range-extensions.

Cotterill, F. P. D. (1996a). New distribution records of insectivorous bats of the families Nycteridae, Rhinolophidae and Vespertilionidae (Microchiroptera: Mammalia) in Zimbabwe. *Arnoldia Zimbabwe*, **10 (8):** 71 - 89. [Abstract]

Cotterill, F. P. D. (1996b). New distribution records of free-tailed bats (Microchiroptera: Molossidae) in Zimbabwe. *Arnoldia Zimbabwe*, **10 (9):** 91 - 102. [Abstract]

Cotterill, F. P. D. (1998). Female reproduction in two species of tropical horseshoe bats (Rhinolophidae) in Zimbabwe. *Journal of Mammalogy*, **79 (4):** 1306 - 1316. [Abstract]

Cotterill, F. P. D. (2001a). New distribution records of leaf-nosed bats (Microchiroptera: Hipposideridae) in Zimbabwe. *Arnoldia Zimbabwe*, **10 (17):** 187 - 198.
Cotterill, F. P. D. (2001b). Further notes on large Afrotropical free-tailed bats of the genus *Tadarida* (Molossidae: Mammalia). *Arnoldia Zimbabwe*, **10 (18):** 199 - 210.
Cotterill, F. P. D. (2001c). The first specimen of Thomas's flat-headed bat, *Mimetillus moloneyi thomasi* (Microchiroptera: Mammalia) in Southern Africa from Mozambique. *Arnoldia Zimbabwe*, **10 (19):** 211 - 218.
Cotterill, F. P. D. (2001d). New specimens of lesser house bats (Vespertilionidae: *Scotoecus*) from Mozambique and Zambia. *Arnoldia Zimbabwe*, **10 (20):** 219 - 223.
Cotterill, F. P. D. (2001e). New records for two species of fruit bats (Chiroptera: Pteropodidae) in southeast Africa, with taxonomic comments. *Durban Museum Novitates*, **26:** 53 - 56.
Cotterill, F. P. D. (2002a). A new species of horseshoe bat (Microchiroptera: Rhinolophdae) from south-central Africa: with comments on its affinities and evolution, and the characterization of rhinolophid species. *Journal of Zoology*, **256 (2):** 165 - 179. doi: 10.1017/S0952836902000201.
Cotterill, F. P. D. (2002b). *Notes on mammal collections and biodiversity conservation in the Ikelenge Pedicle, Mwinilunga district, northwest Zambia.* Occasional Publications in Biodiversity No. 10. Biodiversity Foundation for Africa - Famona, Bulawayo, Zimbabwe: 20 pp.
Cotterill, F. P. D. (2003). *Geomorphological influences on vicariant evolution in some African mammals in the Zambezi Basin: some lessons for conservation.* In Plowman, A. [Ed]: *Ecology and Conservation of Small Antelope. Proceedings of an International Symposium on Duiker and Dwarf Antelope in Africa.* Filander Verlag, Fürth: 11 - 58.
Cotterill, F. P. D. (2004a). *Chapter 6. Mammals of the Four Corners Area.* In Timberlake, J. R. and S. L. Childes : *Biodiversity of the Four Corners Area; Technical Reviews Volume Two (Chapters 5-15).* Occasional Publications in Biodiversity No 15, Biodiversity Foundation for Africa, Bulawayo/Zambezi Society - Harare, Zimbabwe: 229 - 266.
Cotterill, F. P. D. (2008a). *Rhinolophus sakejiensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Cotterill, F. P. D. (2008b). *Rhinolophus silvestris*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Cotterill, F. P. D. (2008c). *Rhinolophus swinnyi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Cotterill, F. P. D. (2008d). *Scotophilus nigrita*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Cotterill, F. P. D. (2008e). *Tadarida lobata*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Cotterill, F. P. D. (2008f). *Tadarida niveiventer*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Cotterill, F. P. D. (2013a). *Rhinolophus denti Dent's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 322 - 323.
Cotterill, F. P. D. (2013b). *Rhinolophus eloquens Eloquent Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 323 - 325.
Cotterill, F. P. D. (2013c). *Rhinolophus sakejiensis Sakeji Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 348 - 350.
Cotterill, F. P. D. (2013d). *Rhinolophus silvestris Forest Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 350 - 351.
Cotterill, F. P. D. (2013e). *Rhinolophus swinnyi Swinny's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 353 - 355.
Cotterill, F. P. D. (2013f). *Nycteris parisii Parisi's Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 456 - 457.
Cotterill, F. P. D. (2013g). *Nycteris woodi Wood's Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 461 - 463.
Cotterill, F. P. D. (2013h). *Sauromys petrophilus Roberts's Flat-headed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 486 - 487.
Cotterill, F. P. D. (2013i). *Tadarida ansorgei Ansorge's Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 495 - 497.
Cotterill, F. P. D. (2013j). *Tadarida bivittata Spotted Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 499 - 500.
Cotterill, F. P. D. (2013k). *Tadarida fulminans Madagascan Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 511 - 513.
Cotterill, F. P. D. (2013l). *Tadarida gallagheri Gallagher's Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 513 - 514.
Cotterill, F. P. D. (2013m). *Tadarida lobata Big-eared Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 515 - 516.
Cotterill, F. P. D. (2013n). *Tadarida niveiventer White-bellied Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 525 - 526.
Cotterill, F. P. D. (2013o). *Tadarida ventralis Giant Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 539 - 540.
Cotterill, F. P. D. (2013p). *Kerivoula argentata Damara Woolly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 726 - 727.
Cotterill, F. P. D. (2013q). *Kerivoula lanosa Lesser Woolly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 730 - 731.
Cotterill, F. P. D. (2015). David L. Harrison 1st October 1926 - 19th March 2015. *African Bat Conservation News*, **38:** 2 - 4.
Cotterill, F. P. D. and R. A. Fergusson (1993a). Capturing free-tailed bats (Chiroptera: Molossidae): the description of a new trapping device. *Journal of Zoology*, **231:** 645 - 651. [Abstract]
Cotterill, F. P. D. and R. A. Fergusson (1993b). Seasonally polyestrous reproduction in a Free-tailed bat *Tadarida fulminans* (Microchiroptera: Molossidae) in Zimbabwe. *Biotropica*, **25 (4):** 487 - 492.
Cotterill, F. P. D. and R. A. Fergusson (1999). Reproductive ecology of Commerson's leaf-nosed bats *Hipposideros commersoni* (Chiroptera: Hipposideridae) in South-Central Africa: interactions between seasonality and large body size; and implications for conservation. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **34 (1):** 53 - 63.

Cotterill, F. P. D. and S. R. Giddings (1987). Observations on the activity patterns of the lesser yellow house bat, *Scotophilus viridis*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **22 (2):** 175. [Abstract]
Cotterill, F. P. D. and M. Happold (2013a). *Rhinolophus darlingi Darling's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 318 - 320.
Cotterill, F. P. D. and M. Happold (2013b). *Rhinolophus fumigatus Rüppell's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 329 - 331.
Cotterill, F. P. D. and M. Happold (2013c). *Rhinolophus hildebrandtii Hildebrandt's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 332 - 334.
Cotterill, F. P. D. and M. Happold (2013d). *Rhinolophus simulator Bushveld Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 351 - 353.
Cotterill, F. P. D. and M. Happold (2013e). *Nycteris macrotis Large-eared Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 451 - 453.
Cotterill, F. P. D. and M. Happold (2013f). *Tadarida midas Midas Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 518 - 520.
Cotterill, F. P. D. and M. Happold (2013g). *Tadarida nigeriae Nigerian Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 523 - 525.
Cotterill, F. P. D. and M. Happold (2013h). *Eptesicus hottentotus Long-tailed Serotine.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 555 - 556.
Cotterill, F. P. D., A. M. Hutson, P. A. Racey and J. Ravino (2008). *Tadarida fulminans*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Cotterill, F. W. (2004b). *Tadarida fulminans*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Cotterill, F. W. (2004c). *Rhinolophus sakejiensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Cotterill, F. W. (2004d). *Scotophilus nigrita*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Cotterill, F. W. (2004e). *Tadarida lobata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Cotterill, F. W. (2004f). *Mops niveiventer*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Cotterill, F. W. (2004g). *Rhinolophus silvestris*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Cotterill, F. W. (2004h). *Rhinolophus swinnyi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Cottle, L. E., E. Gkrania-Klotsas, H. J. Williams, H. E. Brindle, A. J. Carmichael, G. Fry and N. J. Beeching (2013). A multinational outbreak of histoplasmosis following a biology field trip in the Ugandan rainforest. *Journal of Travel Medecine*, **20 (2):** 83 - 87. doi: 10.1111/jtm.12012.
Coulanges, P., Y. Robin, G. Le Gonidec, A. Mayoux and R. Bordahandy (1974). Chiroptères et arbovirus à Madagascar (Isolement de souche de virus Dakr-bat, etude sérologique de Chauves-souris frugivores). *Archives de l'Institut Pasteur de Madagascar.*, **43:** 109 - 118. [Abstract]
Courts, S. E. (1996). Insectivory in two species of fruit bat: *Pteropus livingstonii* and *P. rodricensis*. Abstract. VIIth European Bat Research Symposium: 12 - 16 August 1996 - Veldhoven, The Netherlands: 15 - 16. [Abstract]
Courts, S. E. (1998). Dietary strategies of Old World Fruit Bats (Megachiroptera, Pteropodidae): how do they obtain sufficient protein?. *Mammal Review*, **28 (4):** 185 - 194.
Cowles, R. B. (1936). Notes on the mammalian fauna of Umzumbe Valley, Natal, South Africa. *Journal of Mammalogy*, **17 (2):** 121 - 130. [Abstract]
Cozens, A. B. and S.(M.) Marchant (1952). A contribution to the fauna of the Owerri province. Part II. *The Nigerian Field*, **17 (3):** 116 - 130.
Craib, C. L. (1975). Banana and yellow house bats. *Redwing*12 - 13.
Craven, S. A. (2012). Henry Paul William Lyster Jameson, MA, DSc, PhD (1875 - 1922) - a polymath: zoologist, Transvaal educationist, entrepreneur, civil servant and Marxist. *Transactions of the Royal Society of South Africa*, **67 (3):** 127 - 134. doi: 10.1080/0035919X.2012.720300.
Crawford-Cabral, J. (1966). Quatro formas de mamíferos novas para Angola. *Boletim do Instituto de Investigaçao cientifica de Angola, Luanda*, **3 (2):** 137 - 148. [Abstract]
Crawford-Cabral, J. (1989). A list of Angolan Chiroptera with notes on their distribution. *Garcia de Orta, Série de Zoologia, Lisboa*, **13 (for 1986) (1-2):** 7 - 48. [Abstract]
Crespo, V. D., P. Sevilla, S. Mansino, P. Montoya and F. J. Ruiz-Sánchez (2017). Bats from the classical site of Venta del Moro (Late Miocene, Eastern Spain). *Historical Biology*, **30 (3 - SI):** 317 - 326 (for 2018). doi: 10.1080/08912963.2016.1277995.
Crespon (1844). *Fauna méridionale.* .
Cretzschmar, Ph. J. (1826). *Atlas Reise Nördlichen Afrika, Zoolologie, Säugethiere.* Senckenbergischen Naturforschende Gesellschaft, Frankfurt-am-Main: 1 - 78, pls 1 - 30.
Cretzschmar, Ph. J. (1828). *Atlas Reise Nördlichen Afrika, Zoolologie, Säugethiere.* .
Cretzschmar, Ph. J. (1830). *Atlas Reise Nördlichen Afrika, Zoolologie, Säugethiere.* .
Crichton, E. G. (2000). *7. Sperm storage and fertilization.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 295 - 320.
Crichton, E. G. and P. H. Krutzsch [Eds] (2000). *Reproductive biology of bats.* Academic Press - London San Diego: i - xii; 1 - 510.
Crick, J., G. H. Tignor and K. Moreno (1982). A new isolate of Lagos Bat virus from the Republic of South Africa. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **76 (2):** 211 - 213. [Abstract]
Cronjé, N., N. L. Ithete, M. C. Schoeman and W. Preiser (2019). The detection of diverse coronaviruses, including MERS-related coronaviruses, in South African bat populations and their associated ecology in *Neoromica capensis*. *International Journal of Infectious Diseases*, **79 (S1):** 2 - 3. doi: 10.1016/j.ijid.2018.11.026.
Crucitti, P. (1976). Biometria di una collezione de *Miniopterus schreibersi* (Natt.) (Chiroptera) catturati nel Lazio (Italia). *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **81:** 131 - 138.

Csada, R. (1996). *Cardioderma cor*. *Mammalian Species*, **519:** 1 - 4, 3 figs.
Csorba, G. (2008). Taxonomy of the horseshoe bats of the world (Chiroptera: Rhinolophidae). PhD thesis. i - vi; 1 - 172. URL: http://ganymedes.lib.unideb.hu:8080/dea/bitstream/2437/89636/4/ertekezes_angol.pdf.
Csorba, G., P. (J. J.) Bates, M. Stubbe, A. M. Hutson, S. Aulagnier and F. Spitzenberger (2008). *Nyctalus noctula*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.
Csorba, G., C.-H. Chou, M. Ruedi, T. Görföl, M. Motokawa, S. Wiantoro, V. D. Thong, N. T. Son, L.-K. Lin and N. Furey (2014). The reds and the yellows: a review of Asian *Chrysopteron* Jentink, 1910 (Chiroptera: Vespertilionidae: *Myotis*). *Journal of Mammalogy*, **95 (4):** 663 - 678. doi: 10.1644/13-MAMM-A-200.
Csorba, G., P. Ujhelyi and N. Thomas (1999). Horseshoe bats of the world: systematics, distribution, ecology and conservation. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 19.
Csorba, G., P. Ujhelyi and N. Thomas (2003). *Horseshoe Bats of the World (Chiroptera: Rhinolophidae)*. Alana Books - Shropshire: i - xxxii; 1 - 160.
Cui, J. and L.-F. Wang (2015). Genomic mining reveals deep evolutionary relationships between bornaviruses and bats. *Viruses*, **7 (11):** 5792 - 5800. doi: 10.3390/v7112906.
Cui, J., X. Yuan, L. Wang, G. Jones and S. Zhang (2011). Recent loss of vitamin C biosynthesis ability in bats. *PLoS ONE*, **6 (11) e27114:** 1 - 6. doi: 10.1371/journal.pone.0027114.
Cumming, G. S. and R. T. F. Bernard (1997). Rainfall, food abundance and timing of parturition in African bats. *Oecologia*, **111:** 309 - 317. [Abstract]
Cunneyworth, P. [Ed] (1996a). Kwamarimba Forest Reserve. A biodiversity survey. East Usambara Catchment Forest Project Technical Paper 33 - Forestry and Beekeeping Division & Finnish Forest and Park Service & Society for Environmental Exploration, Tanga: i - xiii; 1 - 73. [Abstract]
Cunneyworth, P. [Ed] (1996b). Kambai Forest Reserve: A biodiversity survey. East Usambara Catchment Forest Project Technical Paper No. 35. - Forestry and Beekeeping Division & Finnish Forest and Park Service & Society for Environmental Exploration, Dar es Salaam, Vantaa & London.: i - x; 1 - 81. [Abstract]
Curran, M., M. Kopp, J. Beck and J. Fahr (2010). Species diversity of bats along an altitudinal gradient in southern Malawi. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference*. 15th IBRC - Prague 23 - 27 August 2010: 118 - 119.
Curran, M., M. Kopp, J. Beck and J. Fahr (2012). Species diversity of bats along an altitudinal gradient on Mount Mulanje, southern Malawi. *Journal of Tropical Ecology*, **28 (3):** 243 - 253. doi: 10.1017/S0266467412000193.
Curry-Lindahl, K. (1956). Ecological Studies on Mammals, Birds, Reptiles and Amphibians in the Eastern Belgian Congo. (Part 1. Report No. 1 of the Lund University Congo Expedition 1951-1952.). *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 42:** 1-78, 23 pls.
Curry-Lindahl, K. (1961a). Contribution à l'étude des vertébrés terrestres en Afrique tropicale. Exploration du Parc National Albert et Parc Natiuonal de la Kagera. II. Miss. K. Curry-Lindahl (1951-1952,1958-1959). *Instituut der Nationale Parken van Belgisch Kongo*1-331, 91 figs, 22 pls.
Curry-Lindahl, K. (1961b). Orbituary: Nils Gyldenstolpe. *The Ibis*, **103a (4):** 627. doi: 10.1111/j.1474-919X.1961.tb02470.x.
Curtis, A. A. and N. B. Simmons (2018). Prevalence of mineralized elements in the rostra of bats (Mammalia: Chiroptera). *Journal of Mammalogy*, **99 (6):** 1387 - 1397. doi: 10.1093/jmammal/gyy134.
Curtis, A. A. and N. B. Simmons (2016). Unique turbinal morphology in horseshoe bats (Chiroptera: Rhinolophidae). *The Anatomical Record*, **300 (2):** 309 - 325 (for 2017). doi: 10.1002/ar.23516.
Cushing, A. C., R. Ossiboff, E. Buckles and N. Abou-Madi (2013). Metastatic pancreatic carcinoma and bronchioloalveolar adenomas in an Egyptian fruit bat (*Rousettus aegyptiacus*). *Journal of Zoo and Wildlife Medicine*, **44 (3):** 794 - 798. doi: 10.1638/2013-0026R.1.
Cuvier, F. (1829). ?? Title still needs to be checked. ?? .
Cuvier, F. (1832). Essai de classification naturelle des vespertilions, et description de plusieurs espèces de ce genre. *Nouvelles Annales du Muséum d'Histoire Naturelle*, **1 (3):** 1 - 30; 2 pls.
Cuvier, G. (1826). Éloge historique de M. le comte de Lacépède. *Mémoire du Muséum d'Histoire Naturelle, Paris*, **13:** 369 - 405 (for 1825).
Cuvier, G. and E. Geoffroy (1795). Méthode mammalogique. *Magazine Encyclopedique*1 annee 2.
Cvikel, N., K. E. Berg, E. Levin, E. Hurme, I. Borissov, A. Boonman, E. Amichai and Y. Yovel (2015). Bats aggregate to improve prey search but might be impaired when their density becomes too high. *Current Biology*, **25:** 206-211. doi: 10.1016/j.cub.2014.11.010.
Cvikel, N., A. Boonman, E. Levin, E. Amichai and Y. Yovel (2013). Full night on-board GPS tracking and audio monitoring of echolocating bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 42. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Cvikel, N., E. Levin, E. Hurme, I. Borissov, A. Boonman, E. Amichai and Y. Yovel (2014). On-board recordings reveal no jamming avoidance in wild bats. *Proceedings of the Royal Society of London*, **B 282:** 20142274. doi: 10.1098/rspb.2014.2274.
Czaplewski, N. J., G. S. Morgan and T. Naeher (2003). Molossid bats from the late Tertiary of Florida with a review of the Tertiary Molossidae of North America. *Acta Chiropterologica*, **5 (1):** 61 - 74.
Czekala, N. M. and K. Benirschke (1974). Observations on a twin pregnancy in the African Long-tongued fruit bat (*Megaloglossus woermanni*). *Bonner zoologische Beitrage*, **25 (4):** 220 - 230. URL: http://zfmk.de/BZB/1974/1974%20Czekala%20N.M.%20u.%20Benirschke%20K.%20p220%20orginal.pdf. [Abstract]
Daday (1840). ?? Title still needs to be checked. ?? .
Daday, J. (1885). Jelentés az Erdélyi Országos Muzeum-Egylet igazgató-választmányának megbízásából az 1885-ik év nyarán végzett chiropterologiai gyujtések eredményérol és az Erdélyi Múzeum-Egylet denevérgyujteményének jegyzéke. *Orvos-Természettudományi Értesito, Kolozsvár (Cluj)*, **X (3):** 266 - 276.
Daday, J. (1887). ?? Title still needs to be checked. ?? .
Daïnou, K., J.-P Bizoux, J.-L. Doucet, G. Mahy, O. J. Hardy and M. Heuertz (2010). Forest refugia revisited: nSSRs and cpDNA sequences support historical isolation in a wide-spread African tree with high colonization capacity, *Milicia excelsa* (Moraceae). *Molecular Ecology*, **19 (20):** 4462 - 4477. doi: 10.1111/j.1365-294X.2010.04831.x. URL: http://www.rjb.csic.es/jardinbotanico/ficheros/documentos/pdf/pubinv/MH/2010Dainou_et_al_MEC2010.pdf.
Dalhoumi, R., P. Aissa and S. Aulagnier (2011). Taxonomie et répartition des chiroptères de Tunisie. *Revue suisse de zoologie*, **118 (2):** 265 - 292.
Dalhoumi, R., P. Aissa and S. Aulagnier (2016a). Seasonal variations of sexual size dimorphism in two Mediterranean bat species from Tunisia: the Kuhl's pipistrelle (*Pipistrellus kuhlii*) and the Isabelline serotine (*Eptesicus isabellinus*). *Folia zoologica: International journal of vertebratology*, **65 (2):** 157 - 163.

Dalhoumi, R., P. Aissa and S. Aulagnier (2016b). Bat species richness and activity in Bou Hedma National Park (central Tunisia). *Turkish Journal of Zoology*, **40 (6):** 864 - 875. doi: 10.3906/zoo-1505-46.
Dalhoumi, R., A. Hedfi, P. Aissa and S. Aulagnier (2014). Bats of the National Park of Jebel Mghilla (Central Tunisia): first survey and habitat-related activity. *Tropical Zoology*, **27 (2):** 53 - 62. doi: 10.1080/03946975.2014.936752.
Dalhoumi, R., H.-E. Loumassine, B. Allegrini, F. Bounaceur and S. Aulagnier (2017a). Seasonal activity of mouse-tailed bats (genus *Rhinopoma*) in the north-western edge of Sahara (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 77. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.
Dalhoumi, R., N. Morellet, P. Aissa and S. Aulagnier (2017b). Seasonal activity pattern and habitat use by the Isabelline serotine bat (*Eptesicus isabellinus*) in an arid environment of Tunisia. *Acta Chiropterologica*, **19 (1):** 141 - 153. doi: 10.3161/15081109ACC2017.19.1.011.
Dalhoumi, R., N. Morellet, P. Aissa and S. Aulagnier (2018). Seasonal activity pattern and habitat use by the Kuhl's pipistrelle (*Pipistrellus kuhlii*) in an arid environment. *European Journal of Wildlife Research*, **64:** 36. doi: 10.1007/s10344-018-1193-y.
Dallimer, M., T. King, D. Cope and M. B. Jiana (2006). Estimation of population density of *Eidolon helvum* on the island of Pr¡ncipe, Gulf of Guinea. *Mammalia*, **70 (1/2):** 48 - 51.
Dal Piaz (1926). ?? Title still needs to be checked. ?? *Atti della Societa veneto-trentini di scienze vat. Resid. Padova*16.
Dalquest, W. W. (1965). Mammals from the Save River, Mozambique, with descriptions of two new bats. *Journal of Mammalogy*, **46 (2):** 254 - 264. [Abstract]
Dalquest, W. W. (1966). *Scotophilus alvenslebeni* Dalquest a synonym of *Scotophilus gigas* Dobson. *Journal of Mammalogy*, **47 (1):** 134.
Dalquest, W. W. (1968). Additional notes on the mammals from Mozambique. *Journal of Mammalogy*, **49 (1):** 117 - 121. [Abstract]
Dammann, P. (2017). Slow aging in mammals - Lessons from African mole-rats and bats. *Seminars in Cell & Developmental Biology*, **70:** 154 - 163. doi: 10.1016/j.semcdb.2017.07.00.
Dammhahn, M. and S. M. Goodman (2013). Trophic niche differentiation and microhabitat utilization revealed by stable isotope analyses in a dry-forest bat assemblage at Ankarana, northern Madagascar. *Journal of Tropical Ecology*, **30 (2):** 97 - 109. doi: 10.1017/S0266467413000825.
Dammhahn, M., C. F. Rakotondramanana and S. M. Goodman (2014). Coexistence of morphologically similar bats (Vespertilionidae) on Madagascar: stable isotopes reveal fine-grained niche differentiation among cryptic species. *Journal of Tropical Ecology*, **31 (2):** 153 - 164 (for 2015). doi: 10.1017/S0266467414000741.
Dandurand, G., F. Duranthon, M. Jarry, D. J. Stratford and L. Bruxelles (2018). Biogenic corrosion caused by bats in Drotsky's Cave (the Gcwihaba Hills, NW Botswana). *Geomorphology*, **327:** 284 - 296 (for 2019). doi: 10.1016/j.geomorph.2018.10.027.
Daniel, B. M., K. E. Green, H. Doulton, D. M. Salim, I. Said, M. Hudson, J. S. Dawson, R. P. Young and A. Houmadi (2016). A bat on the brink? A range-wide survey of the Critically Endangered Livingstone's fruit bat *Pteropus livingstonii*. *Oryx*, **51 (4):** 742 - 751 (for 2017). doi: 10.1017/S0030605316000521.
Daniel, S. (2005). Behavioral body temperature regulation and foraging activity in reproductive female Hemprich's Long-eared Bats (*Otonycteris hemprichii*) in the Negev Desert. Ph.D. Thesis, Ben-Gurion University of the Negev, Beer Sheba, 65 pp.
Daniel, S., C. Korine and B. Pinshow (2010). Foraging behavior of a desert dwelling arthropod-gleaning bat (*Otonycteris hemprichii*) during pregnancy and nursing. *Acta Chiropterologica*, **12 (2):** 293 - 299. doi: 10.3161/150811010X537873.
Danilovich, A., Y. M. Bar and Y. Yovel (2014). Multi-modal perception and decision making in the Egyptian fruit bat. *Journal of Molecular Neuroscience*, **53 (Suppl 1):** S32. doi: 10.1007/s12031-014-0252-4.
Danilovich, S., A. Krishnan, W.-J. Lee, I. Borrisov, O. Eitan, G. Kosa, C. F. Moss and Y. Yovel (2015). Bats regulate biosonar based on the availability of visual information. *Current Biology*, **25 (23):** R1124 - R 1125. doi: 10.1016/j.cub.2015.11.003.
Danilovich, S. and Y. Yovel (2019). Integrating vision and echolocation for navigation and perception in bats. *Science Advances*, **5 (6):** eaaw6503. doi: 10.1126/sciadv.aaw6503.
Danmaigoro, A., J. E. Onu, M. L. Sonfada, M. A. Umaru, S. A. Hena and A. Mahmuda (2014a). Gross and morphometric anatomy of the male reproductive system of bats (*Eidolon helvum*). *Veterinary Medicine International*, **2014:** 358158 (5 pp). doi: 10.1155/2014/358158.
Danmaigoro, A., J. E. Onu, M. L. Sonfada, M. A. Umaru and F. O. Oyelowo (2014b). Histology and histometric anatomy of the male reproductive system of bat (*Eidolon helvum*). *Journal of Histology*, **2014:** 834735 (6 pp). doi: 10.1155/2014/834735.
Daszak, P., C. Zambrana-Torrelio, T. L. Bogich, M. Fernandez, J. H. Epstein, K. A. Murray and H. Hamilton (2012). Interdisciplinary approaches to understanding disease emergence: The past, present, and future drivers of Nipah virus emergence. *Proceedings of the National Academy of Sciences, U.S.A.*, **110 (Suppl. 1):** 3681 - 3688 (for 2013). doi: 10.1073/pnas.1201243109.
Daszkiewicz, P. (2009). L'expédition zoologique polonaise en Algérie d'âpres la correspondance de Wladyslaw Taczanowski a Konstanty Jelski. *Organon*, **41:** 109 - 120.
Daudin (1802). Histoire Naturelle des Quadrupèdes, Didot ed. 14.
Davies, K. T. J., P. J. J. Bates, I. Maryanto, J. A. Cotton and S. J. Rossiter (2013a). The evolution of bat vestibular systems in the face of potential antagonistic selection pressures for flight and echolocation. *PLoS ONE*, **8 (4):** e61998. doi: 10.1371/journal.pone.0061998.
Davies, K. T. J., I. Maryanto and S. J. Rossiter (2013b). Evolutionary origins of ultrasonic hearing and laryngeal echolocation in bats inferred from morphological analyses of the inner ear. *Frontiers in Zoology*, **10:** 2. URL: www.frontiersinzoology.com/content/10/1/2.
Davies, K. T. J., G. Tsagkogeorga and S. J. Rossiter (2014). Divergent evolutionary rates in vertebrate and mammalian specific conserved non-coding elements (CNEs) in echolocating mammals. *BMC Evolutionary Biology*, **14:** 261. doi: 10.1186/s12862-014-0261-5.
Davis, D. H. S. (1957). Studies on Arthropod-borne viruses of Tongaland. III. The small wild mammals in relation to the virus studies. *South African Journal of medical Sciences*, **22:** 55 - 61. [Abstract]
Davis, L. (2007). An introduction to the bats of United Arab Emirates. Echoes Ecology Ltd., Polmont, Scotland: 24 pp. URL: http://www.echoesecology.co.uk/documents/BatsoftheUAE_000.pdf.
Davis, W. B. (1970). *Tomopeas ravus* Miller (Chiroptera). *Journal of Mammalogy*, **51:** 244 - 247.

D'Cruze, N. C., Z. J. McDonell, T. Langeveld, P. D. Brooks, X. Combrink, E. C. J. Seamark and T. C. Kearney (2008). Bat survey in the uMkhuze section of the Greater St. Lucia Wetland Park, KwaZulu-Natal, South Africa. *African Bat Conservation News*, **17:** 4 - 9.

Dean, W. R. J. (1975). *Tyto alba* prey in South West Africa and the Northern Cape. *Zoologica Africana*, **10:** 217 - 219. [Abstract]

Debaeremaeker, K. R. and M. B. Fenton (2003). Basisphenoid and basioccipital pits in microchiropteran bats. *Biological Journal of the Linnean Society*, **78 (2):** 215 - 233.

Debata, S., R. M. Panda and S. K. Palita (2019). Chiropteran diversity and the key determinants of their distribution in Eastern Ghats, India. *Biodiversity and conservation*, **28 (8-9 SI):** 2385 - 2404. doi: 10.1007/s10531-019-01715-w.

De Beaux, O. (1922a). Mammiferi abissini e somali. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **61:** 21 - 34. [Abstract]

De Beaux, O. (1922b). Collezioni zoologiche fatte nell'Uganda dal Dott. E. Bayon. XVII. Mammiferi. Parte II. Chiroptera. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 3, 9 (O.S. 49):** 364 - 373. [Abstract]

De Beaux, O. (1923). Di alcuni Chirotteri africani del Museo civico di Milano. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **62:** 91 - 101. [Abstract]

De Beaux, O. (1924). Mammiferi della Somalia Italiana raccolta del maggiore Vittorio Tedesco Zammarano nel museo civico di Milano. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **62 (3/4):** 247 - 316. [Abstract]

De Beaux, O. (1928). Risultati zoologici della missione inviata dalla R. Societa Geografica Italiana per l'esplorazione dell'oasi di Giarabub (1926-1927). Mammiferi. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **53:** 39 - 76.

De Beaux, O. (1931). Spedizione del Barone Raimondo Franchetti in Dancalia. Mammiferi. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*55.

De Beaux, O. (1932). Spedizione scientifica all'oasi di Cufra (Marzo-Luglio 1931). Mammiferi. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **60:** 374 - 394.

De Beaux, O. (1934). Mammiferi raccolti dal Prof. G. Scortecci nella Somalia Italiana Centrale e Settentrionale nel 1931. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **73 (3):** 261 - 300. [Abstract]

De Beaux, O. (1937). Mammiferi. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **58:** 150 - 173.

De Beaux, O. (1943). Missione biologica Sagan-Omo. VII. Zoologia I. Mammalia. *Reale Accademia d'Italia. Centro studi par l'Africa orientale Italiana*21.

de Blainville, H. M. (1837). Recherches sur l'ancienneté des cheiroptères ou des animaux de la famille des chauves-souris à la surface de la terre, précédées de l'histoire de la science à leur sujet, des principes de leur classification et de leur distribution géographique. *Comptes Rendus des séances de l'Academie des Sciences*, **5:** 807 - 822.

de Blainville, H. M. (1840). ?? Title still needs to be checked. ?? *Ostéographie des Mammifères*.

DeBlase, A. F. (1972). *Rhinolophus euryale* and *R. mehelyi* (Chiroptera, Rhinolophidae) in Egypt and southwest Asia. *Israel journal of zoology*, **21:** 1 - 12. [Abstract]

Decher, J. (1997). Bat community patterns on the Accra Plains of Ghana, West Africa. *Zeitschrift für Säugetierkunde*, **62:** 129 - 142. [Abstract]

Decher, J. and M. Abedi-Lartey (2002). Small mammal zoogeography and diversity in West African forest remnants. Final report to the Ghana Wildlife Division, the National Geographic Committee for Research and Exploration, and Conservation International. University of Vermont, unpublished Report, 99 p.

Decher, J. and J. Fahr (2005). *Hipposideros cyclops*. *Mammalian Species*, **763:** 1 - 7, 3 figs.

Decher, J. and J. Fahr (2007). A conservation assessment of bats (Chiroptera) of Draw River, Boi-Tano, and Krokosua Hills Forest Reserves in the Western Region of Ghana. *Myotis*, **43:** 5 - 30.

Decher, J., A. Hoffmann, J. Schaer, R. W. Norris, B. Kadjo, J. Astrin, A. Monadjem and R. Hutterer (2016). Bat diversity in the Simandou Mountain Range of Guinea, with the description of a new white-winged vespertilionid. *Acta Chiropterologica*, **17 (2):** 255 - 282 (for 2015). doi: 10.3161/15081109ACC2015.17.2.003.

Decher, J., B. Kadjo, M. Abedi-Lartey, E. O. Tounkara and S. Kante (2005). *A rapid survey of small mammals (shrews, rodents, and bats) from the Haute Dodo and Cavally Forests, Côte d'Ivoire.* In Alonso, L. E., F. Lauginie and G. Rondeau : *A Rapid Biological Assessment of two classified forests in South-western Côte d'Ivoire.* Conservation International - Washington, D.C.: 101 - 109.

Decher, J., R. W. Norris and J. Fahr (2010). Small mammal survey in the upper Seli River valley, Sierra Leone. *Mammalia*, **74 (2):** 163 - 176. doi: 10.1515/MAMM.2010.026.

Decher, J., J. Oppong and J. Fahr (2006a). *Chapter 7. Rapid Assessment of Small Mammals at Draw River, Boi-Tano, and Krokosua Hills.* In McCullough, J., J. Decher and D. G. Kpelle : *A Rapid Biological Assessment of the terrestrial ecosystems of the Draw River, Boi-Tano, Tano Nimiri and Krokosua Hills forest reserves, southwestern Ghana.* Conservation International - Washington, D.C.: 57 - 66. doi: 10.1046/j.1471-8286.2003.00580.x.

Decher, J., J. Oppong and J. Fahr (2006b). *Appendix 10. Names and museum location of voucher specimens from the 2003 RAP Survey of the Western Region of Ghana.* In McCullough, J., J. Decher and D. G. Kpelle : *A biological assessment of the terrestrial ecosystems of the Draw River, Boi-Tano, Tano Nimiri and Krokosua Hills forest reserves, southwestern Ghana.* Conservation International - Washington, D.C.: 151 - 152. doi: 10.1046/j.1471-8286.2003.00580.x.

Decher, J., D. A. Schlitter and R. Hutterer (1997). Noteworthy records of small mammals from Ghana with special emphasis on the Accra Plains. *Annals of Carnegie Museum*, **66 (2):** 209 - 227. [Abstract]

Dechmann, D. K. N., R. Suu-Ire, M. Wikelski and J. Fahr (2010). The urban crowd: Foraging ecology of *Eidolon helvum* from the non-migratory subpopulation in Accra, Ghana. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 1 - 356.

de Filippi, F. (1865). *Note di un viaggio in Persia nel 1862.* G. Daelli & C. Editori - Milano.

DeFrees, S. L. and D. E. Wilson (1988). *Eidolon helvum*. *Mammalian Species*, **312:** 1 - 5, 3 figs.

De Graaf, G. (1960). A preliminary investigation of the mammalian microfauna in Pleistocene deposits of caves in the Transvaal system. *Palaeontogy Africana*, **7:** 59 - 118.

De Graaff, G. (1961). On the fossil mammalian microfauna collected at Kromdraai by Draper in 1895. *South African Journal of Sciences*, **57 (9):** 259 - 260.

De Graaff, G. and R. B. Martin (1972). A survey of existing sound recordings of mammals and birds of southern Africa (during the period December 1971 - February 1972). *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **15 (1):** 107 - 125. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/677. [Abstract]

De Graaff, G. and J. A. J. Nel (1970). Notes on the smaller mammals of the eastern Cape National Parks. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **13 (1):** 147 - 149. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/736. [Abstract]

De Graaff, G. and I. L. Rautenbach (1983). A survey of mammals in the newly proclaimed Karoo National Park, South Africa. In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 89 - 99. [Abstract]

Deikumah, J. P., C. A. Mcalpine and M. Maron (2014). Biogeographical and taxonomic biases in tropical forest fragmentation research. *Current Biology*, **28 (6):** 1522 - 1531. doi: 10.1111/cobi.12348.

de Jong, C., H. Field, S. H. Newman and J. H. Epstein (2011). *Chapter 1. Emerging infectious diseases.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 1 - 13. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Dekeyser, P. L. (1955). *Les mammifères de l'Afrique Noire française. I. (2e édition).* IFAN - Dakar.

Dekeyser, P. L. and A. Villiers (1952). Une caverne dans l'Adrar mauritanien. *Bulletin de la direction des mines, Dakar*, **2 (15):** 415 - 420.

Dekeyser, P. L. and A. Villiers (1954). Essai sur le peuplement zoologique terrestre de l'ouest Africain. *Bulletin de l'Institut fondamental d'Afrique noire: sciences naturelles*, **16A (3):** 957 - 970.

Dekeyser, P. L. and A. Villiers (1956). Contribution a l'étude du peuplement de la Mauritanie. Notations écologiques et biogéographiques sur la faune de l'Adrar. *Mémoires de l'Institut français d'Afrique noire*, **44:** 1 - 222.

de La Vega, M.-A., D. Stein and G. P. Kobinger (2015). Ebolavirus evolution: past and present. *PloS Pathogens*, **11 (11):** e1005221. doi: 10.1371/journal.ppat.1005221.

Delcros, G., M. C. Schoeman and P. J. Taylor (2009). Species composition patterns of non-volant and volant small mammal communities in uMkhuze Game Reserve. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 61. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.

Delcros, G., P. J. Taylor and C. M. Schoeman (2010). When size matters: The influence of competition on bat body size. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 122.

Deleuil, R. (1957). Une nouvelle chauve-souris pour la Tunisie: *Otonycteris hemprichi* Peters 1860. *Mammalia*, **21 (2):** 190.

Deleuil, R. and A. Labbe (1955a). Contributions à l'étude des chauves-souris de Tunisie. *Bulletin de la Société des sciences naturelles de Tunisie*, **8:** 39 - 55. [Abstract]

Deleuil, R. and A. Labbe (1955b). Sur la variabilité de la pipistrelle de Kuhl, *Pipistrellus Kuhli*. *Bulletin de la Société des sciences naturelles de Tunisie*, **8:** 237 - 241.

Delfinado, M. D. , Baker, E. W. (1963). Mites of the family Spinturnicidae from the Philippines (Acarina). *Pacific Insects*, **5 (4):** 905 - 920. [Abstract]

Dell, L.-A., J.-L. Kruger, A. Bhagwandin, N. E. Jillani, J. D. Pettigrew and P. R. Manger (2010). Nuclear organization of cholinergic, putative catecholaminergic and serotonergic systems in the brains of two megachiropteran species. *Journal of Chemical Neuranatomy*, **40 (2):** 177 - 195. doi: 10.1016/j.jchemneu.2010.05.008.

Dell, L.-A., J.-L. Kruger, J. D. Pettigrew and P. R. Manger (2013). Cellular location and major terminal networks of the orexinergic system in the brain of two megachiropterans. *Journal of Chemical Neuranatomy*, **53:** 64 - 71. doi: 10.1016/j.jchemneu.2013.09.001.

Delmas, O., E. C. Holmes, C. Talbi, F. Larrous, L. Dacheux, C. Bouchier and H. Bourhy (2008). Genomic diversity and evolution of the lyssaviruses. *PLoS ONE*, **3 (4):** e2057. doi: 10.1371/journal.pone.0002057.

Delmore, J. L., P. L. R. Brennan and T. J. Orr (2018). Reproductive melanization may protect sperm from harmful solar radiation. *Evolutionary Ecology*, **32 (2-3):** 127 - 139. doi: 10.1007/s10682-018-9932-9.

Del Vaglio, M. A., H. Nicolaou, L. Bosso and D. Russo (2011). Feeding habits of the Egyptian fruit bat *Rousettus aegyptiacus* on Cyprus island: a first assessment. *Hystrix, Italian Journal of Mammalogy*, **(n.s.) 22 (2):** 281 - 289. doi: 10.4404/Hystrix-22.2-4587.

Demeler, A. (1981). Small mammals and the food of owls (*Tyto* and *Bubo*) in northern Nigeria. *Vertebrata Hungarica*, **20:** 127 - 136. [Abstract]

Demeter, A. (1982). Prey of the Spotted Eagle-Owl *Bubo africanus* in the Awash National Park, Ethiopia. *Bonner zoologische Beitrage*, **33 (2-4):** 283 - 292. [Abstract]

Demeter, A. and G. Topál (1982a). Kittenberger kálmán kelet-afrikai expedíciói és az általa gyüjtött enlõsök. *Állattani Közlemények*, **LXIX:** 43 - 59.

Demeter, A. and G. Topál (1982b). Ethiopian mammals in the Hungarian Natural History Museum. *Annales historico-naturales Musei Nationalis Hungarici*, **74:** 331 - 349. [Abstract]

Demos, T. C., P. W. Webala, M. Bartonjo and B. D. Patterson (2018). Hidden diversity of African yellow house bats (Vespertilionidae, *Scotophilus*): insights from multilocus phylogenetics and lineage delimitation. *Frontiers in Ecology and Evolution*, **6:** 86. doi: 10.3389/fevo.2018.00086.

de Naurois, R. (1994). *Les oiseaux de l'archipel du Cap Vert.* Instituto de Investigação Cientifica Tropical, Ministerio de Planeamento e da Administração do Territorio, Lisbon. 188 pp.

Dengis, C. A. (1996). *Taphozous mauritianus*. *Mammalian Species*, **522:** 1 - 5, 4 figs.

Dennison, S., L. Gatchell, A. Kayitare, S. Otis and C. Twesigye-Bakwatsa (2008). Rwanda Environmental Threats and Opportunities - Assessment (ETOA) 2008 Update. EPIQ IQC Contract No. EPP-I-00-03-00014-00, Task Order 02: 183 pp. URL: http://pdf.usaid.gov/pdf_docs/PNADN537.pdf.

Denys, C. (2012). Obituary: In memoriam Francis Petter (28 July 1923 - 21 January 2012). *Mammalia*, **76 (2):** 117 - 122. doi: 10.1515/mammalia-2012-0024.

Denys, C., W. Bogdanowicz and S. Aulagnier (1995). First record of *Tadarida aegyptiaca* (Chiroptera, Molossidae) from Morocco. *Mammalia*, **59 (2):** 266 - 268.

Denys, C., C. Callou and B. Mellier (2012). The contribution of Edouard-Louis Trouessart to mammalogy. *Mammalia*, **76 (4):** 355 - 364. doi: 10.1515/mammalia-2011-0131.

Denys, C., B. Kadjo, A. D. Missoup, A. Monadjem and V. Aniskine (2013). New records of bats (Mammalia: Chiroptera) and karyotypes from Guinean Mount Nimba (West Africa). *Italian Journal of Zoology*, **80 (2):** 279 - 290. doi: 10.1080/11250003.2013.775367.

Denys, C., A. D. Missoup, B. Tchiengue, G. Achoundong, A. Ekobo, F. Bilong Bilong, D. M. Lembe and V. Nicolas (2009). Altitudinal distribution and anthropogenic influence on small mammal assemblages on Mount Kupe, SW Cameroon. *Bonner zoologische Beitrage*, **56 (3):** 159 - 173.

De Nys, H. M., P. M. Kingebeni, A. K. Keita, C. Butel, G. Thaurignac, C.-J. Villabona-Arenas, T. Lemarcis, M. Geraerts, N. Vidal, A. Esteban, M. Bourgarel, F. Roger, F. Leendertz, R. Diallo, S.-P. Ndimbo-Kumugo, J. Nsio-Mbeta, N. Tagg, L. Koivogui, A. Toure, E. Delaporte, S. Ahuka-Mundeke, J.-J. M. Tamfum, E. Mpoudi-Ngole, A. Ayouba and M. Peeters (2018). Survey of Ebola viruses in frugivorous and insectivorous bats in Guinea, Cameroon, and the Democratic Republic of the Congo, 2015-2017. *Emerging Infectious Diseases*, **24 (12):** 2228 - 2240. doi: 10.3201/eid2412.180740.

de Paz, O. (1994). Systematic position of *Plecotus* (Geoffroy, 1818) from the Iberian Peninsula (Mammalia: Chiroptera). *Mammalia*, **58 (3):** 423 - 432. doi: 10.1515/mamm.1994.58.3.423. [Abstract]

de Rochebrune, A. T. (1883). Faune de la Sénégambie. Mammifères. *Actes de la Société Linné de Bordeaux*, **37:** 49 - 204.

de Roguin, L. (1988). Notes sur quelques mammifères du Baluchistan iranien. *Revue suisse de zoologie*, **95 (2):** 595 - 606. [Abstract]

Desai, I., H. Pandya, P. Pratyush and B. Suresh (2012). Some observations on the population of naked-rumped tomb bat (*Taphozous nudiventris* Cretzschmar) at the Maharaja Sayajirao University of Baroda campus, Gujarat. *Cibtech Journal of Zoology*, **1 (2):** 27 - 35.

de Selys Longchamps (1839). Etudes de Micromammifères. .

Desmarest, M. A. G. (1803). *Nouveau dictionnaire d'histoire naturelle appliquée aux arts principalement à l'agriculture et à l'économie rurale et domestique: par une Société de Naturalistes et d'Agriculteurs.* Imprimérie de Crapelet. Chez Deterville - Paris: 501.

Desmarest, M. A. G. (1820). *Mammalogie ou description des espèces de mammifères. Première partie, contentant les ordres des bimanes, des quadrumanes et des carnassiers.* Encyclopédie Méthodique - Paris: viii + 276 pp.

De Sousa Dias, A. (1970). Mamiferos de Moçambique. *Anais dos Serviços de Veterinaria de Moçambique*, **16 (for 1968):** 125 - 147. [Abstract]

Desvars, A., T. Duval, C. Punelle, M. Pascal and G. Vouc'h (2009). The Flying Fox *Pteropus seychellensis* of Mayotte (Comoros): Method of capture and blood sampling. *Journal of wildlife diseases*, **45 (3):** 870 - 873.

Devaux, B. (2006). Compte-rendu suivi de chauves-souris pour la DIREN. National des Forêt, La Réunion, France.

De Vree, F. (1969). Notes on *Xiphonycteris spurrelli* Dollman from the Togo Republic (Microchiroptera - Molossidae). *Revue de zoologie et de botanique africaines*, **80 (3-4):** 273 - 280. [Abstract]

De Vree, F. (1971). Notes sur une collection de Chiroptères ouest africains, principalement de la Côte d'Ivoire. *Revue de zoologie et de botanique africaines*, **83 (1-2):** 31 - 49.

De Vree, F. (1972). Description of a new form of *Pipistrellus* from Ivory Coast (Chiroptera). *Revue de zoologie et de botanique africaines*, **85 (3-4):** 412 - 416. [Abstract]

De Vree, F. (1973a). A note on the occurrence of the Dark Brown Serotine, *Eptesicus brunneus* (Thomas, 1880) in Ivory Coast (Cheiroptera). *Revue de zoologie et de botanique africaines*, **87 (1):** 142 - 145.

De Vree, F. (1973b). New data on *Scotophilus gigas* Dobson, 1875 (Microchiroptera - Vespertilionidae). *Zeitschrift für Säugetierkunde*, **38 (4):** 189 - 196. [Abstract]

De Vree, F., A. De Roo and W. N. Verheyen (1969). Contribution à l'étude des Chiroptères de la République du Togo. *Revue de zoologie et de botanique africaines*, **80 (1-2):** 200 - 207.

De Vree, F., J. Hulselmans and W. N. Verheyen (1970). Contribution à l'étude des Chiroptères de la République du Togo. 2. Liste préliminaire des Chiroptères récoltés par la deuxième mission zoologique belge au Togo. *Revue de zoologie et de botanique africaines*, **82 (1-2):** 41 - 46. [Abstract]

De Vree, F. and E. Van der Straeten (1971). Contribution à l'étude des chiroptères de la République du Togo. 3. Liste préliminaire des chiroptères récoltés par la troisième Mission Zoologique Belge au Tongo. *Revue de zoologie et de botanique africaines*, **83 (1-2):** 159 - 164.

de Winton, W. E. (1897). LXIV. Descriptions of two new mammals from West Africa. *Annals and Magazine of Natural History*, **ser. 6, 20 (120):** 524.

de Winton, W. E. (1898). 5. On a collection of mammals from Morocc. *Proceedings of the Zoological Society of London*, **1897, IV:** 953 - 962.

de Winton, W. E. (1899a). 2. List of the Mammals obtained by Mr. R. McD. Hawker during his recent Expedition to Somaliland. *Proceedings of the Zoological Society of London*, **1898, IV:** 761 - 768.

de Winton, W. E. (1899b). XXXVIII. On mammals collected by Lieut.-Colonel W. Giffard in the Northern Territory of the Gold Coast. *Annals and Magazine of Natural History*, **ser. 7, 4 (23):** 353 - 359. [Abstract]

de Winton, W. E. (1900). 3. On the mammals obtained in Southern Abyssinia by Lord Lovat during an expedition from Berbera to the Blue Nile. *Proceedings of the Zoological Society of London*, **1900, I:** 79 - 84. [Abstract]

de Winton, W. E. (1901a). V. Notes on Bats of the genus *Nyctinomus* found in Africa. *Annals and Magazine of Natural History*, **ser. 7, 7 (37):** 36 - 42. [Abstract]

de Winton, W. E. (1901b). On a new species of bat from the Soudan. *Annals and Magazine of Natural History*, **ser. 7, 7 (37):** 45 - 46.

de Winton, W. E. (1901c). List of mammals collected by the Hon. N.C. Rothschild and Mr. A.F.R. Woollaston, principally near Shendi, on the Upper Nile, in 1901. *Novitates Zoologicae*, **8:** 397 - 401.

de Winton, W. E., H. O. Forbes and W. R. Ogilvie-Grant (1903). *Mammalia.* In Forbes, H. O. : *The Natural History of Sokotra and Abd-el-Kuri. Being the report upon the results of the conjoint expedition to these islands in 1898-9, by Mr. W.R. OGILVIE-GRANT, of the British Museum, and dr. H.O. FORBES, of the Liverpool Museums.* The Free Public Museums Liverpool & R.H. Porter - Liverpool & London. [Abstract]

Dick, C. W. and K. Dittmar (2014). *Chapter 6. Parasitic bat flies (Diptera: Streblidae and Nycteribiidae): Host specificity and potential as vectors.* In Klimpel, S. and H. Mehlhorn : *Bats (Chiroptera) as vectors of diseases and parasites. Facts and myths.* Parasitology Research Monographs, 5 - Springer Verlag - Berlin Heidelberg: 131 - 155. doi: 10.1007/978-3-642-39333-4_6.

Dickson, K. V. R., C. W. Twiston Davies, A. Routh, R. Killick and A. R. Barbon (2016). Radiographic cardiac silhouette measurement in captive Livingstone's Fruit Bats (*Pteropus livingstonii*). *Journal of Zoo and Wildlife Medicine*, **47 (4):** 963 - 969. doi: 10.1638/2015-0126.1.

Didier, R. (1965). Etude systematique de l'os penien des mammiferes (suite). Chiropteres, megachiroteres: Fam. des Pteropodidae. *Mammalia*, **29 (3):** 331 - 342. [Abstract]

Dieckmann, R. C. (1979). Note on the smaller mammals of the Hester Malan Nature Reserve, Springbok, Namaqualand. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **14 (2):** 85 - 89. doi: 10.1080/02541858.1979.11447653. [Abstract]
Dieterlen, F., H. Turni and K. Marquart (2013). Type specimens of mammals in the collection of the Museum of Natural History Stuttgart. *Stuttgarter Beiträge zur Naturkunde*, **A (N.S.) 6:** 291 - 303. URL: http://www.naturkundemuseum-bw.de/sites/default/files/publikationen/serie-a/ans06-17_dieterlen.pdf.
Dietrich, M., Y. Gomard, E. Lagadec, B. Ramasindrazana, G. Le Minter, V. Guernier, A. Benlali, G. Rocamora, W. Markotter, S. M. Goodman, K. Dellagi and P. Tortosa (2018a). Biogeography of *Leptospira* in wild animal communities inhabiting the insular ecosystem of the western Indian Ocean islands and neighboring Africa. *Emerging microbes & infections*, **7:** 57. doi: 10.1038/s41426-018-0059-4.
Dietrich, M., T. Kearney, E. C. J. Seamark and W. Markotter (2016a). The excreted microbiota of bats: evidence of niche specialisation based on multiple body habitats. *FEMS Microbiology Letters*, **364 (1):** fnw284 (for 2017). doi: 10.1093/femsle/fnw284.
Dietrich, M., T. Kearney, E. C. J. Seamark, J. T. Paweska and W. Markotter (2018b). Synchronized shift of oral, faecal and urinary microbiotas in bats and natural infection dynamics during seasonal reproduction. *Royal Society Open Science*, **5:** 180041. doi: 10.1098/rsos.180041.
Dietrich, M. and W. Markotter (2019). Studying the microbiota of bats: Accuracy of direct and indirect samplings. *Ecology and Evolution*, **9 (4):** 1730 - 1735. doi: 10.1002/ece3.4842.
Dietrich, M., K. Mühldorfer, P. Tortosa and W. Markotter (2015a). *Leptospira* and bats: story of an emerging friendship. *PloS Pathogens*, **11 (11):** e1005176. doi: 10.1371/journal.ppat.1005176.
Dietrich, M., M. A. Tjale, J. Weyer, T. Kearney, E. C. J. Seamark, L. H. Nel, A. Monadjem and W. Markotter (2016b). Diversity of *Bartonella* and *Rickettsia* spp. in bats and their blood-feeding ectoparasites from South Africa and Swaziland. *PLoS ONE*, **11 (3):** e0152077. doi: 10.1371/journal.pone.0152077.
Dietrich, M., D. A. Wilkinson, A. Benlali, E. Lagadec, B. Ramasindrazana, K. Dellagi and P. Tortosa (2015b). *Leptospira* and paramyxovirus infection dynamics in a bat maternity enlightens pathogen maintenance in wildlife. *Environmental Microbiology*, **17 (11):** 4280 - 4289. doi: 10.1111/1462-2920.12766.
Dietrich, M., D. A. Wilkinson, V. Soarimalala, S. M. Goodman, Dellagi, K., Tortosa and P. (2014). Diversification of an emerging pathogen in a biodiversity hotspot: *Leptospira* in endemic small mammals of Madagascar. *Molecular Ecology*, **23 (11):** 2783 - 2796. doi: 10.1111/mec.12777.
Dietz, C. (2005). Illustrated identification key to the bats of Egypt. . URL: http://www.uni-tuebingen.de/tierphys/Kontakt/mitarbeiter_seiten/Identification%20key%20to%20the%20bats%20of%20Egypt.pdf.
Dietz, C. , Kiefer, A. (2017). *Veldgids Vleermuizen van Europa.* KNNV Uitgeverij - Zeist: 405 pp.
Dietz, C. and O. von Helversen (2004). *Illustrated identification key to the bats of Europe.* Electronic publication - Tuebingen & Erlangen: 72 pp. URL: http://public.carnet.hr/speleo/znanost/sismisi/Dietz_von_Helversen_2004IDkey_1.pdf.
Dieuleveut, T., V. Lieron and Y. Hingrat (2010). Nouvelles données sur la répartition des Chiroptères dans le Maroc oriental (années 2007 à 2009). *Bulletin de l'Institut Scientifique, Rabat, Sciences de la Vie*, **32 (1):** 33 - 40.
Dippenaar, N. J., J. Meester, I. L. Rautenbach and D. A. Wolhuter (1983). The status of southern African mammal taxonomy. In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 103 - 107. [Abstract]
Disca, T., B. Allegrini and V. Prié (2014). Caractéristiques acoustiques des cris d'écholocation de 16 espèces de chiroptères (Mammalia, Chiroptera) du Maroc. *Le Vespère*, **3:** 209 - 229.
Dittmar, K., C. F. Morse, C. W. Dick and B. D. Patterson (2015). *13. Bat fly evolution from the Eocene to the Present (Hippoboscoidea, Streblidae and Nycteribiidae).* In Morand, S., B.R. Krasnov and D.T.J. Littlewood [Eds]: *Parasite diversity and diversification: evolutionary ecology meets phylogenetics.* Cambridge University Press: 246 - 264.
Djilali, K., M. Sekour, K. Souttou, L. Ababsa, O. Guezoul, C. Denys and S. Doumandji (2016). Diet of Short-eared Owl *Asio flammeus* (Pontoppidan, 1763) in desert area at Hassi El Gara (El Golea, Algeria). *Zoology and Ecology*, **26 (3):** 159 - 165. doi: 10.1080/21658005.2016.1184907.
Djossa, A. B., H. Yédomonhan, A. C. Adomou and A. B. Sinsin (2012). Land use impact on tree fruiting performance: implications for food resources availability for flying foxes in Benin, West Africa. *International Journal of Science and Advanced Technology*, **2 (3):** 9 - 24.
Djossa, B. A., J. Fahr, E. K. V. Kalko and B. Sinsin (2008). Fruit selection and effects of seed handling by flying foxes on germination rates of shea trees, a key resource in northern Benin, West Africa. *Ecotropica*, **14 (1):** 37 - 48.
Djossa, B. A. and B. A. Sinsin (2010). *7.20. Diversité des chauves-souris au Bénin / Diversity of bats in Benin.* In Sinsin, B. and D. Kampmann : *Atlas de la Biodiversité de l'Afrique de l'Ouest - Biodiversity Atlas of West Africa. Tome I. Volume I: Benin.* Cotonou & Frankfurt/Main: 490 - 499.
Djossa, B. A., H. C. Toni, I. D. Adekanmbi, F. K. Tognon and B. A. Sinsin (2015). Do flying foxes limit flower abortion in African baobab (*Adansonia digitate*)? Case study in Benin, West Africa. *Fruits*, **70 (5):** 281 - 287. doi: 10.1051/fruits/2015029.
Dobigny, G., R. Cornette, S. Moulin and E. Ag Sidiyène (2001). *The mammals of Adrar des Iforas (Mali), with special emphasis on small mammals: Systematics and biogeographical implications.* In Denys, C., L. Granjon and A. Poulet : *African Small Mammals / Petits mammifères africains.* Institut de Recherche pour le Développement collection - Colloques et séminaires Paris: 445 - 458.
Dobson, G. E. (1871a). On a new genus of bats, with description of a new species of *Kerivoula*. *Proceedings of the Asiatic Society, Bengalen*77 - 78.
Dobson, G. E. (1871b). On a new genus and species of Rhinolophidæ, with description of a new species of *Vesperus*, and notes on some other species of insectivorous bats from Persia. *Journal of the Asiatic Society of Bengal*, **40 (4):** 455 - 461.
Dobson, G. E. (1871c). ?? Title still needs to be checked. ?? *Proceedings of the Zoological Society of London*.
Dobson, G. E. (1872a). On the osteology of *Triænops persicus*. *Journal of the Royal Asiatic Society of Bengalen*, **41 (2):** 137 - 141.
Dobson, G. E. (1872b). Chiroptera. In Stoliczka, F. : *Notice of the Mammals and Birds inhabiting Kachh. Journal of the Asiatic Society of Bengal*, **41 (3):** 220 - 223.
Dobson, G. E. (1872c). Brief descriptions of five new species of Rhinolophine bats. *Journal of the Royal Asiatic Society of Bengalen*, **41 (4):** 336 - 338.
Dobson, G. E. (1873). 5. On secondary sexual characters in the Chiroptera. *Proceedings of the Zoological Society of London*, **1873,II:** 241 - 252.

Dobson, G. E. (1874). Descriptions of new species of Chiroptera from India and Yunan. *Journal of the Asiatic Society of Bengal*, **43 (2):** 237 - 238.
Dobson, G. E. (1875a). XVI. Description of a very large species of *Scotophilus* from Western Africa. *Annals and Magazine of Natural History*, **ser. 4, 16 (92):** 122 - 123.
Dobson, G. E. (1875b). 4. On the genus *Scotophilus*, with description of a new genus and species allied thereto. *Proceedings of the Zoological Society of London*, **1875, III:** 368 - 373.
Dobson, G. E. (1875c). 1. On the genus *Chalinobus*, with descriptions of new or little-known species. *Proceedings of the Zoological Society of London*, **1875, III:** 381 - 388.
Dobson, G. E. (1875d). 1. Descriptions of new or little-known species of bats of the genus *Vesperugo*. *Proceedings of the Zoological Society of London*, **1875, III:** 470 - 474.
Dobson, G. E. (1875e). XLVII. Conspectus of the suborders, families and genera of Chiroptera arranged according to their natural affinities. *Annals and Magazine of Natural History*, **ser. 4, 16 (95):** 345 - 357. [Abstract]
Dobson, G. E. (1876a). 8. A monograph of the genus *Taphozous* Geoff. *Proceedings of the Zoological Society of London*, **1875, IV:** 546 - 556. [Abstract]
Dobson, G. E. (1876b). XXXV. Description of a new species of the genus *Nyctinomus* from South Africa. *Annals and Magazine of Natural History*, **ser. 4, 17 (101):** 348.
Dobson, G. E. (1876c). XXXII. Additional remarks on the classification of the genera of Chiroptera. *Annals and Magazine of Natural History*, **ser. 4, 18 (106):** 345 - 347.
Dobson, G. E. (1876d). LI. Description of a new species of *Vesperugo* from Zanzibar. *Annals and Magazine of Natural History*, **ser. 4, 18 (108):** 500 - 501.
Dobson, G. E. (1876e). Monograph of the Asiatic Chiroptera and catalogue of the species of bats in the collection of the Indian Museum Calcutta. 228 pp.
Dobson, G. E. (1877). A monograph of the group *Molossi*. *Proceedings of the Zoological Society of London*, **1876, IV:** 701 - 735.
Dobson, G. E. (1878). *Catalogue of the Chiroptera of the collection of the British Museum.* Trustees of the British Museum - London: i - xlii; 1 - 567, plates i - xxx. doi: 10.5962/bhl.title.55341.
Dobson, G. E. (1879a). Notes on *Myxopoda aurita*, Miln.-Edw. *Proceedings of the Zoological Society of London*, **1878, IV:** 871 - 873.
Dobson, G. E. (1879b). 12. Notes on recent additions to the collection of Chiroptera in the Museum d'Histoire Naturelle at Paris, with descriptions of new and rare species. *Proceedings of the Zoological Society of London*, **1878, IV:** 873 - 880.
Dobson, G. E. (1880a). 1. Notes on some species of Chiroptera from Zanzibar, with descriptions of new and rare species. *Proceedings of the Zoological Society of London*, **1879, IV:** 715 - 719.
Dobson, G. E. (1880b). Sur quelques espèces de chiroptères provenant d'une collection faite en Algérie par M. Fernand Lataste. *Bulletin de la Société zoologique de France*, **5:** 232 - 236. [Abstract]
Dobson, G. E. (1880c). *Report on accessions to our knowledge of the chiroptera during the past two years (1878 - 1880).* Report 50th Meeting British Association Advancement Science 1880: 169 - 197. [Abstract]
Dobson, G. E. (1881). 4. On the structure of the pharynx, larynx and hyoid bones in the Epomophori; with remarks on its relation to the habitats of these animals. *Proceedings of the Zoological Society of London*, **1881, III:** 685 - 693.
Dobson, G. E. (1885). Notes on species of chiroptera in the collection of the Genoa Civic Museum, with descriptions of new species. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 2 (O.S. 22):** 16 - 19.
Dobson, M. (1998). Mammal distributions in the western Mediterranean: the role of human intervention. *Mammal Review*, **28 (2):** 77 - 88. [Abstract]
Dobson, M. and A. Wright (2000). Faunal relationships and zoogeographical affinities of mammals in north-west Africa. *Journal of Biogeography*, **27 (2):** 417 - 424.
Doderlein, P. (1871). *Alcune generalita Intorno la Fauna Sicula de Vertebrati.* ???: 29 - 37.
Doggart, N., M. S. Dilger, P. Cunneyworth and E. Fanning (1999a). Kwamgumi Forest Reserve: A biodiversity survey. East Usambara Conservation Area Management Programme - Technical Paper: 40: i - ix; 1 - 88.
Doggart, N., L. Joseph, J. Bayliss and E. Fanning (1999b). Manga Forest Reserve: A biodiversity survey. East Usambara Conservation Area Management Programme, Technical Paper 41. Forestry and Beekeeping Division, Finnish Forest and Park Service and the Society for Environmental Exploration - Dar es Salaam, Vantaa and London: i - viii; 1 - 87. URL: http://easternarc.or.tz/downloads/E-Usam/EUCAMP/tecpap41.pdf.
Dollman, G. (1908). On a collection of bats from Yola, Northern Nigeria, collected by Mr. G.W. Webster. *Annals and Magazine of Natural History*, **ser. 8, 2 (12):** 545 - 547. [Abstract]
Dollman, G. (1909). XLV. On mammals collected by Mr. S.A. Neave, M.A. B. Sc (Oxon.) in Katanga, Congo Free State. *Annals and Magazine of Natural History*, **ser. 8, 3 (16):** 348 - 354. doi: 10.1080/00222930908692589. [Abstract]
Dollman, G. (1910). XXV. On a collection of mammals made by Mr. S.A. Neave during his expedition in Northern Rhodesia. *Annals and Magazine of Natural History*, **ser. 8, 4 (21):** 173 - 181. [Abstract]
Dollman, G. (1911). Description of a new genus of molossine bats from West Africa. *Annals and Magazine of Natural History*, **ser. 8, 7 (38):** 210 - 212. [Abstract]
Dollman, G. (1914a). Notes on a collection of East African mammals presented to the British Museum by Mr. G.P. Cozens. *Proceedings of the Zoological Society of London*, **1914, II (21):** 307 - 318. [Abstract]
Dollman, G. (1914b). Notes on mammals collected by Dr. Christy in the Congo and by Dr. Bayer in Uganda and British East Africa. *Revue de zoologie africaine*, **4 (1):** 75 - 90. doi: 10.5962/bhl.part.13888.
Dolman, R. W. and L. K. Ammerman (2015). Molecular systematics of *Nyctinomops* (Chiroptera: Molossidae). *Western North American Naturalist*, **75 (1):** 43 - 51. doi: 10.3398/064.075.0105.
Dondini, G. and S. Vergari (2004). Osservazioni in Cattivita'sul ciclo stagionale del peso corporeo e sull'efficienza digestiva di *Pipistrellus kuhlii* e *Hypsugo savii* (Chiroptera: Vespertilionidae). *Hystrix, Italian Journal of Mammalogy*, **(n.s.) 15 (1):** 55 - 62.
Dongmo, W., F. Kechia, R. Tchuenguem, C. Nangwat, I. Yves, J.-R. Kuiate and J.-P. Dzoyem (2016). In vitro antifungal susceptibility of environmental isolates of *Cryptococcus* spp. from the west region of Cameroon. *Ethiopian Journal of Health Science*, **26 (6):** 555 - 560. doi: 10.4314/ejhs.v26i6.8.
Dool, S. E., S. J. Puechmaille, C. Dietz, J. Juste, C. Ibáñez, P. Hulva, S. G. Roué, E. J. Petit, G. Jones, D. Russo, R. Toffoli, A. Viglino, A. Martinoli, S. J. Rossiter and E. C. Teeling (2013). Phylogeography and postglacial recolonization of Europe by *Rhinolophus hipposideros*: evidence from multiple genetic markers. *Molecular Ecology*, **22 (15):** 4055 - 4070. doi: 10.1111/mec.12373.

Dool, S. E., S. J. Puechmaille, N. M. Foley, B. Allegrini, A. Bastian, G. L. Mutumi, T. G. Maluleke, L. J. Odendaal, E. C. Teeling and D. S. Jacobs (2016a). Nuclear introns outperform mitochondrial DNA in inter-specific phylogenetic reconstruction: Lessons from horseshoe bats (Rhinolophidae: Chiroptera). *Molecular phylogenetics and evolution*, **97:** 196 - 212. doi: 10.1016/j.ympev.2016.01.003.

Dool, S. E., S. J. Puechmaille, C. Kelleher, K. McAney and E. C. Teeling (2016b). The effects of human-mediated habitat fragmentation on a sedentary woodland-associated species (*Rhinolophus hipposideros*) at its range margin. *Acta Chiropterologica*, **18 (2):** 377 - 393. doi: 10.3161/15081109ACC2016.18.2.006.

Doria, G. (1887). Res Ligusticae. I. I chirotteri trovati finora in Liguria. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 4 (O.S. 24):** 385 - 474.

Dornburg, A., J. G. Colosi, C. Maser, A. T. Reese and G. J. Watkins-Colwell (2011). A survey of the Yale Peabody Museum collection of Egyptian mammals collected during construction of the Aswan High Dam, with an Emphasis on material from the 1962 - 1965 Yale University prehistoric expedition to Nubia. *Bulletin of the Peabody Museum of Natural History*, **52 (2):** 255 - 272. doi: 10.3374/014.052.0206.

Dorst, J. (1947). Les chauves-souris de la faune malgache. *Bulletin du Muséum national d'histoire naturelle de Paris*, **(2) 19 (4):** 306 - 313. [Abstract]

Dorst, J. (1948). Les chiroptères du genre *Triaenops* Dobson (Hipposidérines). *Mammalia*, **12 (1):** 15 - 21. doi: 10.1515/mamm.1948.12.1.15.

Dorst, J. (1949). Remarques sur la dentition de lait des chiroptères. *Mammalia*, **13 (1):** 45 - 48. doi: 10.1515/mamm.1949.13.1.45.

Dorst, J. (1952). Note sur la dentition de lait de *Nycteris capensis* (Chiroptères, Nyctéridés). *Bulletin du Musée de Paris*, **(2) 24 (6):** 515 - 518.

Dorst, J. (1953a). Note sur la dentition d'un fœtus de *Lavia frons* (Chiroptères, Mégadermatidés). *Mammalia*, **17 (2):** 83 - 84. doi: 10.1515/mamm.1953.17.2.83.

Dorst, J. (1953b). Considérations sur le genre *Otomops* et description d'une espèce nouvelle de Madagascar (Chiroptères, Molossidés). *Mémoires de l'Institut Scientifique de Madagascar*, **(A) 8:** 235 - 240.

Dorst, J. (1954). Nécrologie: G. H. H. Tate 1894 - 1953. *Mammalia*, **18 (2):** 222. doi: 10.1515/mamm.1954.18.2.222.

Dorst, J. (1957a). Coloration anormale chez un Minioptère de Schreibers. *Mammalia*, **21 (2):** 191.

Dorst, J. (1957b). Considérations sur la dentition de lait des chiroptères de la famille des Molossidés. *Mammalia*, **21 (2):** 133 - 135. doi: 10.1515/mamm.1957.21.2.133.

Dorst, J. (1960). A propos de quelques chiroptères du Sénégal, et description d'une forme nouvelle du genre *Pipistrellus*. *Bulletin du Muséum national d'histoire naturelle de Paris*, **(2) 31(6):** 471 - 474 (for 1959). [Abstract]

Dorst, J. (1963). Présence de *Pipistrellus rüppelli* au Tchad. *Mammalia*, **27 (3):** 443.

Dorst, J. (1980). Nécrologie: Henri Heim de Balsac (1899 - 1979). *Mammalia*, **44 (2):** 275 - 276. doi: 10.1515/mamm.1980.44.2.275.

Dorst, J. (1982). Découverte de *Taphozous nudiventris* dans l'Aïr (Chiroptères). *Mammalia*, **46 (3):** 407 - 408. doi: 10.1515/mamm.1982.46.3.395.

Dorst, J. and R. de Naurois (1966). Présence de l'oreillard (*Plecotus*) dans l'archipel du Cap-Vert et considérations biogéographiques sur le peuplement de ces iles. *Mammalia*, **30 (2):** 292 - 301. doi: 10.1515/mamm.1966.30.2.292. [Abstract]

Dorst, J. and F. Petter (1959). Présence en Afrique du nord d'une chauve-souris du genre *Tadarida*. *Mammalia*, **23 (4):** 560 - 561. doi: 10.1515/mamm.1959.23.4.559.

Dorst, J. and J. Prévost (1972). Notes sur quelques chiroptères collectés en Ethiopie. *Mammalia*, **36 (3):** 395 - 399. [Abstract]

dos Reis, M., J. Inoue, M. Hasegawa, R. J. Asher, P. C. J. Donoghue and Z. Yang (2012). Phylogenomic datasets provide both precision and accuracy in estimating the timescale of placental mammal phylogeny. *Proceedings of the Royal Society of London*, **B 279 (1742):** 3491 - 3500. doi: 10.1098/rspb.2012.0683.

Doty, A. C. (2012). Aspects of heterothermy in four species of afrotropical bats. MSc, Nelson Mandela Metropolitan University: : i - vi; 1 - 83.

Doty, A. C. and A. P. Martin (2012). Assessment of bat and avian mortality at a pilot wind turbine at Coega, Port Elizabeth, Eastern Cape, South Africa. *New Zealand Journal of Zoology*, **40 (1):** 75 - 80 (for 2013). doi: 10.1080/03014223.2012.741068.

Dougnon, T. J., A. B. Djossa, I. Youssao, T. M. Kpodékon and C. Ogni (2012). Bats as bushmeat in Benin: yield in carcass and meat quality of the fruit bats *Eidolon helvum* (Kerr, 1792) and *Epomophorus gambianus* (Ogilby, 1835). *International Journal of Science and Advanced Technology*, **2 (3):** 81 - 90.

Doutre, M. P. and H. Sarrat (1973). Sérotypes de salmonelles isolées chez les chiroptères frugivores et insectivores du Sénégal. Importance épidémiologique. *Revue d'élevage et de Médecine Vétérinaire des Pays Tropicaux*. [Abstract]

Downs, C. T., A. Awuah, M. Jordaan, L. Magagula, T. Mkhize, C. Paine, E. Raymond-Bourret and L. A. Hart (2015). Too hot to sleep? Sleep behaviour and surface body temperature of Wahlberg's epauletted fruit bat. *PLoS ONE*, **10 (3):** e0119419. doi: 10.1371/journal.pone.0119419.

Downs, C. T., B. Mqokeli and P. Singh (2011a). Sugar assimilation and digestive efficiency in Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*). *Comparative Biochemistry and Physiology*, **A 161 (3):** 344 - 348 (for 2012). doi: 10.1016/j.cbpa.2011.12.003.

Downs, C. T., M. M. Zungu and M. Brown (2011b). Seasonal effects on thermoregulatory abilities of the Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*) in KwaZulu-Natal, SouthAfrica. *Journal of Thermal Biology*, **37 (2):** 144 - 150 (for 2012). doi: 10.1016/j.jtherbio.2011.12.003.

Dowsett, R. J., D. L. Harrison and L. Granjon (1991). Bats (Chiroptera) from the Mayombe and lower Kouilou (with a checklist for Congo). *Tauraco Research Report*, **4:** 251 - 263. [Abstract]

Drake-Brockman, R. E. (1910). *The mammals of Somaliland*. Hurst and Blackett, Ltd., London: i - xvii; 1 - 203.

Drane, A. L., R. Shave, A. Routh and A. Barbon (2017). An exploratory investigation of echocardiographic parameters and the effects of posture on cardiac structure and function in the Livingstone's fruit bat (*Pteropus livingstonii*). *Veterinary Radiology & Ultrasound*, **59 (1):** 89 - 97 (for 2018). doi: 10.1111/vru.12539.

Drexler, J. F., V. M. Corman and C. Drosten (2013a). Ecology, evolution and classification of bat coronaviruses in the aftermath of SARS. *Antiviral Research*, **101:** 45 - 56 (for 2014). doi: 10.1016/j.antiviral.2013.10.013.

Drexler, J. F., V. M. Corman, F. Gloza-Rausch, A. Seebens, A. Ipse, T. Kruppa, M. A. Muller, E. K. V. Kalko, Y. Adu-Sarkodie, S. Oppong and C. Drosten (2009). Henipavirus RNA in African Bats. *PLoS ONE*, **4 (7):** e6367. doi: 10.1371/journal.pone.0006367.

Drexler, J. F., V. M. Corman, A. N. Lukashev, J. M. A. van den Brand, A. P. Gmyl, S. Brünink, A. Rasche, N. Seggewiß, H. Feng, L. M. Leijten, P. Vallo, T. Kuiken, A. Dotzauer, R. G. Ulrich, S. M. Lemon, C. Drosten and the Hepatovirus Ecology Consortium (2015). Evolutionary origins of hepatitis A virus in small mammals. *Proceedings of the National Academy of Sciences, U.S.A.*, **112 (49):** 15190 - 15195. doi: 10.1073/pnas.1516992112.

Drexler, J. F., V. M. Corman, M. A. Müller, A. N. Lukashev, A. Gmyl, B. Coutard, A. Adam, D. Ritz, L. M. Leijten, D. Van Riel, R. Kallies, S. M. Klose, F. Gloza-Rausch, T. Binger, A. Annan, Y. Adu-Sarkodie, S. Oppong, M. Bourgarel, D. Rupp, B. Hoffmann, M. Schlegel, B. M. Kümmerer, D. H. Krüger, J. Schmidt-Chanasit, A. Aguilar Setién, V. M. Cottontail, T. Hemachudha, S. Wacharapluesadee, K. Osterrieder, R. Bartenschlager, S. Matthee, M. Beer, T. Kuiken, C. Reusken, E. M. Leroy, R. G. Ulrich and C. Drosten (2013b). Evidence for novel hepaciviruses in Rodents. *PloS Pathogens*, **9 (6):** e1003438. doi: 10.1371/journal.ppat.1003438.

Drexler, J. F., V. M. Corman, M. A. Müller, G. D. Maganga, P. Vallo, T. Binger, F. Gloza-Rausch, A. Rasche, S. Yordanov, A. Seebens, S. Oppong, Y. A. Sarkodie, C. Pongombo, A. N. Lukashev, J. Schmidt-Chanasit, A. Stöcker, A. J. Borges Carneiro, S. Erbar, A. Maisner, F. Fronhoffs, R. Buettner, E. K. V. Kalko, T. Kruppa, C. R. Franke, R. Kallies, E. R. N. Yandoko, G. Herrler, C. Reusken, A. Hassanin, D. H. Krüger, S. Matthee, R. G. Ulrich, E. M. Leroy and C. Drosten (2012a). Bats host major mammalian paramyxoviruses. *Nature Communications*, **3 (796):** 1 - 12. doi: 10.1038/ncomms1796.

Drexler, J. F., A. Geipel, A. König, V. M. Corman, D. Van Riel, L. M. Leijten, C. M. Bremer, A. Rasche, V. M. Cottontail, G. D. Maganga, M. Schlegel, M. A. Müller, A. Adam, S. M. Klose, A. J. B. Carneiro, A. Stöcker, C. R. Franke, F. Gloza-Rausch, J. Geyer, A. Annan, Y. Adu-Sarkodie, S. Oppong, T. Binger, P. Vallo, M. Tschapka, R. G. Ulrich, W. H. Gerlich, E. Leroy, T. Kuiken, D. Glebe and C. Drosten (2013c). Bats carry pathogenic hepadnaviruses antigenically related to hepatitis B virus and capable of infecting human hepatocytes. *Proceedings of the National Academy of Sciences, U.S.A.*, **110 (40):** 16151 - 16156. doi: 10.1073/pnas.1308049110.

Drexler, J. F., A. Seelen, V. M. Corman, A. F. Tateno, V. Cottontail, R. M. Zerbinati, F. Gloza-Rausch, S. M. Klose, Y. Adu-Sarkodie, S. K. Oppong, E. K. V. Kalko, A. Osterman, A. Rasche, A. Adam, M. A. Müller, R. G. Ulrich, E. M. Leroy, A. N. Lukashev and C. Drosten (2012b). Bats worldwide carry Hepatitis E virus-related viruses that form a putative novel genus within the family *Hepeviridae*. *Journal of Virology*, **86 (17):** 9134 - 9147. doi: 10.1128/JVI.00800-12.

Dubois, G. (1955). Les Trematodes de chiroptères de la collection Villy Aellen. Etude suivie d'une revision du sous-genre *Prostodendrium* Dollfus 1937 (*Lecithodendriinae* Lühe). *Revue suisse de zoologie*, **62 (33):** 469 - 506. [Abstract]

Dubois, G. (1956). Contribution à l'étude des Trematodes de Chiroptères. *Revue suisse de zoologie*, **63 (30):** 683 - 695.

Duckworth, J. W., D. L. Harrison and R. J. Timmins (1993). Notes on a collection of small mammals from the Ethiopian Rift Valley. *Mammalia*, **57 (2):** 278 - 282.

Duckworth, J. W. and R. J. Timmins (1992). *The bats of Nechisar National Park*. In ??? : *A survey of Nechisar National Park Ethiopia*. International Council for Bird Preservation, Study Report: 35 - 39.

Duke, H. L. (1934). *Hypsignathus Monstrosus*. *Uganda Journal*, **1 (1):** 72 - 74.

Đulic, B. (1966). Kromosomi somatickih stanica kao. Indikatori. Interspecificke sroonosti nekih rinolofida (Mammamlia, Chiroptera). *Bioloski Glasnik*, **19:** 65 - 96.

Đulic, B. (1967). Comparative study of the chromosomes of the spleen of some European Rhinolophidae (Mammalia, Chiroptera). *Bulletin Scientifique du Conseil Academique RSF Yougoslavia, Section A - Zagreb*, **12 (3-4):** 63 - 65.

Đulic, B. (1980). *Morphological characteristics and distribution of Plecotus auritus and Plecotus austriacus in some regions of Yugoslavia*. In Wilson, D. E. and A. L Gardner : *Proceedings of the Fifth International Bat Research Conference* 151 - 161.

Đulic, B. (1984). *Chromosomes of four Indian species of Microchiroptera*. Proceedings of the Sixth International Bat Research Conference - Ile-Ife: 25 - 37.

Đulic, B. and M. Mrakovcic (1980). Chromosomes of European free-tailed bat, *Tadarida teniotis* (Rafinesque, 1814, Mammalia, Chiroptera, Molossidae). *Biosistematika*, **6:** 109 - 112.

Đulic, B. and F. A. Mutere (1973a). Comparative study of the chromosomes of some Mollosid bats from eastern Africa. *Periodicum biologorum - Societas Scientiarum Naturalium Croatica*, **75:** 61 - 65. [Abstract]

Đulic, B. and F. A. Mutere (1973b). Les chromosomes de trois espèces des Megachiroptères (Mammalia, Chiroptera) d'Afrique orientale. *Caryologia*, **26 (3):** 389 - 396. [Abstract]

Đulic, B. and F. A. Mutere (1974). The chromosomes of two bats from East Africa: *Rhinolophus clivosus* Cretzschmar 1928 and *Hipposideros caffer* (Sundervall, 1946). *Periodicum biologorum - Societas Scientiarum Naturalium Croatica*, **76:** 31 - 34.

Đulic, B. and F. A. Mutere (1977). Chromosomes of some East African bats. *Säugetierkundlige Mitteilungen*, **25:** 231 - 233. [Abstract]

Đulic, B. and B. Soldatovic (1969). Les chromosomes de *Rhinolophus mehelyi* Mastchie, 1900 (Mammalia, Chiroptera). *Caryologia*, **22 (1):** 1 - 5. doi: 10.1080/00087114.1969.1079632. [Abstract]

Duméril, A. M. C. (1806). *Zoologie Analytique, ou méthode naturelle de classification des animaux, rendue plus facile à l'aide de tableaux synoptiques*. Allais, Paris: i - xxxiv; 1 - 344.

Dumitrescu, M., J. Tanaschi and T. R. Orghidan (1962-3). Raspindirea chiropterelor in R.P. Romana. *Lucr. Inst. Speol. Emil Racivita. Edit Acad.Romania*, **1 - 2:** 509 - 575.

Dumont, E. R., K. Etzel and D. Hempel (1999). Bat salivary proteins segregate according to diet. *Mammalia*, **63 (2):** 159 - 166. doi: 10.1515/mamm.1999.63.2.159.

Duncan, F. M. (1937). On the dates of publication of the Society's 'Proceedings,' 1859-1926. With an appendix containing the dates of publication of 'Proceedings,' 1830-1858, ..., and of the 'Transactions,' 1833-1869, ..., originally published in P.Z.S. 193, 1913. *Proceedings of the Zoological Society of London*, **107 (A):** 71 - 84. [Abstract]

Duncan, R. S. and C. A. Chapman (1999). Seed dispersal and potential forest succession in abandoned agriculture in Tropical Africa. *Ecological Applications*, **9 (3):** 998 - 1008.

Dunlop, J. (1997). *Coleura afra*. *Mammalian Species*, **566:** 1 - 4, 3 figs.

Dunlop, J. (1999). *Mops midas*. *Mammalian Species*, **615:** 1 - 4, 3 figs.

Dunning, D. C. and M. Krüger (1995). Aposematic sounds in African moths. *Biotropica*, **27 (2):** 227 - 231. [Abstract]

Dunning, D. C. and M. Krüger (1996). Predation upon moths by free-foraging *Hipposideros caffer*. *Journal of Mammalogy*, **77 (3):** 708 - 715. [Abstract]

Dunnum, J. L. and J. A. Cook (2012). Gerrit Smith Miller: his influence on the enduring legacy of natural history collections. *Mammalia*, **76 (4):** 365 - 373. doi: 10.1515/mammalia-2012-0071.

Dunnum, J. L., B. S. McLean, R. C. Dowler and the Systematic Collections Committee of the American Society of Mammalogists (2018). Mammal collections of the Western Hemisphere: a survey and directory of collections. *Journal of Mammalogy*, **99 (6):** 1307 - 1322. doi: 10.1093/jmammal/gyy151.

Dupuy, A. P. (1973). Premier inventaire des mammifères du Parc Nationale de Basse-Cassamance (Sénégal). *Bulletin de l'Institut fondamental d'Afrique noire: sciences naturelles*, **35 (A) (1):** 186 - 197. [Abstract]

Durbin, J. (2007). New legislation for the protection of Malagasy species. 11: 4 - 6.

Durette-Desset, M.-C. and A.-G. Chabaud (1975). Nématodes Trichostrongyloidea: Parasites de Microchiroptères. *Annales de Parasitologie*, **50 (3):** 303 - 337. [Abstract]

Duron, O., U. E. Schneppat, A. Berthomieu, S. M. Goodman, B. Droz, C. Paupy, J. Obame Nkoghe, N. Rahola and P. Tortosa (2014). Origin, acquisition and diversification of heritable bacterial endosymbionts in louse flies and bat flies. *Molecular Ecology*, **23 (8):** 2105 - 2117. doi: 10.1111/mec.12704.

Dusbábek, F. and W. Bergmans (1980). Spinturnicid mites from some Nigerian bats (Acarina, Spinturnicidae). *Bulletin Zoologisch Museum, Universiteit Amsterdam*, **7 (7):** 65 - 72. [Abstract]

Duszynski, D. W. (2002). Coccidia (Apicomplexa: Eimeriidae) of the mammalian order Chiroptera. *Special Publication The Museum of Southwestern Biology*, **5:** i - iv; 1 - 42.

Du Toit, S. (2006). Photographic record of a Mauritian Tomb bat *Taphozous mauritianus* E. Geoffroy Saint-Hilaire, 1818 (Emballonuridae) from Mogale City (Gauteng, South Africa). *African Bat Conservation News*, **9:** 3 - 4.

Duval, L., C. Mejean, G. D. Maganga, B. K. Makanga, L. B. Mangama Koumba, M. A. Peirce, F. Ariey and M. Bourgarel (2012). The chiropteran haemosporidian *Polychromophilus melanipherus*: A worldwide species complex restricted to the family Miniopteridae. *Infection, Genetics and Evolution*, **12 (7):** 1558 - 1566. doi: 10.1016/j.meegid.2012.06.006.

Duval, L., V. Robert, G. Csorba, A. Hassanin, M. Randrianarivelojosia, J. Walston, T. Nhim, S. M. Goodman and F. Ariey (2007). Multiple host-switching of Haemosporidia parasites in bats. *Malaria Journal*6 (157). doi: 10.1186/1475-2875-6-157.

Dybowski, J. (1893). *La route du Chad. Du Loango au Chari.* De Firmin-Didot & Cie: 1 - 383.

Dzikwi, A. A., I. I. Kuzmin, J. U. Umoh, J. K. P. Kwaga, A. A. Ahmad and C. E. Rupprecht (2010). Evidence of Lagos Bat Virus Circulation among Nigerian Fruit Bats. *Journal of wildlife diseases*, **46 (1):** 267 - 271.

Ebigbo, N. M., J. Fahr and E. K. V. Kalko (2001). Flexibility in echolocation behaviour of narrow space "CF" bats in defined behavioural situations in Côte d'Ivoire. Gesellschaft fur Tropenökologie e.V. Tagungsband. 14. Jahrestagung - Bremen: 39.

Eckalbar, W. L., S. A. Schlebusch, M. K. Mason, Z. Gill, A. V. Parker, B. M. Booker, S. Nishizaki, C. Muswamba-Nday, E. Terhune, K. A. Nevonen, N. Makki, T. Friedrich, J. E. VanderMeer, K. S. Pollard, L. Carbone, J. D. Wall, N. Illing and N. Ahituv (2016). Transcriptomic and epigenomic characterization of the developing bat wing. *Nature Genetics*, **48 (5):** 528 - 536. doi: 10.1038/ng.3537.

Eckerle, I., L. Ehlen, R. Kallies, R. Wollny, V. M. Corman, V. M. Cottontail, M. Tschapka, S. Oppong, C. Drosten and M. A. Müller (2014). Bat airway epithelial cells: a novel tool for the study of zoonotic viruses. *PLoS ONE*, **9 (1):** e84679. doi: 10.1371/journal.pone.0084679.

Edungbola, L. D. (1981). Parasites of house-dwelling, insectivorous bats from Alabe, Kwara State, Nigeria. *Journal of parasitology*, **67 (2):** 287 - 288.

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), , More, S., A. Bøtner, A. Butterworth, P. Calistri, K. Depner, S. Edwards, B. Garin-Bastuji, M. Good, C. Gortázar Schmidt, V. Michel, M. A. Miranda, S. S. Nielsen, M. Raj, L. Sihvonen, H. Spoolder, J. A. Stegeman, H.-H. Thulke, A. Velarde, P. Willeberg, C. Winckler, F. Baldinelli, A. Broglia, B. Beltrán Beck, L. Kohnle, J. Morgado and D. Bicout (2017). Assessment of listing and categorisation of animal diseases within the framework of the Animal Health Law (Regulation (EU) No 2016/429): Ebola virus disease. *EFSA Journal*, **15 (7):** 4890, 37 pp. doi: 10.2903/j.efsa.2017.4890.

Eger, J. (2013a). *Glauconycteris curryae Curry's Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 567 - 568.

Eger, J. (2013b). *Miniopterus schreibersii Schreibers's Long-fingered Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 721 - 722.

Eger, J. L. (2001). Emendation of *Glauconycteris curryi*. *Acta Chiropterologica*, **3 (2):** 248.

Eger, J. L. and M. B. Fenton (2003). *Rhinolophus paradoxolophus*. *Mammalian Species*, **731:** 1 - 4, 3 figs.

Eger, J. L. and L. Mitchell (1990). Obituary Randolph Lee Peterson: 1920-1989. *Journal of Mammalogy*, **71:** 707 - 713.

Eger, J. L. and L. Mitchell (2003). *Chiroptera, bats.* In Goodman, S.M. and J.P. Benstead : *The Natural History of Madagascar.* The University of Chicago Press - Chicago, USA and London, UK: 1287 - 1298.

Eger, J. L. and R. L. Peterson (1979). Distribution and systematic relationship of *Tadarida bivittata* and *Tadarida ansorgei* (Chiroptera: Molossidae). *Canadian journal of zoology*, **57 (10):** 1887 - 1895. [Abstract]

Eger, J. L. and D. A. Schlitter (2001). A new species of *Glauconycteris* from West Africa (Chiroptera: Vespertilionidae). *Acta Chiropterologica*, **3 (1):** 1 - 10.

Eghbali, H., S. Shahabi, N. Najafi, R. Mehdizadeh, S. Yousefi and M. Sharifi (2017). Postnatal growth, wing development and age estimations in the Mediterranean horseshoe bat *Rhinolophus euryale* (Chiroptera: Rhinolophidae) in Kerend cave, western Iran. *Mammalia*, **82 (3):** 276 - 287 (for 2018). doi: 10.1515/mammalia-2017-0006.

Eick, G. N., D. S. Jacobs and C. A. Matthee (2005). A nuclear DNA Phylogenetic perspective on the evolution of echolocation and historical biogeography of extant bats (Chiroptera). *Molecular biology and evolution*, **22 (9):** 1869 - 1886. doi: 10.1093/molbev/msi180.

Eick, G. N., D. S. Jacobs, F. Yang and M. Volleth (2007). Karyotypic differences in two sibling species of *Scotophilus* from South Africa (Vespertilionidae, Chiroptera, Mammalia). *Cytogenetic and Genome Research*, **118 (1):** 72 - 77. doi: 10.1159/000106444.

Eisenberg, J. F. and D. E. Wilson (1978). Relative brain size and feeding strategies in the Chiroptera. *Evolution*, **32 (4):** 740 - 751. [Abstract]

Eisenring, M., J. Beck, B. Agwanda, E. Kioko and M. Curran (2016). Effects of habitat age and disturbance intensity on the biodiversity of three trophic levels in Central Kenya. *African Journal of Ecology*, **54 (2):** 225 - 234. doi: 10.1111/aje.12292.

Eisentraut, M. (1941). Beitrag zur Oekologie Kameruner Chiropteren. *Mitteilungen aus dem Zoologischen Museum in Berlin*, **25 (2):** 245 - 273. [Abstract]

Eisentraut, M. (1945). Biologie der Flederhunde (Megachiroptera). Nach einem hinterlassenen Manuskript von Dr. Heinrich Jansen. *Biologia generalis*, **18:** 327 - 435. [Abstract]

Eisentraut, M. (1956a). Der Langzungen-Flughund, *Megaloglossus woermanni*, ein Blütenbesucher. *Zeitschrift für Morphologie und Ökologie der Tiere*, **45:** 107 - 112. [Abstract]

Eisentraut, M. (1956b). Beitrag zur Chiropteren-Fauna von Kamerun (Westafrika). *Zoologische Jahrbücher: Abteilung für Systematik*, **84 (3):** 505 - 540. [Abstract]
Eisentraut, M. (1957). Beitrag zur Säugetierfauna des Kamerungebirges und Verbreitung der Arten in den verschiedenen Höhenstufen. *Zoologische Jahrbücher: Abteilung für Systematik*, **85 (6):** 619 - 672.
Eisentraut, M. (1958). Beitrag zur Chiropterenfauna Ostafrikas. (Ergebnisse der Deutschen Zoologischen Ostafrika-Expedition 1951/52. Gruppe Lindner, Stuttgart, Nr 28, und Gruppe Knipper, Bremen). *Veröffentlichungen der Überseemuseum Bremen*, **(A), 3 (1):** 17 - 24. [Abstract]
Eisentraut, M. (1960a). Der Rassenkreis *Rousettus aegyptiacus* E. Geoff. *Bonner zoologische Beitrage*, **10 (for 1959) (3-4):** 218 - 235. [Abstract]
Eisentraut, M. (1960b). Zur Kenntnis der westafrikanischen Flughundgattung *Scotonycteris*. *Bonner zoologische Beitrage*, **10 (for 1959) (3-4):** 298 - 309. [Abstract]
Eisentraut, M. (1960c). Zwei neue Rhinolophiden aus Guinea. *Stuttgarter Beiträge zur Naturkunde*, **39:** 1 - 7. [Abstract]
Eisentraut, M. (1963). *Die Wirbeltiere des Kamerungebirges*. Paul Parey - Hamburg & Berlin: 1 - 353.
Eisentraut, M. (1964). La faune de chiroptères de Fernando-Po. *Mammalia*, **28 (4):** 529 - 552. [Abstract]
Eisentraut, M. (1965). Der Rassenkreis *Rousettus angolensis* (Bocage). *Bonner zoologische Beitrage*, **16 (1-2):** 1 - 6. [Abstract]
Eisentraut, M. (1968). Die tiergeographische Bedeutung des Oku-Gebirges im Bamenda-Banso-Hochland (Westkamerun). *Bonner zoologische Beitrage*, **19 (3/4):** 170 - 175. [Abstract]
Eisentraut, M. (1969). Gibt es in West-Afrika eine auf Montangebiete beschränkte Säugetierfauna? *Bonner zoologische Beitrage*, **20 (4):** 325 - 334. URL: http://zfmk.de/BZB/1969/1969%20Eisentraut%20M.%20p325%20orginal.pdf. [Abstract]
Eisentraut, M. (1973). Die Wirbeltierfauna von Fernando Poo und Westkamerun. Unter besonderer Berücksichtigung der Bedeutung der pleistozänen Klimaschwankungen für die heutige Faunenverteilung. *Bonner zoologische Monographiens*, **3:** 1 - 428, pls 1-5.
Eisentraut, M. (1974). Mammalogische Notizen aus Kamerun. *Bonner zoologische Beitrage*, **24 (4):** 355 - 360 (for 1973). URL: http://zfmk.de/BZB/1973/1973%20Eisentraut%20M.%20p355%20orginal.pdf. [Abstract]
Eisentraut, M. (1975). Weiterer Beitrag zur Saugetierfauna von Kamerun. *Bonner zoologische Beitrage*, **26 (1-3):** 76 - 93. URL: http://zfmk.de/BZB/1975/1975%20Eisentraut%20M.%20p76.pdf. [Abstract]
Eisentraut, M. and H. Knorr (1957). Les Chauves-souris cavernicoles de la Guinée française. *Mammalia*, **21 (4):** 321 - 340. [Abstract]
Eiting, T. P. and G. F. Gunnell (2009). Global completeness of the bat fossil record. *Journal of Mammalian Evolution*, **16:** 151 - 173. doi: 10.1007/s10914-009-9118-x.
Eizirik, E, W. J. Murphy and S. J. O'Brien (2001). Molecular dating and biogeography of early placental mammal radiation. *Journal of Heredity*, **92:** 212 - 219.
Ekeolu, O. K. and O. E. Adebiyi (2018). Hematology and erythrocyte osmotic fragility of the Franquet's fruit bat (*Epomops franqueti*). *Journal of Basic and Clinical Physiology and Pharmacology*, **29 (4):** 391 - 394. doi: 10.1515/jbcpp-2017-0169.
Elbl, A., U. H. Rahm and G. Mathys (1966). Les mammifères et leurs tiques dans la forêt du Ruggege (République Rwandaise). *Acta Tropica*23 (3). [Abstract]
El-Gabbas, A. and C. F. Dormann (2018). Wrong, but useful: regional species distribution models may not be improved by range-wide data under biased sampling. *Ecology and Evolution*, **8 (4):** 2196 - 2206. doi: 10.1002/ece3.3834.
El Ibrahimi, S. and H. Rguibi Idrissi (2015). Nouveau bilan de connaissances des chauves-souris au Maroc. *Revue scientifique Bourgogne-Nature*, **21/22:** 357 - 366.
Ellerman, J. R. (1954). Die taksonomie van die soogdiere van die Unie van Suid Afrika. *Annale van die Universiteit van Stellenbosch / Annals of the university of Stellenbosch*, **30 A (1):** 14 - 33.
Ellerman, J. R. and T. C. S. Morrison-Scott (1951). *Checklist of Palaearctic and Indian mammals 1758 to 1946.* Trustees of the British Museum (Natural History) - London: 1 - 810.
Ellerman, J. R. and T. C. S. Morrison-Scott (1966). *Checklist of Palaearctic and Indian Mammals 1758 to 1946. (2nd Edition).* London.
Ellerman, J. R., T. C. S. Morrison-Scott and R. W. Hayman (1953). *Southern African Mammals 1758 to 1951: a reclassification.* British Museum (Natural History) - London: 363 pp, 3 maps. doi: 10.5962/bhl.title.113025. [Abstract]
Elliot, D. G. (1897). List of mammals obtained by the Field Columbian Museum East African Expedition to Somali-land in 1896. *Field Columbian Museum Publication, Zoological Series*, **19 - 20 (1) 6 - 7:** 109 - 155. [Abstract]
Elliot, D. G. (1907). A catalogue of the collection of mammals in the Field Museum of Natural History. *Field Columbian Museum Publication, Zoological Series*, **115 (8):** 490 - 540. [Abstract]
El Najjar, F., L. Lampe, M. L. Baker, L.-F. Wang and R. E. Dutch (2015). Analysis of cathepsin and furin proteolytic enzymes involved in viral fusion protein activation in cells of the bat reservoir host. *PLoS ONE*, **10 (2):** e0115736. doi: 10.1371/journal.pone.0115736.
Eloff, F. C. and G. De Graaff (1963). A note on the golden moles, bats and rodents of Inhaca Island. *South African Journal of Sciences*, **59 (3):** 88 - 89.
El-Rayah, M. A. (1980). Systematics of African molossid bats of the subgenus *Xiphonycteris* of the genus *Tadarida* (Molossidae: Chiroptera). PhD Thesis - University of Toronto: i - xv; 1 - 280. URL: https://idl-bnc.idrc.ca/dspace/bitstream/10625/5743/1/IDL-5743.pdf. [Abstract]
El-Rayah, M. A. (1981). A new species of bat of the genus *Tadarida* (family Molossidae) from West Africa. *Life Science Occasional Papers - Royal Ontario Museum*, **36:** 1 - 10. [Abstract]
El Sayed, S. M., A. A. Abdelrahman, H. A. Ozbak, H. A. Hemeg, A. M. Kheyami, N. Rezk, M. B. El-Ghoul, M. M. H. Nabo and Y. M. Fathy (2016). Updates in diagnosis and management of Ebola hemorrhagic fever. *Journal of Research in Medical Sciences*, **21:** 84. doi: 10.4103/1735-1995.192500.
Emerick, C. M. and R. A. Duncan (1982). Age progressive volcanism in the Comores Archipelago, western Indian-Ocean and implications for Somali plate-tectonics. *Earth and Planetary Science Letters*, **60:** 415-428.
Emerson, J. K. and A. M. Roark (2007). Composition of guano produced by frugivorous, sanguivorous, and insectivorous bats. *Acta Chiropterologica*, **9 (1):** 261 - 267. doi: 10.3161/1733-5329(2007)9[261:COGPBF]2.0.CO;2.
Emmons, L. H., A Gautier-Hion and G. Dubost (1983). Community structure of the frugivorous-folivorous forest mammals of Gabon. *Journal of Zoology*, **199:** 209 - 222.
Emms, C. and L. K. Barnett (2005). Gambian biodiversity: A provisional checklist of all species recorded within The Gambia, West Africa. Part two: Vertebrates. 3rd version. University of Warwick - UK: 52 pp.

Emms, C. and L. K. Barnett (2006). Gambian Biodiversity: A Provisional Checklist of all species recorded within The Gambia, West Africa. Part Two: Vertebarates. 4th Version. University of Warwick - UK: 90 pp.

Enders, A. C., C. J. P. Jones, P. J. Taylor and A. M. Carter (2009). Placentation in the Egyptian slit-faced bat *Nycteris thebaica* (Chiroptera: Nycteridae). *Placenta*, **30 (9):** 792 - 799. doi: 10.1016/j.placenta.2009.07.004.

Entwistle, A. (C.) (2001). Community-based protection successful for the Pemba flying fox. *Oryx*, **35 (4):** 355 - 356. doi: 10.1111/j.1365-3008.2001.0208f.pp.x.

Entwistle, A. (C.) and N. Corp (1997a). Status and distribution of the Pemba flying fox *Pteropus voeltzkowi*. *Oryx*, **31 (2):** 135 - 142. doi: 10.1046/j.1365-3008.1997.d01-7.x. [Abstract]

Entwistle, A. C. and N. Corp (1997b). The diet of *Pteropus voeltzkowi*, an endangered fruit bat endemic to Pemba Island, Tanzania. *African Journal of Ecology*, **35 (4):** 351 - 360. [Abstract]

Epstein, J. H. and H. Field (2011). *Chapter 4. Disease surveillance in free-ranging bat populations: challenges and logistical considerations.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 47 - 62. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Epstein, J. H. and S. H. Newman (2011). *Chapter 7. The use of telemetry to understand bat movement and ecology.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 151 - 161. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Erasmus, B. H. and I. L. Rautenbach (1984). New records of occurrences of six species of small mammals in the northern Cape Province. *South African Journal of Wildlife Research*, **14:** 91 - 96. [Abstract]

Eriksson, O. (2014). Evolution of angiosperm seed disperser mutualisms: the timing of origins and their consequences for coevolutionary interactions between angiosperms and frugivores. *Biological Reviews*, **91 (1):** 168 - 186 (for 2016). doi: 10.1111/brv.12164.

Erxleben, J. C. P. (1777). *Systema Regni Animalis per classes, ordines, genera, species, varietates : cvm synonymia et historia animalivm: Classis I. Mammalia.* Lipsiae: Impensis Weygandtanis: I - XLVIII; 1 - 636.

Eshar, D., R. Lapid, M. Weinberg and R. King (2017). Feasibility of reagent test strips to estimate blood urea nitrogen concentrations in Egyptian fruit bats (*Rousettus aegyptiacus*). *Israel Journal of Veterinary Medicine*, **72 (3):** 7 - 10.

Esona, M. D., S. Mijatovic-Rustempasic, C. Conrardy, S. Tong, I. V. Kuzmin, B. Agwanda, R. F. Breiman, K. Banyai, M. Niezgoda, C. E. Rupprecht, J. R. Gentsch and M. D. Bowen (2010). Reassortant group A rotavirus from straw-colored fruit bat (*Eidolon helvum*). *Emerging Infectious Diseases*, **16 (12):** 1844 - 1852. URL: http://www.cdc.gov/eid/content/16/12/pdfs/1844.pdf.

Espinosa-Álvarez, O., P. A. Ortiz, L. Lima, A. G. Costa-Martins, M. G. Serrano, S. Herder, G. A. Buck, E. P. Camargo, P. B. Hamilton, J. R. Stevens and M. M. G. Teixeira (2018). *Trypanosoma rangeli* is phylogenetically closer to Old World trypanosomes than to *Trypanosoma cruzi*. *International Journal for Parasitology*, **48 (7):** 569 - 584. doi: 10.1016/j.ijpara.2017.12.008.

Esselstyn, J. A., C. H. Oliveros, M. T. Swanson and B. C. Faircloth (2017). Investigating difficult nodes in the placental mammal tree with expanded taxon sampling and thousands of ultraconserved elements. *Genome Biology and Evolution*, **9 (9):** 2308 - 2321. doi: 10.1093/gbe/evx168.

Essghaier, M. F. A., I. M. Taboni and K. S. Etayeb (2015). The diversity of wild animals at Fezzan Province (Libya). *Biodiversity Journal*, **6 (1):** 245 - 252.

Estrada-Peña, A. and C. Sanchez (1988). Two new species of *Steatonyssus* (Acarina: Macronyssidae) from bats in the Canary Islands. with the description of male and protonymph of *Parasteatonyssus hoogstraal* (Keegan). *Revista Ibérica de Parasitologia*, **48 (3):** 303 - 311. [Abstract]

Estrada-Peña, A. and J. Serra-Cobo (1991). The Acarinia and Nycteribidia zones of *Miniopterus schreibersi* Kuhl (Mammalia: Chiroptera) in the northeast of Spain. *Folia parasitologica*, **38 (4):** 345 - 354. [Abstract]

Evans, J. S., D. L. Horton, A. J. Easton, A. R. Fooks and A. C. Banyard (2012). Rabies virus vaccines: Is there a need for a pan-lyssavirus vaccine? *Vaccine*, **30 (52):** 7447 - 7454. doi: 10.1016/j.vaccine.2012.10.015.

Evans, L. and A.-L. Mourad (2018). DStretch® and Egyptian tomb paintings: A case study from Beni Hassan. *Journal of Archaeological Science: Reports*, **18:** 78 - 84. doi: 10.1016/j.jasrep.2018.01.011.

Evenhuis, H. L. (2003). Publication and dating of the journals forming the *Annals and Magazine of Natural History* and the *Journal of Natural History*. *Zootaxa*, **385:** 1 - 68.

Eversmmann, E. (1840). Mittheilungen über einige neue und einige weniger gekannte Saugethiere Russlands. *Bulletin de la Société Impériale Nationale de Moscou*, **1:** 3 - 59.

Evin, A., M. Baylac, M. Ruedi, M. Mucedda and J.-M. Pons (2008). Taxonomy, skull diversity and evolution in a species complex of *Myotis* (Chiroptera: Vespertilionidae): a geometric morphometric appraisal. *Biological Journal of the Linnean Society*, **95 (3):** 529 - 538.

Evin, A., I. Horácek and P. Hulva (2011). Phenotypic diversification and island evolution of pipistrelle bats (*Pipistrellus pipistrellus* group) in the Mediterranean region inferred from geometric morphometrics and molecular phylogenetics. *Journal of Biogeography*, **38 (11):** 2091 - 2105. doi: 10.1111/j.1365-2699.2011.02556.x.

Evin, A., V. Nicolas, G. Beuneux, R. Toffoli, C. Cruaud, A. Couloux and J.-M. Pons (2010). Geographical origin and endemism of Corsican Kuhl's pipistrelles assessed from mitochondrial DNA. *Journal of Zoology*, **284 (1):** 31 - 39 (for 2011). doi: 10.1111/j.1469-7998.2010.00778.x. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1469-7998.2010.00778.x/pdf.

Ezenwa, V. O., A.-H. Prieur-Richard, B. Roche, X. Bailly, P. Becquart, G. E. García-Peña, P. R. Hosseini, F. Keesing, A. Rizzoli, G. Suzán, M. Vignuzzi, M. Vittecoq, J. N. Mills and J.-F. Guégan (2015). Interdisciplinarity and infectious diseases: An Ebola case study. *PloS Pathogens*, **11 (8):** e1004992. doi: 10.1371/journal.ppat.1004992.

Fa, J. E. (1991). *Conservación de los ecosistemas forestales de Guinea Ecuatorial.* IUCN, Gland, Switzerland and Cambridge, U.K., xii + 221 pp. [Abstract]

Fadda, C., E. Verheyen and M. Corti (1999). Phylogeny and systematics of three endemic Ethiopian species: 1. Morphology and molecular phylogeny. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 35.

Fagre, A. C. and R. C Kading (2019). Can bats serve as reservoirs for arboviruses? *Viruses*, **11 (3):** 215. doi: 10.3390/v11030215.

Fagre, A. C., J. S. Lee, R. M. Kityo, N. A. Bergren, E. C. Mossel, T. Nakayiki, B. Nalikka, L. Nyakarahuka, A. T. Gilbert, J. Kerbis Peterhans, M. B. Crabtree, J. S. Towner, B. R. Amman, T. K. Sealy, A. J. Schuh, S. T. Nichol, J. J. Lutwama, B. R. Miller

and R. C. Kading (2019). Discovery and characterization of Bukakata orbivirus (*Reoviridae: Orbivirus*), a novel virus from a Ugandan bat. *Viruses*, **11 (3):** 209. doi: 10.3390/v11030209.

Fahmy, M. A. M., A. M. Abdel-Rahman and R. Khalifa (1978). *Trypanosoma (Schizotrypanum) assiutis* sp. nov. from the house mouse *Mus musculus*, with a comparative study on *Trypanosoma (Schizotrypanum) vespertilionis* of the Egyptian bat *Vesperugo kuhli*. *Parasitology*, **77:** 249 - 254. [Abstract]

Fahr, J. (1996). Die Chiroptera der Elfenbeinküste (unter Berücksichtigung des westafrikanischen Raumes): Taxonomie, Habitatpräferenzen und Lebensgemeinschaften. Diploma Thesis, Julius-Maximilians-University Würzburg, 204 pp. + 36 maps.

Fahr, J. (2001). A fresh look at afrotropical bat assemblages: combining different sampling techniques and spatial scales. *Bat Research News*, **42 (3):** 98.

Fahr, J. (2004a). *Kerivoula smithi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004b). *Scotophilus nucella*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004c). *Rhinolophus ziama*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004d). *Rhinolophus ruwenzorii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004e). *Rhinolophus maclaudi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004f). *Rhinolophus hilli*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004g). *Rhinolophus guineensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004h). *Pipistrellus nanulus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004i). *Pipistrellus inexspectatus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004j). *Neoromicia tenuipinnis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004k). *Neoromicia brunneus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004l). *Kerivoula phalaena*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004m). *Kerivoula cuprosa*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004n). *Hypsugo eisentrauti*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004o). *Hypsugo crassulus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004p). *Kerivoula eriophora*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004q). *Scotophilus nux*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2004r). *Neoromicia guineensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Fahr, J. (2007a). *Appendix 10. Revised checklist of bat species recorded from Liberia (modified from Koopman et al. 1995).* In Hoke, P., R. Demey and A. Peal [Eds]: *A Rapid Biological Assessment of North Loma, Gola and Grebo National forests, Liberia.* Conservation International - Arlington, Virginia: 103 - 105.

Fahr, J. (2007b). *Appendix 11. Additional bat species previously recorded from localities near RAP survey sites.* In Hoke, P., R. Demey and A. Peal [Eds]: *A Rapid Biological Assessment of North Loma, Gola and Grebo National forests, Liberia.* Conservation International - Arlington, Virginia: 106.

Fahr, J. (2008a). *Pipistrellus tenuipinnis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008b). *Kerivoula cuprosa*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>. doi: 10.2305/IUCN.UK.2008.RLTS.T10971A3232396.en.

Fahr, J. (2008c). *Kerivoula eriophora*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008d). *Kerivoula phalaena*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008e). *Kerivoula smithii*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008f). *Pipistrellus brunneus*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008g). *Pipistrellus crassulus*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008h). *Pipistrellus eisentrauti*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008i). *Pipistrellus guineensis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008j). *Rhinolophus guineensis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008k). *Rhinolophus hilli*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008l). *Rhinolophus maclaudi*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>. doi: 10.2305/IUCN.UK.2008.RLTS.T19549A8973675.en.

Fahr, J. (2008m). *Rhinolophus ruwenzorii*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008n). *Rhinolophus ziama*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008o). *Scotophilus nucella*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>. doi: 10.2305/IUCN.UK.2008.RLTS.T44934A10966288.en.

Fahr, J. (2008p). *Scotophilus nux*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008q). *Pipistrellus inexspectatus*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2008r). *Pipistrellus nanulus*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Fahr, J. (2011a). *3.5. Les chauves-souris d'Afrique de l'Ouest / Bats of West Africa.* In Sinsin, B., A. Thiombiano, S. Konaté and D. Kampmann : *Biodiversity Atlas of West Africa, Volumes I-III: Benin, Burkina Faso & Côte d'Ivoire*. Cotonou, Ouagadougou, Abidjan & Frankfurt/Main: 110 - 117.
Fahr, J. (2011b). *5.7. Les chauves-souris - Histoire de la recherche, savoir actuelle et perspectives / Bats - History of research, current knowledge, and future prospects.* In Konaté, S. and D. Kampmann : *Biodiversity Atlas of West Africa, Volume III: Côte d'Ivoire.* Abidjan & Frankfurt/Main: 196 - 201.
Fahr, J. (2013a). *Genus Nanonycteris Veldkamp's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 277.
Fahr, J. (2013b). *Nanonycteris veldkampi Veldkamp's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 278 - 280.
Fahr, J. (2013c). *Genus Scotonycteris Tear-drop Fruit Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 294.
Fahr, J. (2013d). *Scotonycteris ophiodon Pohle's Fruit Bat (Snake-toothed Fruit Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 295 - 297.
Fahr, J. (2013e). *Scotonycteris zenkeri Zenker's Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 297 - 299.
Fahr, J. (2013f). *Rhinolophus guineensis Guinean Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 331 - 332.
Fahr, J. (2013g). *Rhinolophus hilli Hill's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 334 - 336.
Fahr, J. (2013h). *Rhinolophus hillorum Upland Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 336 - 337.
Fahr, J. (2013i). *Rhinolophus maclaudi Maclaud's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 342 - 343.
Fahr, J. (2013j). *Rhinolophus ruwenzorii Rwenzori Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 347 - 348.
Fahr, J. (2013k). *Rhinolophus ziama Ziama's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 355 - 356.
Fahr, J. (2013l). *Hipposideros cyclops Cyclops Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 380 - 383.
Fahr, J. (2013m). *Hipposideros fuliginosus Sooty Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 383 - 385.
Fahr, J. (2013n). *Hipposideros jonesi Jones's Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 387 - 389.
Fahr, J. (2013o). *Hipposideros lamottei Lamotte's Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 389 - 390.
Fahr, J. (2013p). *Hipposideros marisae Aellen's Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 391 - 392.
Fahr, J. (2013q). *Saccolaimus peli Pel's Pouched Bat (Giant Pouched Bat, Black-hawk Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 425 - 427.
Fahr, J. (2013r). *Nycteris arge Bates's Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 442 - 443.
Fahr, J. (2013s). *Nycteris intermedia Intermediate Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 450 - 451.
Fahr, J. (2013t). *Nycteris major Dja Slit-faced Bat (Ja Slit-faced Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 453 - 454.
Fahr, J. (2013u). *Nycteris nana Dwarf Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 455 - 456.
Fahr, J. (2013v). *Genus Myopterus Winged-mouse Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 475 - 476.
Fahr, J. (2013w). *Myopterus daubentonii Daubenton's Winged-mouse Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 476 - 478.
Fahr, J. (2013x). *Myopterus whitleyi Bini Winged-mouse Bat (Whitley's Winged-mouse Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 478 - 479.
Fahr, J. (2013y). *Tadarida aloysiisabaudiae Duke of Abruzzi's Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 493 - 495.
Fahr, J. (2013z). *Tadarida bemmeleni Gland-tailed Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 497 - 499.
Fahr, J. (2013aa). *Tadarida congica Congo Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 507 - 509.
Fahr, J. (2013ab). *Tadarida demonstrator Mongalla Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 509 - 511.
Fahr, J. (2013ac). *Glauconycteris superba Pied Butterfly Bat (Superb Butterfly Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 575 - 576.
Fahr, J. (2013ad). *Mimetillus moloneyi Moloney's Mimic Bat (Moloney's Flat-headed Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 586 - 588.
Fahr, J. (2013ae). *Pipistrellus brunneus Dark-brown Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 613 - 614.
Fahr, J. (2013af). *Pipistrellus crassulus Broad-headed Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 617 - 619.
Fahr, J. (2013ag). *Pipistrellus tenuipinnis White-winged Pipistrelle (Slender-winged Pipistrelle).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 655 - 657.
Fahr, J. (2013ah). *Kerivoula cuprosa Copper Woolly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 727 - 728.
Fahr, J. (2013ai). *Kerivoula phalaena Spurrell's Woolly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 731 - 732.

Fahr, J. (2013aj). *Kerivoula smithii Smith's Woolly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 733 - 734.

Fahr, J., M. Abedi-Lartey, T. Esch, M. Machwitz, R. Suu-Ire, M. Wikelski and D. K. N. Dechmann (2015). Pronounced seasonal changes in the movement ecology of a highly gregarious central-place forager, the African (straw-coloured fruit bat (*Eidolon helvum*). *PLoS ONE*, **10 (10):** e0138985. doi: 10.1371/journal.pone.0138985.

Fahr, J., B. A. Djossa and H. Vierhaus (2006a). *Rapid assessment of bats (Chiroptera) in Déré, Diécké and Mt. Béro classified forests, southeastern Guinea; including a review of the distribution of bats in Guinée Forestière.* In Wright, H. E., J. McCullough, L. E. Alonso and M. S. Diallo : *A Rapid Biological Assesssment of Three Classified Forests in Southeastern Guinea.* Conservation International - Washington, D.C.: French: 69 - 81; English: 168 - 180.

Fahr, J., B. A. Djossa and H. Vierhaus (2006b). *Annexe 10. Espèces de chiroptères supplémentaires de la Guinée Forestière dans la Forêt Classée du pic de Fon, la Réserve de la biosphère du Massif de Ziama et dans Réserve de la biosphère des Monts Nimba.* In Wright, H. E., J. McCullough, L. E. Alonso and M. S. Diallo : *RAP Bulletin of Biological Assessment.* Conservation International - Washington, D.C.: 245 - 247.

Fahr, J. and N. M. Ebigbo (2003). A conservation assessment of the bats of the Simandou Range, Guinea, with the first record of *Myotis welwitschii* (Gray, 1866) from West Africa. *Acta Chiropterologica*, **5 (1):** 125 - 141. doi: 10.3161/001.005.0116.

Fahr, J. and N. M. Ebigbo (2004). *Chapter 6. Rapid survey of bats (Chiroptera) in the Forêt Classée du Pic de Fon, Guinea.* In McCullough, J. : *A rapid biological assessment of the Forêt Classée du Pic de Fon, Simandou Range, south-eastern Republic of Guinea.* RAP Bulletin of Biological Assessment. Center for Applied Biodiversity Science (CABS), Conservation International, Rio Tinto. - Washington, D.C.: 69 - 77.

Fahr, J., N. M. Ebigbo, B. Djossa, S. Schmid, K. Soer, A. Voglozin, B. Sinsin and E. K. V. Kalko (2003). The influence of local and regional factors on the diversity, structure, and function of West African bat communities (Chiroptera). Abstract. Sustainable use and conservation of biological diversity. A challenge for society. Symposium Report. Part A. International Symposium 1 - 4 December 2003 - Berlin.

Fahr, J., N. M. Ebigbo and E. K. V. Kalko (2001a). *Patterns in niche partitioning of echolocation frequencies within the guild of narrow space "CF" bats in Côte d'Ivoire - A test of resource partitioning based on echolocation call frequencies.* Gesellschaft für Tropenökologie e.V. Tagungsband. 14. Jahrestagung - Bremen: 37 - 38.

Fahr, J., N. M. Ebigbo and E. K. V. Kalko (2001b). *The influence of local and regional factors on the diversity, structure, and function of West African bat communities (Chiroptera).* Biolog - German Programme on Biodiversity and Global Change. Status report 2001: 144 - 145.

Fahr, J. and D. S. Jacobs (2004). *Kerivoula africana*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Fahr, J. and D. (S.) Jacobs (2008). *Kerivoula africana*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Fahr, J., D. (S.) Jacobs, F. P. D. Cotterill and P. J. Taylor (2008). *Glauconycteris superba*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Fahr, J., D. S. Jacobs, F. W. Cotterill and P. Taylor (2004). *Glauconycteris superba*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Fahr, J. and E. K. V. Kalko (2002). *Spatial and temporal patterns in the structure of bat assemblages in Ivoy Coast, West Africa.* Gesellschaft für Tropenökologie e.V. Tagungsband. 15. Jahrestagung - Göttingen: 41.

Fahr, J. and E. K. V. Kalko (2010a). Biome transitions as centres of diversity: habitat heterogeneity and diversity patterns of West African bat assemblages across spatial scales. *Ecography*, **34 (2):** 177 - 352 (for 2011). doi: 10.1111/j.1600-0587.2010.05510.x.

Fahr, J. and E. K. V. Kalko (2010b). Biome transitions as centres of diversity: habitat heterogeneity and diversity patterns of West African bat assemblages across spatial scales. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 131.

Fahr, J., H. Vierhaus, R. Hutterer and D. Kock (2002). A revision of the *Rhinolophus maclaudi* species group with the description of a new species from West Africa (Chiroptera: Rhinolophidae). *Myotis*, **40:** 95 - 126.

Fain, A. (1953a). Notes sur une collection de Rongeurs, Insectivores et Chauves-souris, capturés dans la région d'endémie pesteuse de Blukwa (Ituri: Congo Belge). *Revue de zoologie et de botanique africaines*, **48 (1-2):** 89 - 101.

Fain, A. (1953b). Note sur une curieuse variation de couleur chez *Nycteris macrotis* Dobson. *Revue de zoologie et de botanique africaines*, **48 (1-2):** 102 - 103.

Fain, A. (1958). Les Acariens psoriques parasites des chauves-souris. I. Revision du genre *Nycteridocoptes* Oudemans, avec description de trois espèces nouvelles chez les Rousettes Africaines. *Revue de zoologie et de botanique africaines*, **58 (3-4):** 232 - 248.

Fain, A. (1959a). Les Acariens psoriques parasites des chauves-souris. VII. Nouvelles observations sur le genre *Nycteridocoptes* Oudemans 1898. *Acarologia*, **1 (3):** 335 - 353.

Fain, A. (1959b). Les Acariens psoriques parasites des Chauves-souris. VIII. Une nouvelle espèce du genre *Chirnyssus* FAIN 1959 (Sarcoptidae), chez une Chauve-souris congolaise. *Revue de zoologie et de botanique africaines*, **59 (3-4):** 249 - 255.

Fain, A. (1959c). Les Acariens psoriques parasites des chauves-souris. IX. Nouvelles observations sur le genre *Psorergates* Tyrrell. *Bulletin en Annalen van de Koninklijke Belgische Entomologische Vereniging*, **95 (7-8):** 232 - 248.

Fain, A. (1959d). Les Acariens psoriques parasites des chauves-souris. XI. Le genre *Notoedres* Railliet 1893. *Revue de zoologie et de botanique africaines*, **60 (1-2):** 131 - 167.

Fain, A. (1959e). Les Acariens psoriques parasites des chauves-souris. XII. Deux nouvelles espèces des genres *Teinocoptes* et *Chirobia* chez des Rousettes africaines (Sarcoptiformes - Teinocoptidae). *Bulletin en Annalen van de Koninklijke Belgische Entomologische Vereniging*, **95 (11-12):** 336 - 341. [Abstract]

Fain, A. (1960). Les Acariens psoriques parasites des chauves-souris. XIII. La famille Demodicidae Nicolet. *Acarologia*, **2 (1):** 80 - 87.

Fain, A. (1963). Les acariens psoriques parasites des chauves-souris. XXVI. Nouvelles espèces des genres *Nycteridocoptes* et *Notoedres* (Sarcoptidae: Sarcoptiformes). *Bulletin en Annalen van de Koninklijke Belgische Entomologische Vereniging*, **99 (17):** 249 - 259.

Fain, A. (1967). Les Acariens psoriques parasites des chauves-souris XXVIII. *Teinocoptes ituriensis* sp. n., avec une clé et une liste des espèces du genre *Teinocoptes* (Teinocoptidae: Sarcoptiformes). *Revue de zoologie et de botanique africaines*, **75 (3-4):** 363 - 368. [Abstract]

Fain, A. (1972). Notes sur les Punaises parasites de Chiroptères de la République du Zaïre avec description de deux espèces et d'une sous-espèce nouvelles. *Revue de zoologie et de botanique africaines*, **85 (3-4):** 187 - 202.
Fain, A. (1978). Les Myobiidae d'Afrique au sud du Sahara et de Madagascar (Acarina - Prostigmata). *Museum Royal de l'Afrique Centrale*, **8 (224):** i - 186. [Abstract]
Fain, A. (1994). Adaptation, specificity and host-parasite coevolution in mites (Acari). *International Journal for Parasitology*, **24 (8):** 1273 - 1283. [Abstract]
Fain, A. and V. Aellen (1994). Notes sur une petite collection d'acariens (Acari) parasites récoltés sur des chiroptères de la collection du Muséum d'histoire naturelle de Genève. *Bulletin de la Société neuchâteloise des sciences naturelles*, **117:** 59 - 66. [Abstract]
Fain, A. and P. Elsen (1972). Un nouveau Cimicide du Cameroun: *Stricticimex puylaerti* sp.n. *Revue de zoologie et de botanique africaines*, **85 (1-2):** 142 - 146. [Abstract]
Fairon, J. (1980). Deux nouvelles espèces de cheiroptères pour la faune du massif de l'Air (Niger): *Otonycteris hemprichi* Peters, 1859 et *Pipistrellus nanus* (Peters, 1852). *Bulletin - Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, **52 (17):** 1 - 7.
Fairon, J., R. Gilson, R. Jooris, T. Faber and C. Meisch (1982). Cartographie provisoire de la faune chiroptèrologique Belgo-Luxembourgeoise. *Bulletin du Centre de Baguement et de la Recherche Chiroptèrologique de Belgique*, **7:** 1 - 125.
Fajardo, S. (2002). *Presencia de murciélagos frugivoros (megaquirópteros) en libertad en Tenerife.* Gobierno de Canarias (Informe técnico no publicado), de Tenerife. 24 pp.
Falcoz, L. (1924a). Dipteres Pupipares du Muséum Nationale d'Histoire naturelle de Paris (Streblidæ et Nycteribiidæ). *Bulletin du Muséum national d'histoire naturelle de Paris*, **30:** 223 - 230.
Falcoz, L. (1924b). Dipteres Pupipares du Muséum Nationale d'Histoire naturelle de Paris (Streblidae et Nycteribiidae). (Suite). *Bulletin du Muséum national d'histoire naturelle de Paris*, **30:** 309 - 315.
Falcoz, L. (1924c). Dipteres Pupipares du Museum Nationale d'Histoire naturelle de Paris (Streblidae et Nycteribiidae). (Fin). *Bulletin du Muséum national d'histoire naturelle de Paris*, **30:** 368 - 389.
Falcoz, L. (1931). Matériaux pour la connaissance des Diptères Pupipares. I. *Parasitology*, **23:** 264 - 269. [Abstract]
Fanchette, R. and C. Gonzalves (2010). Third national report to the convention of biological diversity. Government of the Seychelles - Department of Environment: 1 - 150. URL: http://www.cbd.int/doc/world/sc/sc-nr-03-en.pdf.
Farfar, A., M. L. Bendjeddou, Z. Bouslama, W. Metallaoui, R. A. Korba, Z. Amr and M. A. A. Baker (2017). Bats of the El Kala Biosphere Reserve, northeastern Algeria (Chiroptera). *Lynx (Praha)*, **ns 48:** 79 - 92.
Farhang-Azad, A. and D. A. Schlitter (1978). *Capillaria hepatica* in small mammals collected from Shoa province, Ethiopia. *Journal of wildlife diseases*, **14:** 358 - 361. [Abstract]
Farina, L. L., D. J. Heard, D. M. LeBlanc, J. O. Hall, G. Stevens, J. F. X. Wellehan and C. J. Detrisac (2005). Iron storage disease in captive Egyptian fruit bats (*Rousettus aegyptiacus*): Relationship of blood iron parameters to hepatic iron concentrations and hepatic histopathology. *Journal of Zoo and Wildlife Medicine*, **36 (2):** 212 - 221.
Farkašová, H., T. Hron, J. Paces, P. Hulva, P. Benda, R. J. Gifford and D. Elleder (2017). Discovery of an endogenous Deltaretrovirus in the genome of long-fingered bats (Chiroptera: Miniopteridae). *Proceedings of the National Academy of Sciences, U.S.A.*, **114 (12):** 3145 - 3150. doi: 10.1073/pnas.1621224114.
Farney, J. and E. D. Fleharty (1969). Aspect ratio, loading, wing span, and membrane areas of bats. *Journal of Mammalogy*, **50 (2):** 362 - 367. [Abstract]
Fasel, N., V. Saladin and H. Richner (2016). Alternative reproductive tactics and reproductive success in male *Carollia perspicillata* (Seba's short-tailed bat). *Journal of Evolutionary Biology*, **29 (11):** 2242 - 2255. doi: 10.1111/jeb.12949.
Fatio, V. (1869). *Faune des Vertébres Suisse.* .
Fawcett, K., D. S. Jacobs, A. Surlykke and J. M. Ratcliffe (2015). Echolocation in the bat, *Rhinolophus capensis*: the influence of clutter, conspecifics and prey on call design and intensity. *Biology Open*, **4:** 693 - 701. doi: 10.1242/bio.201511908.
Fawcett, K., L. Jakobsen, D. Jacobs, A. Surlykke and J. Ratcliffe (2013). The effects of conspecifics on echolocation in bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 49. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Fedden, M. O. and H. L. Macleod (1986). *Bat research in western Cameroon.* In Stuart, S. N. : *Conservation of Cameroun montane forests.* International Council for Bird Preservation - Cambridge, U.K.: 175 - 195.
Fedyk, A. and S. Fedyk (1970). Karyotypes of some species of Vespertilionid bats from Poland. *Acta Theriologica*, **15 (20):** 295 - 302. [Abstract]
Fedyk, S. and A. L. Ruprecht (1983). Chromosomes of some species of Vespertilionid bats. I. Banding patterns of Eptesicus serotinus chromosomes. *Acta Theriologica*, **28:** 159-170.
Feely, J. M. (2009). isiXhosa names of South African land mammals. *African Zoology*, **44 (2):** 141 - 150. doi: 10.1080/15627020.2009.11407448.
Feijoo, M. and A. Parada (2017). Macrosystematics of eutherian mammals combining HTS data to expand taxon coverage. *Molecular and Phylogenetic Evolution*, **113:** 76 - 83. doi: 10.1016/j.ympev.2017.05.004.
Feiler, A. (1984). Ueber Säugetiere der Insel Sao Tomé (Mammalia). *Zoologische Abhandlungen - Staatliches Museum für Tierkunde, Dresden*, **40 (7):** 75 - 78. [Abstract]
Feiler, A. (1986). Zur Faunistik und Biometrie angolanischer Fledermäuse (Mammalia, Mega- et Microchiroptera). *Zoologische Abhandlungen - Staatliches Museum für Tierkunde, Dresden*, **42 (5):** 65 - 77. [Abstract]
Feiler, A. (1988). Die Säugetiere der Inseln im Golf von Guinea und ihre Beziehungen zur Säugetierfauna des westafrikanischen Festlandes (Mammalia). *Zoologische Abhandlungen - Staatliches Museum für Tierkunde, Dresden*, **44 (8):** 83 - 88. [Abstract]
Feiler, A. (1990). *Distribution of mammals in Angola and notes on biogeography.* In Peters, G. and R. Hutterer : *Vertebrates in the tropics.* Museum Alexander Koenig - Bonn: 221 - 236. [Abstract]
Feiler, A., J. Haft and P. Widmann (1993). Beobachtungen und Untersuchungen an Säugetieren der Insel Sao Tomé (Golf von Guinea) (Mammalia). *Faunistische Abhandlungen - Staatliches Museum für Tierkunde, Dresden*, **19 (4):** 21 - 35. [Abstract]
Feiler, A. and A. L. Pires (1984). Ueber *Chaerophon pumila* (Cretzschmar) in Angola (Mammalia, Chiroptera, Molossidae). *Faunistische Abhandlungen - Staatliches Museum für Tierkunde, Dresden*, **12 (5):** 53 - 54. [Abstract]
Feldman, R., J. O. Whitaker and Y. Yom-Tov (2000). Dietary composition and habitat use in a desert insectivorous bat community in Israel. *Acta Chiropterologica*, **2:** 15 - 22.
Felten, H. (1956). Fledermäuse fressen Skorpione. *Natur und Volk - Senckenbergische naturforschenden Gesellschaft*, **86:** 53 - 57.

Felten, H. (1962). Bemerkungen zu Fledermäusen der Gattungen *Rhinopoma* und *Taphozous* (Mammalia, Chiroptera). *Senckenbergiana biologica*, **43 (2):** 171 - 176. [Abstract]
Felten, H. (1971). Eine neue Art der Fledermaus-Gattung *Eptesicus* aus Kleinasien (Chiroptera: Vespertilionidae). *Senckenbergiana biologica*, **52 (6):** 371 - 376. [Abstract]
Felten, H., F. Spitzenberger and G. Storch (1977). Zur Kleinsaugerfauna West-Anatoliens. Teil IIIa. *Senckenbergiana biologica*, **58 (1/2):** 1 - 44. [Abstract]
Feng, Y., Y. Li, S. Fu, X. Li, J. Song, H. Zhang, W. Yang, Y. Zhang, H. Pan and G. Liang (2017). Isolation of Kaeng Khoi virus (KKV) from *Eucampsipoda sundaica* bat flies in China. *Virus Research*, **238:** 94 - 100. doi: 10.1016/j.virusres.2017.06.007.
Fenton, M. B. (1972). The structure of aerial-feeding bat faunas as indicated by ears and wing elements. *Canadian journal of zoology*, **50 (3):** 287 - 296. doi: 10.1139/z72-039. [Abstract]
Fenton, M. B. (1975). Observations on the Biology of some Rhodesian bats, including a key to the Chiroptera of Rhodesia. *Life Sciences Royal Ontario Museum, University of Toronto*, **104:** 1 - 27. [Abstract]
Fenton, M. B. (1983). Roosts used by the African bat, *Scotophilus leucogaster* (Chiroptera: Vespertilionidae). *Biotropica*, **15 (2):** 129 - 132. [Abstract]
Fenton, M. B. (1984). *Sperm competition? The case of vespertilionid and rhinolophid bats.* In Smith, R.L. [Ed]: *Sperm competition and the evolution of animal mating systems.* Academic Press, New York: 573 - 587.
Fenton, M. B. (1985). The feeding behaviour of insectivorous bats: Echolocation, foraging strategies, and resource partitioning. *Bulletin of the Transvaal Museum*, **21:** 5 - 16. [Abstract]
Fenton, M. B. (1986a). Design of bat echolocation calls: implications for foraging ecology and communication. *Mammalia*, **50 (2):** 193 - 205. doi: 10.1515/mamm.1986.50.2.193. [Abstract]
Fenton, M. B. (1986b). *Hipposideros caffer* (Chiroptera: Hipposideridae) in Zimbabwe: morphology and echolocation calls. *Journal of Zoology*, **210 (3):** 347 - 353. doi: 10.1111/j.1469-7998.1986.tb03638.x. [Abstract]
Fenton, M. B. (1987). Foraging and habitat use by *Nycteris grandis* (Chiroptera: Nycteridae) in Zimbabwe. *Journal of Zoology*, **211:** 709 - 716.
Fenton, M. B. (1992). Pelage pattern and crypsis in roosting bats: *Taphozous mauritianus* and *Epomophorus* species. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **35 (2):** 49 - 55. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/404. [Abstract]
Fenton, M. B. (1994). Echolocation: its impact on the behaviour and ecology of bats. *Ecoscience*, **1 (1):** 21 - 30. [Abstract]
Fenton, M. B. (1997). Science and the conservation of bats. *Journal of Mammalogy*, **78 (1):** 1 - 14. doi: 10.2307/1382633. [Abstract]
Fenton, M. B. (2003a). Science and the conservation of bats: where to next?. *Wildlife Society Bulletin*, **31 (1):** 6 - 15.
Fenton, M. B. (2003b). Eavesdropping on the echolocation and social calls of bats. *Mammal Review*, **33 (3):** 193 - 204.
Fenton, M. B. (2004a). *47. Aerial-Feeding Bats: Getting the most out of echolocation.* In Thomas, J.A., C.F. Moss and M. Vater : *Echolocation in bats and dolphins.* The University of Chicago Press: 350 - 355.
Fenton, M. B. (2004b). *Bat natural history and echolocation.* In Brigham, R.M., E.K.V. Kalko, G. Jones, S. Parsons and H.J.G.A. Limpens : *Bat Echolocation Research. Tools, techniques and analysis* Bat Conservation International - Austin, Texas: 2 - 6. URL: http://www.batcon.org/pdfs/stories/BatEcholocationResearch.pdf.
Fenton, M. B. (2010). Convergences in the diversification of bats. *Current Zoology*, **56 (4):** 454 - 468.
Fenton, M. B. (2013). A perspective on bats (Chiroptera). *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **55 (1):** 1140, 3 pp. doi: 10.4102/koedoe.v55i1.1140.
Fenton, M. B. and G. P. Bell (1981). Recognition of species of insectivorous bats by their echolocation calls. *Journal of Mammalogy*, **62 (2):** 233 - 243.
Fenton, M. B. and W. Bogdanowicz (2002). Relationships between external morphology and foraging behaviour: bats in the genus *Myotis*. *Canadian journal of zoology*, **80 (6):** 1004 - 1013. doi: 10.1139/z2-083.
Fenton, M. B., S. Bouchard, M. J. Vonhof and J. Zigouris (2011). Time-expansion and zero-crossing period meter systems present significantly different views of echolocation calls of bats. *Journal of Mammalogy*, **82 (3):** 721 - 727. doi: 10.1644/1545-1542(2001)082<0721:TEAZCP>2.0.CO;2.
Fenton, M. B., N. G. H. Boyle, T. M. Harrison and D. J. Oxley (1977a). Activity patterns, habitat use, and prey selection by some African insectivorous bats. *Biotropica*, **9 (2):** 73 - 85. [Abstract]
Fenton, M. B., R. M. Brigham, A. M. Mills and I. L. Rautenbach (1985). The roosting and foraging areas of *Epomophorus wahlbergi* (Pteropodidae) and *Scotophilus viridis* (Vespertilionidae) in Kruger National Park, South Africa. *Journal of Mammalogy*, **66 (3):** 461 - 468. [Abstract]
Fenton, M. B., D. H. M. Cumming, J. M. Hutton and C. M. Swanepoel (1987a). Foraging and habitat use by *Nycteris grandis* (Chiroptera: Nycteridae) in Zimbabwe. *Journal of Zoology*, **211:** 709 - 716. [Abstract]
Fenton, M. B., D. H. M. Cumming and D. J. Oxley (1977b). Prey of bat hawks and availability of bats. *Condor*, **79:** 495 - 497.
Fenton, M. B., D. H. M. Cumming, I. L. Rautenbach, G. S. Cumming, M. S. Cumming, G. Ford, R. D. Taylor, J. Dunlop, M. D. Hovorka, D. S. Johnston, C. V. Portfors, M. C. Kalcounis and Z. Mahlanga (1998a). Bats and the loss of tree canopy in African woodlands. *Conservation Biology*, **12 (2):** 399 - 407. [Abstract]
Fenton, M. B. and J. L. Eger (2002). *Chaerephon chapini*. *Mammalian Species*, **692:** 1 - 2, 3 figs.
Fenton, M. B. and J. H. Fullard (1979). The influence of moth hearing on bat echolocation strategies. *Journal of Comparative Physiology*, **A 132 (1):** 77 - 86. [Abstract]
Fenton, M. B., C. L. Gaudet and M. L. Leonard (1983). Feeding behaviour of the bats *Nycteris grandis* and *Nycteris thebaica* (Nycteridae) in captivity. *Journal of Zoology*, **200:** 347 - 354. [Abstract]
Fenton, M. B. and D. R. Griffin (1997). High-altitude pursuit of insects by echolocating bats. *Journal of Mammalogy*, **78 (1):** 247 - 250. [Abstract]
Fenton, M. B., D. S. Jacobs, E. J. Richardson, P. J. Taylor and W. White (2004). Individual signatures in the frequency-modulated sweep calls of African large-eared, free-tailed bats *Otomops martiensseni* (Chiroptera: Molossidae). *Journal of Zoology*, **262 (1):** 11 - 19.
Fenton, M. B. and R. L. Peterson (1972). Further notes on *Tadarida aloysiisabaudiae* and *Tadarida russata* (Chiroptera - Molossidae - Africa). *Canadian journal of zoology*, **50 (1):** 19 - 24. doi: 10.1139/z72-004. [Abstract]
Fenton, M. B., C. V. Portfors, I. L. Rautenbach and J. M. Waterman (1998b). Compromises: sound frequencies used in echolocation by aerial-feeding bats. *Canadian journal of zoology*, **76:** 1174 - 1182. [Abstract]
Fenton, M. B., C. V. Portfors-Yeomans and I. L. Rautenbach (19xx). Extending bats ranges of perception: The roles of vision and echolocation. 1 - 30.

Fenton, M. B. and I. L. Rautenbach (1986). A comparison of the roosting and foraging behaviour of three species of African insectivorous bats (Rhinolophidae, Vespertilionidae, and Molossidae). *Canadian journal of zoology*, **64:** 2860 - 2867. [Abstract]
Fenton, M. B. and I. L. Rautenbach (1998). *Impacts of ignorance and human and elephant populations on the conservation of bats in African woodlands.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 261 - 270.
Fenton, M. B., I. L. Rautenbach, D. Chipese, M. B. Cumming, M. K. Musgrave, J. S. Taylor and T. Volpers (1993). Variation in foraging behaviour, habitat use, and diet of Large slit-faced bats (*Nycteris grandis*). *Zeitschrift für Säugetierkunde*, **58 (2):** 65 - 74. [Abstract]
Fenton, M. B., I. L. Rautenbach, S. E. Smith, C. M. Swanepoel, J. Grosell and J. van Jaarsveld (1994). Raptors and bats: threats and opportunities. *Animal Behaviour*, **48:** 9 - 18. [Abstract]
Fenton, M. B., B. Shalmon and D. Makin (1999). Roost switching, foraging behavior, and diet of the Vespertilionid bat, *Otonycteris hemprichii*. *Israel journal of zoology*, **45:** 501 - 504.
Fenton, M. B., C. M. Swanepoel, R. M. Brigham, J. Cebek and M. B. C. Hickey (1990). Foraging behavior and prey selection by large Slit-faced bats (*Nycteris grandis*; Chiroptera: Nycteridae). *Biotropica*, **22 (1):** 2 - 8. [Abstract]
Fenton, M. B., P. J. Taylor, D. S. Jacobs, E. J. Richardson, E. Bernard, S. Bouchard, K. R. Debaremaeker, H. Ter Hofstede, L. Hollis, C. L. Lausen, J. S. Lister, D. Rambaldini, J. M. Ratcliffe and E. Reddy (2002). Researching little-known species: the African bat *Otomops martiensseni* (Chiroptera: Molossidae). *Biodiversity and conservation*, **11:** 1583 - 1606.
Fenton, M. B., D. C. Tennant and J. Wyszecki (1987b). Using echolocation calls to measure the distribution of bats: The case of *Euderma maculatum*. *Journal of Mammalogy*, **68 (1):** abstract.
Fenton, M. B. and D. W. Thomas (1980). Dry-season overlap in activity patterns, habitat use, prey selection by sympatric African insectivorous bats. *Biotropica*, **12 (2):** 81 - 90. [Abstract]
Fenton, M. B., D. W. Thomas and R. Sasseen (1981). *Nycteris grandis* (Nycteridae): an African carnivorous bat. *Journal of Zoology*, **194:** 461 - 465. [Abstract]
Fenton, M. B., J. M. Waterman, J. D. Roth, E. Lopez and S. E. Fienberg (1998c). Tooth breakage and diet: a comparison of bats and carnivores. *Journal of Zoology*, **246 (1):** 83 - 88. [Abstract]
Fereidouni, S., L. Kwasnitschka, A. Balkema Buschmann, T. Müller, C. Freuling, J. Schatz, J. Pikula, H. Bandouchova, R. Hoffmann, B. Ohlendorf, G. Kerth, S. Tong, R. Donis, M. Beer and T. Harder (2015). No virological evidence for an influenza A-like viruses in European bats. *Zoonoses and Public Health*, **62:** 187 - 189.
Ferguson, W. W. (2002). *The mammals of Israel.* Gefen Publishing House - Jerusalem - New York: 160 pp.
Fernández-Llamazares, A., A. López-Baucells, R. Rocha, S. F. M. Andriamitandrina, Z. E. Andriatafika, D. Burgas, E. M. Temba, L. Torrent and M. Cabeza (2018). Are sacred caves still safe havens for the endemic bats of Madagascar? *Oryx*, **52 (2):** 271 - 275. doi: 10.1017/S0030605317001648.
Fernsby, N. (2004). First South African Record of the Giant yellow house bat. *Journal of the Endangered Wildlife Trust*, **50 (4):** 5.
Fernsby, N. (2005). New bat discovered in South Africa. . URL: http://www.batsgauteng.org.za/NewBat.htm.
Fernsby, N., L. Cohen, L. R. Richards, P. J. Taylor and M. F. Child (2016). *A conservation assessment of Scotophilus nigrita.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Ferris, G. F. (1930). Some African Diptera Pupipara. *Parasitology*, **22 (3):** 275 - 282. [Abstract]
Festa, A. (1907). Spedizione al Ruwenzori di S. A. R. Luigi Amedeo di Savoia Duca degli Abruzzi. XI. *Nyctinomus Aloysii-Sabaudiae*, nov. spec. (diagnosi preventiva). *Bollettino del Museo Zoologica Anatomica Comparativo de l'Universita de Torino*, **22 (546):** 1 - 2.
Fidgett, A. L., S. Sanderson and E. Fletcher (2004). *The effect of food presentation on the mortality rates and reproductive success of a colony of Rodriges fruit bats (Pteropus rodricensis).* European Association of Zoo- and Wildlife Veterinarians (EAZWV) 5th scientific meeting, May 19 - 23 - 2004, Ebeltoft. Denmark:7 pp..
Field, H. and J. H. Epstein (2011). *Chapter 5. Significant zoonotic diseases identified in bats. Henipaviruses.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 64 - 79. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.
Findley, J. S. (1972). Phenetic relationships among bats of the genus *Myotis*. *Systematic zoology*, **21 (2):** 31 - 52. [Abstract]
Findley, J. S. and H. Black (1983). Morphological and dietary structuring of a Zambian insectivorous bat community. *Ecology*, **64 (4):** 625 - 630. [Abstract]
Findley, J. S. and C. Jones (1967). Taxonomic relationships of bats of the species *Myotis fortidens*, *M. lucifugus*, and *M. occultus*. *Journal of Mammalogy*, **48 (3):** 429 - 444.
Findley, J. S., E. H. Studier and D. E. Wilson (1972). Morphologic properties of bat wings. *Journal of Mammalogy*, **53 (3):** 429 - 444. [Abstract]
Findley, J. S. and G. L. Traut (1970). Geographic variation in *Pipistrellus hesperus*. *Journal of Mammalogy*, **51 (4):** 741 - 765. [Abstract]
Findley, J. S. and D. E. Wilson (1983). Are Bats rare in tropical Africa?. *Biotropica*, **15 (4):** 299 - 303.
Finger, N. M., A. Bastian and D. S. Jacobs (2017). To seek or speak? Dual function of an acoustic signal limits its versatility in communication. *Animal Behaviour*, **127:** 135 - 152. doi: 10.1016/j.anbehav.2017.03.005.
Finkelstein, A., D. Derdikman, A. Rubin, J. N. Foerster, L. Las and N. Ulanovsky (2014). Three-dimensional head-direction coding in the bat brain. *Nature*, **517 (7533):** 159 - 164 (for 2015). doi: 10.1038/nature14031.
Fiorillo, G., P. Bocchini and J. Buceta (2018). A predictive spatial distribution framework for filovirus-infected bats. *Scientific Reports*, **8:** 7970. doi: 10.1038/s41598-018-26074-4.
Fischer, F., M. Gross and K. E. Linsenmair (2002). Updated list of the larger mammals of the Comoé National Park, Ivory Coast. *Mammalia*, **66 (1):** 83 - 92.
Fischer, J. B. (1829). *Synopsis Mammalium.* J. G. Cottae , Stuttgardtiae: i - xlii, 1 - 752.
Fischer, K., V. P. d. Reis and A. Balkema-Buschmann (2017). Bat astroviruses: towards understanding the transmission dynamics of a neglected virus family. *Viruses*, **9 (2):** 34. doi: 10.3390/v9020034.
Fisher, C. R., D. G. Streicker and M. J. Schnell (2018). The spread and evolution of rabies virus: conquering new frontiers. *Nature Reviews Microbiology*, **16:** 241 - 255. doi: 10.1038/nrmicro.2018.11.

Fisher, R. D. and C. A. Ludwig (2015). Catalog of type specimens of recent mammals: Orders Didelphimorphia through Chiroptera (excluding Rodentia) in the National Museum of Natural History, Smithsonian Institution. *Smithsonian Contributions to Zoology*, **644:** i - viii; 1 - 110.
Fisk, G. H. R. (1890). Exhibit of an albino bat. *Proceedings of the Zoological Society of London*, **1890, I:** 97.
Fitzinger, L. J. (1861). Die Ausbeute der österreichischen Naturforscher an Säugethieren und Reptilien während der Weltumsegelung Sr. Majestäts Fregatte Novara. *Sitzungsberichte der Köninglichen Akademie für Wissenschaften aus Wien, mathematisch naturwissenschaftliche Klasse*, **42 (1) 25:** 383 - 416 (for 1860).
Fitzinger, L. J. (1870a). Kritische Durchsicht der Ordnung der Flatterthiere oder Handflügler (Chiroptera). Familie der Kamnasen (Rhinolophi). II. Abtheilung. *Sitzungsberichte der Köninglichen Akademie für Wissenschaften aus Wien, mathematisch naturwissenschaftliche Klasse*, **I (I) 5:** 123 - 198.
Fitzinger, L. J. (1870b). Kritische Durchsicht der Ordnung der Flatterthiere oder Handflügler (Chiroptera). Familie der Fledermäuse (Vespertiliones). IV. Abteilung. *Sitzungsberichte der Köninglichen Akademie für Wissenschaften aus Wien, mathematisch naturwissenschaftliche Klasse*, **62 (7):** 211 - 317.
Fitzpatrick, T. J. (1911). *Rafinesque. A sketch of his life with bibliography.* The Historical Department of Iowa. Des Moines. 241 pp.
Flanders, F., G. Jones, P. Benda, C. Dietz, S. Zhang, G. Li, M. Sharifi and S. J. Rossiter (2008). Phylogeography of the greater horseshoe bat, *Rhinolophus ferrumequinum*: Contrasting results from mitochondrial and microsatellite data. *Molecular Ecology*, **18 (2):** 306 - 318 (for 2009). doi: 10.1111/j.1365-294X.2008.04021.x.
Flanders, J. and G. Jones (2009). Roost use, ranging behavior, and diet of Greater horseshoe bats (*Rhinolophus ferrumequinum*) using a transitional roost. *Journal of Mammalogy*, **90 (4):** 888 - 896. doi: 10.1644/08-MAMM-A-352.1.
Flannery, T. F. (1990). *Mammals of New Guinea.* Robert Brown & Associates, Carina Queensland Australia: i - iii, 1 - 440.
Flannery, T. F. (1995a). *Mammals of the South-West Pacific and Moluccan Islands.* Comstock, Cornell: 464 pp.
Flannery, T. F. (1995b). *Mammals of New Guinea. 2nd revised and updated edition.* Robert Brown & Associates, Carina Queensland Australia: 568 pp.
Flasar, I. (1997). Prof. Dr. Friedrich Anton Kolenati. *Vespertilio*, **2:** 149 - 171.
Fleetwood, J. D. L. (1962). Notes on mammals new to Kenya Colony. *Durban Museum Novitates*, **6 (17):** 203 - 211.
Fleming, J. (1822). *The Philosophy of Zoology; or, a general view of the structure, functions, and classification of animals. Volume 2.* Archibald Constable & Co - Edinburgh: 618 pp.
Fleming, T. H., C. Geiselman and W. J. Kress (2009). The evolution of bat pollination: a phylogenetic perspective. *Annals of Botany*. doi: 10.1093/aob/mcp197.
Fleming, T. H., E. T. Hooper and D. E. Wilson (1972). Three central American bat communities: structure, reproductive cycle, and movement patterns. *Ecology*, **53 (4):** 555 - 569.
Fleming, T. H., A. A. Nelson and V. M. Dalton (1998). Roosting behaviour of the lesser long-nosed bat, *Leptonycteris curasoae*. *Journal of Mammalogy*, **79 (1):** 147 - 155.
Fleming, T. H. and V. J. Sosa (1994). Effects of nectarivorous and frugivorous mammals on reproductive success of plants. *Journal of Mammalogy*, **75 (4):** 845 - 851.
Florens, F. B. V. (2015). Flying foxes face cull despite evidence. *Science*, **350 (6266):** 1325 - 1326.
Florens, F. B. V. (2016). Mauritius culls threatened fruit bats. *Nature*, **530:** 33.
Florens, F. B. V. and C. Baider (2018). Mass-culling of a threatened island flying fox species failed to increase fruit growers' profits and revealed gaps to be addressed for effective conservation. *Journal for Nature Conservation*, **47:** 58 - 64 (for 2019). doi: 10.1016/j.jnc.2018.11.008.
Florens, F. B. V., C. Baider, V. Marday, G. M. N. Martin, Z. Zmanay, R. Oleksy, G. Krivek, C. E. Vincenot, D. Strasberg and T. Kingston (2017). Disproportionately large ecological role of a recently mass-culled flying fox in native forests of an oceanic island. *Journal for Nature Conservation*, **40:** 85 - 93. doi: 10.1016/j.jnc.2017.10.002.
Flower, S. S. (1900). 1. On the mammalia of Siam and the Malay Peninsula. *Proceedings of the Zoological Society of London*, **1900, II:** 306 - 379.
Flower, S. S. (1901). 1. Notes on the fauna of the White Nile and its tributaries. *Proceedings of the Zoological Society of London*, **1900, IV:** 950 - 955. [Abstract]
Flower, S. S. (1932). 22. Notes on the recent mammals of Egypt, with a list of the species recorded from that kingdom. *Proceedings of the Zoological Society of London*, **101:** 369 - 450. [Abstract]
Flower, W. H. and R. Lydekker (1891). *An introduction to the study of mammals living and extinct.* A. and C. Black, London: i - xvi; 1 - 763.
Fodeke, A. A. (2017). Organic phosphate binding inhibits high pH t-isomerization of the ß-chain in straw-coloured fruit bat (*Eidolon helvum*) haemoglobin. *South African Journal of Chemistry*, **70 (1):** 181 - 188. doi: 10.17159/0379-4350/2017/v70a25.
Foggin, C. M. (1988). Rabies and rabies-related viruses in Zimbabwe: Historical, virological and ecological aspects. PhD thesis, University of Zimbabwe - Harare.
Foley, H. (1922). Contribution a l'étude de la faune saharienne (Première Note). *Bulletin de la Société d'histoire naturelle de l'Afrique du nord*, **13:** 70 - 76. [Abstract]
Foley, N. M., S. M. Goodman, C. V. Whelan, S. J. Puechmaille and E. Teeling (2017). Towards navigating the Minotaur's labyrinth: cryptic diversity and taxonomic revision within the speciose genus *Hipposideros* (Hipposideridae). *Acta Chiropterologica*, **19 (1):** 1 - 18. doi: 10.3161/15081109ACC2017.19.1.001.
Foley, N. M., M. S. Springer and E. C. Teeling (2016). Mammal madness: is the mammal tree of life not yet resolved? *Philosophical transactions of the Royal Society of London*, **B 371:** 20150140. doi: 10.1098/rstb.2015.0140.
Foley, N. M., V. D. Thong, P. Soisook, S. M. Goodman, K. N. Armstrong, D. S. Jacobs, S. J. Puechmaille and E. C. Teeling (2014). How and why overcome the impediments to resolution: Lessons from rhinolophid and hipposiderid bats. *Molecular biology and evolution*, **32 (2):** 313 - 333 (for 2015). doi: 10.1093/molbev/msu329.
Fontenille, D., F. Rodhain, J. P. Digoutte, C. Mathiot, J. Morvan and P. Coulanges (1989). Les cycles de transmission du Virus West-Nile a Madagascar, Ocean Indien. *Annales de la Société belge de médecine tropicale*, **69:** 233 - 243. [Abstract]
Foord, S. H., L. H. Swanepoel, S. W. Evans, C. S. Schoeman, B. F. N. Erasmus, M. C. Schoeman, M. Keith, A. Smith, E. V. Mauda, N. Maree, N. Nembudani, A. S. Dippenaar-Schoeman, T. C. Munyai and P. J. Taylor (2018). Animal taxa contrast in their scale-dependent responses to land use change in rural Africa. *PLoS ONE*, **13(5):** e0194336. doi: 10.1371/journal.pone.0194336.
Forbes, K. M., P. W. Webala, A. J. Jääskeläinen, S. Abdurahman, J. Ogola, M. M. Masika, I. Kivistö, H. Alburkat, I. Plyusnin, L. Levanov, E. M. Korhonen, E. Huhtamo, D. Mwaengo, T. Smura, A. Mirazimi, O. Anzala, O. Vapalahti and T. Sironen

(2019). Bombali Virus in *Mops condylurus* bat, Kenya. *Emerging Infectious Diseases*, **25 (5):** 955 - 957. doi: 10.3201/eid2505.181666.

Forman, G. L. (1973). Studies of gastric morphology in North American Chiroptera (Emballonuridae, Noctilionidae and Phyllostomatidae). *Journal of Mammalogy*, **54 (4):** 909 - 923. URL: www.jstor.org/stable/1379085. [Abstract]

Formella, M. and D. Gatherer (2016). The serology of *Ebolavirus* - a wider geographical range, a wider genus of viruses, or a wider range of virulence? *Journal of general virology*, **97(12):** 3120 - 3130. doi: 10.1099/jgv.0.000638.

Forsyth Major, C. I. (1897). 7. On the General Results of a Zoological Expedition to Madagascar in 1894 - 96. *Proceedings of the Zoological Society of London*, **1896, IV:** 971 - 981.

Foster, M. N., T. M. Brooks, A. Cuttelod, N. De Silva, L. D. C. Fishpool, E. A. Radford and S. Woodley (2012). The identification of sites of biodiversity conservation significance: progress with the application of a global standard. *Journal of Threatened Taxa*, **4 (8):** 2733 - 2744.

Fountain, K. (I.), Roberts, L., V. Young, A. Barbon, S.-M. Frosini, D. H. Lloyd and A. Loeffler (2019). Diversity of staphylococcal species cultured from captive Livingstone's fruit bats (*Pteropus livingstonii*) and their environment. *Journal of Zoo and Wildlife Medicine*, **50 (1):** 266 - 269. doi: 10.1638/2018-0121.

Fountain, K. I., K. B. Stevens, D. H. Lloyd and A. Loeffler (2017). Skin disease in captive bats: results of an online survey of zoos and rehabilitators in Europe, North America and Australasia. *Veterinary Dermatology*, **28 (2):** 219 - 224; e51 - e52. doi: 0.1111/vde.12410.

Fox, S., H. Spencer and G. M. O'Brien (2009). Analysis of twinning in flying-foxes (Megachiroptera) reveals superfoetation and multiple-paternity. *Acta Chiropterologica*, **10 (2):** 271 - 278 (for 2008). doi: 10.3161/150811008X414845.

Fracasso, M. P. A., L. d. O. Salles and F. A. Perini (2011). Upper molar morphology and relationships among higher taxa in bats. *Journal of Mammalogy*, **92 (2):** 421 - 432. doi: 10.1644/09-MAMM-A-415.1.

Francis, C. M. and J. Habersetzer (1998). *Interspecific and Intraspecific Variation in echolocation call frequency and morphology of Horseshoe Bats, Rhinolophus and Hipposideros.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 169 - 179.

Francis, C. M. and J. E. Hill (1998). New records and a new species of *Myotis* (Chiroptera, Vespertilionidae) from Malaysia. *Mammalia*, **62 (2):** 241 - 252. [Abstract]

Francis, C. M., D. Kock and J. Habersetzer (1999). Sibling species of *Hipposideros ridleyi* (Mammalia, Chiroptera, Hipposideridae). *Senckenbergiana biologica*, **79 (2):** 255 - 270.

Franco, A. and M. Rodrigues de los Santos (2001). *Libro Rojo de los Vertebrados Amenazados de Andalucia.* Consejería de Medio Ambiente, Junta de Andalucía.

Frank, R., T. Kuhn, A. Werblow, A. Liston, J. Kochmann and S. Klimpel (2015). Parasite diversity of European *Myotis* species with special emphasis on *Myotis myotis* (Microchiroptera, Vespertilionidae) from a typical nursery roost. *Parasites & Vectors*, **8:** 101. doi: 10.1186/s13071-015-0707-7.

Fraser (1843). A new species of bat, belonging to the genus *Rhinolophus*, and four new species of birds from Western Africa. *Proceedings of the Zoological Society of London*, **XI (cxxi):** 25 - 27.

Frauenfeld, G. (1856). Ueber eine neue Fliegengattung: *Raymondia*, aus der Familie der Coriaceen, nebst Beschreibung zweier Arten derselben. *Sitzungsberichte der Königlichen Akademie für Wissenschaften aus Wien, mathematisch naturwissenschaftliche Klasse*, **18:** 320 - 333.

Frechkop, S. (1938). *Exploration du Parc National Albert. Mission G. F. De Witte (1933 - 1935). Fascicule 10. Mammifères.* Institut des Parcs Nationaux du Congo Belge, Brussels: 1 - 103.

Frechkop, S. (1943). Exploration du Parc National Albert. Mission S. Frechkop (1937-1938). Fascicule I. Mammifères. *Instituut der Nationale Parken van Belgisch Kongo*186 pp.

Frechkop, S. (1944). Exporation du Parc National de la Kagera. Mission S. Frechkop 1938. Exploratie van het National Park der Kagera: zending S. Frechkop (1938). Fasc. 1, Mammifères. *Instituut der Nationale Parken van Belgisch Kongo*1 - 56, 3 pls 3 figs.

Frechkop, S. (1954). *Exploration du Parc National de l'Upemba. Mission G. F. De Witte en collaboration avec W. Adam, A. Janssens, L Van Meel et R. Verheyen (1946 - 1949). Fascicule 14. Mammifères.* Institut des Parcs Nationaux du Congo Belge. Instituut der Nationale Parken van Belgisch Congo, Brussels: 1 - 39.

Freeman, P. W. (1979). Specialized insectivory: beetle-eating and moth-eating molossid bats. *Journal of Mammalogy*, **60 (3):** 467 - 479. doi: 10.2307/1380088. [Abstract]

Freeman, P. W. (1981a). Correspondence of food habits and morphology in insectivorous bats. *Journal of Mammalogy*, **62 (1):** 166 - 173.

Freeman, P. W. (1981b). A multivariate study of the family Molossidae (Mammalia, Chiroptera) morphology, ecology, evolution. *Fieldiana: zoology*, **n.s. 7:** i - viii; 1 - 173. doi: 10.5962/bhl.title.3128. [Abstract]

Freeman, P. W. (1984). Functional cranial analysis of large animalivorous bats (Microchiroptera). *Biological Journal of the Linnean Society*, **21:** 387 - 408. [Abstract]

Freeman, P. W. (1988). Frugivorous and animalivorous bats (Microchiroptera): dental and cranial adaptations. *Biological Journal of the Linnean Society*, **33:** 249 - 272. [Abstract]

Freeman, P. W. (1992). Canine teeth of bats (Microchiroptera): size, shape and role in crak propagation. *Biological Journal of the Linnean Society*, **45:** 97 - 115, 7 figs. [Abstract]

Freeman, P. W. (1995). Nectarivorous feeding mechanisms in bats. *Biological Journal of the Linnean Society*, **56 (3):** 439 - 463. doi: 10.1006/bijl.1995.0080. [Abstract]

Freeman, P. W. (1998). *Form, Function, and Evolution in Skulls and Teeth of Bats.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 140 - 156.

Freeman, P. W. (2000). Macroevolution in Microchiroptera: Recoupling morphology and ecology with phylogeny. *Evolutionary Ecology Research*, **2:** 317 - 335.

Freeman, P. W. and C. A. Lemen (1992). *Morphometrics of the family Emballonuridae.* In Griffiths, T. A. and D. Klingerer : *Contributions to Mammalogy in honor of Karl F. Koopman. Bulletin of the American Museum of Natural History*54 - 61. [Abstract]

Freeman, P. W. and W. N. Weins (1997). Pucturing ability of bat canine teeth: The tip. In Yates, T. L., W. L Gannon and D. E. Wilson : *Life among the muses: papers in honor of James S. Findley. Special Publication The Museum of Southwestern Biology*, **3:** 225 - 232. [Abstract]

Freidl, G. S., T. Binger, M. A. Müller, E. De Bruin, J. Van Beek, V. M. Corman, A. Rasche, J. F. Drexler, A. Sylverken, A. K. Oppong, Y. Adu-Sarkodie, M. Tschapka, V. M. Cottontail, C. Drosten and M. Koopmans (2015). Serological evidence of influenza a viruses in frugivorous bats from Africa. *PLoS ONE*, **10 (5):** e0127035. doi: 10.1371/journal.pone.0127035.

Freitas, T. R. O., M. R. Bogo and A. U. Christoff (1992). G-, C-bands and NOR studies in two species of bats from Southern Brazil (Chiroptera: Vespertilionidae, Molossidae). *Zeitschrift für Säugetierkunde*, **57:** 330 - 334. [Abstract]
Freuling, C. M., T. Binger, M. Beer, Y. Adu-Sarkodie, J. Schatz, M. Fischer, D. Hanke, B. Hoffmann, D. Höper, T. C. Mettenleiter, S. K. Oppong, C. Drosten and T. Müller (2015). Lagos bat virus transmission in an *Eidolon helvum* bat colony, Ghana. *Virus Research*, **210:** 42 - 45. doi: 10.1016/j.virusres.2015.07.009.
Friant, M. (1951). La dentition temporaire, dite lacteale, de la Rousette (*Rousettus leachi* A. Sm.), Chiroptère frugivore. *Académie des Sciences*890 - 892. [Abstract]
Friant, S., S. B. Paige and T. L. Goldberg (2015). Drivers of bushmeat hunting and perceptions of zoonoses in Nigerian hunting communities. *PLoS Neglected Tropical Diseases*, **9 (5):** e0003792. doi: 10.1371/journal.pntd.0003792.
Friedmann, Y. and B. Daly (2004). *Red Data Book of the Mammals of South Africa: A Conservation Assessment.* In Friedmann, Y. and B. Daly CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. - South Africa.
Fröbisch, J. and R. R. Reisz (2009). The Late Permian herbivore *Suminia* and the early evolution of arboreality in terrestrial vertebrate ecosystems. *Proceedings of the Royal Society of London*, **B 276 (1673):** 3611 - 3618. doi: 10.1098/rspb.2009.0911.
Frost, D. R. and R. M. Timm (1992). Phylogeny of Plecotine Bats (Chiroptera:"Vespertilionidae"): Summary of the evidence and proposal of a logically consistent taxonomy. *American Museum Novitates*, **3034:** 1 - 16, 4 figs. [Abstract]
Fujii, H., S. Watanabe, D. Yamane, N. Ueda, K. Iha, S. Taniguchi, K. Kato, Y. Tohya, S. Kyuwa, Y. Yoshikawa and H. Akashi (2010). Functional analysis of *Rousettus aegyptiacus* "signal transducer and activator of transcription 1" (STAT1). *Developmental and Comparative Immunology*, **34:** 598 - 602. doi: 10.1016/j.dci.2010.01.004.
Fujita, M. S. and T. H. Kunz (1984). *Pipistrellus subflavus*. *Mammalian Species*, **228:** 1 - 6, 3 figs.
Fukui, D., T. Hirao, M. Murakami and H. Hirakawa (2011). Effects of treefall gaps created by windthrow on bat assemblages in a temperate forest. *Forest Ecology and Management*, **261(9):** 1546 - 1552. doi: 10.1016/j.foreco.2011.02.001.
Funaioli, U. (1959). I mammiferi della Somalia. Cenni al loro intreesse nell'economia del Paese. Primo elenco. *Rivista di agricoltura subtropicale e tropicale*, **53 (4-6):** 176 - 196. [Abstract]
Funaioli, U. (1971). *Guida breve dei mammiferi della Somalia.* Inst. Agron. Oltr.
Funaioli, U. and B. Lanza (1968). On some bats from Somalia. *Monitore zoologico italiana*, **(n.s.) 2 (suppl.):** 199 - 202. [Abstract]
Funaioli, U. and A. M. Simonetta (1966). The mammalian fauna of the Somali Republic: Status and conservation problems. *Monitore zoologico italiana*, **(suppl.), 74:** 285 - 347. [Abstract]
Funakoshi, K., A. Zubaid and S. Matsumura (1995). Regular pulse emission in some megachiropteran bats. *Zoological Science*, **12 (4):** 503 - 505. [Abstract]
Funk, S. and P. Piot (2014). Mapping Ebola in wild animals for better disease control. Identifying the regions where wild animal populations could transmit the Ebola virus should help with efforts to prepare at-risk areas for future outbreaks. *eLife*, **3:** e04565. doi: 10.7554/eLife.04565.
Funmilayo, O. (1976a). Diet and roosting damage and environmental pollution by the straw-coloured fruit-bat in south-western Nigeria. *The Nigerian Field*, **41:** 136 - 142.
Funmilayo, O. (1976b). Fruit bats for meat: are too many taken?. *Oryx*, **14:** 377 - 378.
Funmilayo, O. (1979). Ecology of the straw-coloured fruit bat in Nigeria. *Revue de zoologie africaine*, **93:** 589 - 600.
Funmilayo, O. (1980). *Mammals and birds affecting food production and storage in Nigeria.* Proceedings of the 9th Vertebrate Pest Conference; paper 13: 97 - 100. URL: http://digitalcommons.unl.edu/vpc9/13.
Furman, A., T. Öztunç and E. Çoraman (2010). On the phylogeny of *Miniopterus schreibersii schreibersii* and *Miniopterus schreibersii pallidus* from Asia Minor in reference to other *Miniopterus* taxa (Chiroptera: Vespertilionidae). *Acta Chiropterologica*, **12 (1):** 61 - 72.
Gaisler, J. (1970). The bats (Chiroptera) collected in Afghanistan by the Czechoslovak expeditions of 1965-1967. *Acta scientiarum naturalium Academiae scientiarum Bohemicae - Brno*, **4 (6):** 1 - 56. [Abstract]
Gaisler, J. (1983). Nouvelles données sur les Chiroptères du nord algérien. *Mammalia*, **47 (3):** 359 - 369. [Abstract]
Gaisler, J. (1984). Bats of northern Algeria and their winter activity. *Myotis*, **21 - 22 (for 1983-1984):** 89 - 95. [Abstract]
Gaisler, J. (2001). *Rhinolophus euryale Blasius, 1853 - Mittelmeerhufeisennase.* In Niethammer, J. and F. Krapp [Eds]: *Handbuch der Säugetiere Europas. Band 4: Fledertiere. Teil I: Chiroptera I, Rhinolophidae, Vespertilionidae 1.* Aula Verlag, Wiebelsheim. 59 - 74.
Gaisler, J. (2013a). *Rhinolophus euryale Mediterranean Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 325 - 326.
Gaisler, J. (2013b). *Rhinolophus ferrumequinum Greater Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 327 - 328.
Gaisler, J. (2013c). *Rhinolophus hipposideros Lesser Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 338 - 340.
Gaisler, J. (2013d). *Rhinolophus mehelyi Méhely's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 345 - 346.
Gaisler, J. and K. Kowalski (1986). Results of the netting of bats in Algeria (Mammalia: Chiroptera). *Vestnik ceskoslovenské Spolecnosti zoologické*, **50:** 161 - 173. [Abstract]
Gaisler, J., G. Madkour and J. Pelikán (1972). On the bats (Chiroptera) of Egypt. *Acta scientiarum naturalium Academiae scientiarum Bohemicae - Brno*, **6 (8):** 1 - 40. [Abstract]
Gale, P. (2017). Could bat cell temperature and filovirus filament length explain the emergence of Ebola virus in mammals? Predictions of a thermodynamic model. *Transboundary and Emerging Diseases*, **64 (6):** 1676 - 1693. doi: 10.1111/tbed.12580.
Gallagher, M. D. and D. L. Harrison (1977). Report on the bats (Chiroptera) obtained by the Zaire River Expedition. *Bonner zoologische Beitrage*, **28 (1-2):** 19 - 32.
Gallagher, M. D. and D. L. Harrison (1988). The small mammals of the Wahiba Sands, Oman. *Journal of Oman Studies Special Report*, **3:** 437 - 442. [Abstract]
Garbutt, N. (1999). *Mammals of Madagascar.* Pica Press - Sussex.
García-Mudarra, J. L., C. Ibañez and J. Juste (2009). The Straits of Gibraltar: barrier or bridge to Ibero-Moroccan bat diversity? *Biological Journal of the Linnean Society*, **96 (2):** 434 - 450. doi: 10.1111/j.1095-8312.2008.01128.x.
García-Pérez, R., M. Gottschling, G. Wibbelt and I. G. Bravo (2013). Multiple evolutionary origins of bat papillomaviruses. *Veterinary Microbiology*, **165 (1-2):** 51 - 60. doi: 10.1016/j.vetmic.2013.01.009.

García-Pérez, R., C. Ibáñez, J. M. Godínez, N. Aréchiga, I. Garin, G. Pérez-Suárez, O. de Paz, J. Juste, J. E. Echevarría and I. G. Bravo (2014). Novel papillomaviruses in free-ranging Iberian bats: No virus-host co-evolution, no strict host specificity, and hints for recombination. *Genome Biology and Evolution*, **6 (1):** 94 - 104. doi: 10.1093/gbe/evt211.
Gardiner, J. D., J. D. Altringham, E. Papadatou and R. L. Nudds (2014). Excepting *Myotis capaccinii*, the wings' contribution to take-off performance does not correlate with foraging ecology in six species of insectivorous bat. *Biology Open*, **3 (11):** 1057 - 1062.
Gardiner, J. D. and R. L. Nudds (2011). No apparent ecological trend to the flight-initiating jump performance of five bat species. *Journal of experimental biology*214 (13). 2182 - 2188. doi: 10.1242/jeb.055871.
Gardner, A., M. S. Thompson, D. Fontenot, N. Gibson and D. J. Heard (2007). Radiographic evaluation of cardiac size in flying fox species (*Pteropus rodricensis, P. hypomelanus*, and *P. vampyrus*). *Journal of Zoo and Wildlife Medicine*, **38 (2):** 192 - 200. doi: 10.1638/1042-7260(2007)038[0192:REOCSI]2.0.CO;2.
Gardner, A. L. (2005). The gender of genus-group names ending in either *-otis* or *-otus*. *Bulletin of Zoological Nomenclature*, **62 (3):** 183 - 184.
Gardner, A. L. and V. Hayssen (2004). A guide to constructing and understanding synonymies for Mammalian Species. *Mammalian Species*, **739:** 1 - 17.
Garg, B. L. (1955). Significance of the orbito-temporal region in the skull of the small bats of Ajmer. *Current Science, Madras*, **24 (2):** 55 - 56.
Garnham, P. C. C. (1973). The zoogeography of *Polychromophilus* and description of a new species of a Gregarine (*Lankesteria galliardi*). *Annales de Parasitologie humaine et comparée*, **48 (2):** 231 - 242.
Garnham, P. C. C. and R. B. Heisch (1953). On a new blood parasite of insectivorous bats. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **47 (5):** 357 - 363. [Abstract]
Gatome, C. W., D. K. Mwangi, H.-P. Lipp and I. Amrein (2010a). Hippocampal neurogenesis and cortical cellular plasticity in Wahlberg's epauletted fruit bat: A qualitative and quantitative study. *Brain; Behavior and Evolution*, **76 (2):** 116 - 127. doi: 10.1159/000320210.
Gatome, C. W., L. Slomianka, D. K. Mwangi, H.-P. Lipp and I. Amrein (2010b). The entorhinal cortex of the Megachiroptera: A comparative study of Wahlberg's epauletted fruit bat and the straw-coloured fruit bat. *Brain Structure and Function*, **214 (4):** 375 - 393.
Gaucher, P. (1992). New records of an Epauleted fruit bat *Epomophorus labiatus* Temminck, 1837 (Mammalia: Chiroptera: Pteropodidae) in Saudi Arabia. *Mammalia*, **56 (4):** 657 - 659.
Gaucher, P. (1993). First record of *Scotophilus leucogaster* (Cretzschmar, 1826) (Mammalia: Chiroptera: Verspertilionidae) in Saudi Arabia. *Mammalia*, **57 (1):** 146 - 147.
Gaucher, P. and A. Brosset (1990). Record of *Hipposideros* (*Syndesmotis*) *megalotis* (Heuglin) in Saudi Arabia. *Mammalia*, **54 (4):** 653 - 654.
Gaudry, M. J., J. F. Storz, G. T. Butts, K. L. Campbell and F. G. Hoffmann (2014). Repeated evolution of chimeric fusion genes in the ß-globin gene family of Laurasiatherian Mammals. *Genome Biology and Evolution*, **6 (5):** 1219 - 1233. doi: 10.1093/gbe/evu097.
Gautier-Hion, A. and M. Colyn (2000). Rapport final de synthèse - ECOFAC II - Termes de référence Biodiversité animale et Ecologie. Projet ECOFAC - Rennes, France: 34 pp.
Gautier-Hion, A. and G. Michaloud (1989). Are figs always keystone resources for tropical frugivorous vertebrates? A test in Gabon. *Ecology*, **70 (6):** 1826 - 1833. [Abstract]
Gbogbo, F. and M. O. Kyei (2017). Knowledge, perceptions and attitude of a community living around a colony of straw-coloured fruit bats (*Eidolon helvum*) in Ghana after Ebola virus disease outbreak in West Africa. *Zoonoses and Public Health*, **64 (8):** 628 - 635. doi: 10.1111/zph.12357.
Gebhard, J. and W. Bogdanowicz (2004). *Nyctalus noctula (Schreber, 1774) - Großer Abensegler.* In Krapp, F. : *Handbuch der S„ugetiere Europas.* : 607 - 694.
Geider, M. and D. Kock (1991). Kleinsäuger im Nebelwaldgebiet des Forêt de Nyungwe, Rwanda. *Natur und Museum - Bericht der Senckenbergische naturforschenden Gesellschaft*, **121 (7):** 210 - 216.
Geldenhuys, C. J., C. Ham and H. Ham [Eds] (2011). *Sustainable forest management in Africa: Some Solutions to Natural Forest Management Problems in Africa.* Proceedings of the Sustainable Forest Management in Africa Symposium. Stellenbosch, 3 - 7 November 2008: i - xi; 1 - 537. URL: http://scholar.sun.ac.za/handle/10019.1/17385.
Geldenhuys, M., M. Mortlock, J. Weyer, O. Bezuidt, E. C. J. Seamark, T. Kearney, C. Gleasner, T. H. Erkkila, H. Cui and W. Markotter (2018). A metagenomic viral discovery approach identifies potential zoonotic and novel mammalian viruses in *Neoromicia* bats within South Africa. *PLoS ONE*, **13 (3):** e0194527. doi: 10.1371/journal.pone.0194527.
Geldenhuys, M., J. Weyer, L. H. Nel and W. Markotter (2013). Coronaviruses in South African bats. *Vector-Borne and Zoonotic Diseases*, **13 (7):** 516 - 519. doi: 10.1089/vbz.2012.1101.
Gelderblom, C. M., G. N. Bronner, A. T. Lombard and P. J. Taylor (1995). Patterns of distribution and current protection status of the Carnivora, Chiroptera and Insectivora in South Africa. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **30 (3):** 103 - 114. [Abstract]
Gembu, T/G.-C., A. Bapeamoni, K. Kaswera, A. Upoki and A. Dudu (2011). *Wild fauna and forest management in D.R. Congo: Bats, Birds and Elephant Shrews in Yoko Forest Reserve.* Proceedings of the Sustainable Forest Management in Africa Symposium. Stellenbosch, 3 - 7 November 2008: 111 - 117. URL: http://scholar.sun.ac.za/handle/10019.1/17385.
Gembu Tungaluna, G.-C. (2012). Peuplement et dynamique alimentaire des chiroptères frugivores (Mammalia) de la Réserve Forestière de Yoko (province Orientale, R.D.Congo). PhD Thesis - University of Kisangani, DRC: i - xi; 1 - 172;.
Gembu Tungaluna, G.-C., V. Van Cakenberghe, P. Musaba Akawa, B. Dudu Akaibe, E. Verheyen, F. De Vree and J. Fahr (2013). Rediscovery of *Glauconycteris superba* Hayman, 1939 (Chiroptera: Vespertilionidae) after 40 years at Mbiye Island, Democratic Republic of the Congo. *European Journal of Taxonomy*, **42:** 1 - 18. doi: 10.5852/ejt.2013.42.
Genov, T., R. Stoykova-Hajinikolova and R. Mészáros (1992). *Molinostrongylus* spp. (Nematoda: Molineidae) from bats in Bulgaria, with a review of European species. *Parasitologia Hungarica*, **25:** 53 - 68. [Abstract]
Genoways, H. H. and J. R. Baker (1972). *Stenoderma rufum. Mammalian Species*, **18:** 1 - 4, 4 figs.
Genoways, H. H., R. D. Bradley, D. J. Schmidly, L. C. Bradley, J. J. Bull, K. McBee, M. Hamilton and P. A. Larsen (2018). Obituary Robert James Baker (1942 - 2018). *Journal of Mammalogy*, **99 (4):** 983 - 1012. doi: 10.1093/jmammal/gyy072.
Genoways, H. H. and D. A. Schlitter (1981). Collections of recent mammals of the world, exclusive of Canada and the United States. *Annals of Carnegie Museum*, **50 (3):** 47 - 80.
Genoways, H. H. and D. A. Schlitter (1985). Survey of the recent mammal collections of the world. *Acta zoologica Fennica*, **170:** 41 - 42. [Abstract]
Geoffroy Saint-Hilaire, E. (1803). *Catalogue des Mammifères du muséum national d'histoire naturelle, Paris.* 272 pp.

Geoffroy Saint-Hilaire, E. (1806). Mémoire sur le genre et les espèces de Vespertilion, l'un des genres de la famille des Chauves-souris. *Annales du Musée d'Histoire naturelle de Paris*, **8:** 187 - 205; pls. 46 - 48.
Geoffroy Saint-Hilaire, E. (1810a). Description des Roussettes et des Cephalotes, deux nouveaux genres de la famille des Chauve-souris. *Annales du Musée d'Histoire naturelle de Paris*, **15:** 86 - 108.
Geoffroy Saint-Hilaire, E. (1810b). Addition au memoire sur le genre et les especes de vespertilions. *Annales du Musée d'Histoire naturelle de Paris*, **15:** 109.
Geoffroy Saint-Hilaire, E. (1810c). Sur les Phyllostomes et les Megadermes, deux genres de la famille des Chauve-souris. *Annales du Musée d'Histoire naturelle de Paris*, **15:** 157 - 198.
Geoffroy Saint-Hilaire, E. (1813a). De l'organisation et de la détermination des Nyctères, une des familles de Chauves-souris. *Annales du Musée d'Histoire naturelle de Paris*, **20:** 11 - 20.
Geoffroy Saint-Hilaire, E. (1813b). Sur un genre des chauves-souris, sous le nom de Rhinolophes. *Annales du Musée d'Histoire naturelle de Paris*, **20:** 254 - 266.
Geoffroy Saint-Hilaire, E. (1813c). *Déscription de l'Egypte ou recueil des observations et des recherches qui ont été faites en Egypte pendant l'expédition de l'Armee française.* Histoire naturelle. Tome Second - Paris.
Geoffroy Saint-Hilaire, E. (1818). *Description des Mammifères qui se trouve en Egypte.* France-commission de l'Egypte. Description de l'Egypte. Histoire naturelle. Tome Second - Paris.
Geoffroy-Saint-Hilaire, E. (1826). Notice sur M. le comte de Lacépède. *Mémoire du Muséum d'Histoire Naturelle, Paris*, **13:** 77 - 81 (for 1825).
Geoffroy Saint-Hilaire, I. (1831). ?? Title still needs to be checked. ?? .
Georgiakakis, P. and D. Russo (2012). The distinctive structure of social calls by Hanák's dwarf bat *Pipistrellus hanaki*. *Acta Chiropterologica*, **14 (1):** 167 - 174. doi: 10.3161/150811012X654385.
Geraads, D., J.-P. Rayal and F.-Z. Sbihi-Alaoui (2010). Mammalian faunas from the Pliocene and Pleistocene of Casablanca (Morocco). *Historical Biology*, **22:** 275 - 285. doi: 10.1080/08912960903458011.
Gereau, R. E., N. Cumberlidge, C. Hemp, A. Hochkirch, T. Jones, M. Kariuki, C. N. Lange, S. P. Loader, P. K. Malonza, M. Menegon, P. K. Ndang'ang'a, F. Rovero and P. Shirk (2016). Globally threatened biodiversity of the Eastern Arc Mountains and Coastal Forests of Kenya and Tanzania. *Journal of East African Natural History*, **105 (1):** 115 - 201. doi: 10.2982/028.105.0104.
Gerell, R. (1999). *Myotis mystacinus.* In Mitchell-Jones, A J., G. Amori, W. Bogdanowicz, B. Kryštufek, P. J. H. Reijnders, F. Spitzenberger, M. Stubbe, J. B. M. Thissen, V. Vohralík and J. Zima : *The Atlas of European Mammals*. Academic Press, London, UK.
Gerell, R. and K. Lundberg (1985). Social organization in the bat *Pipistrellus pipistrellus*. *Behavioral ecology and sociobiology*, **16 (2):** 177 - 184. [Abstract]
Gerlach, J. (1993). The conservation of Silhouette Island, Seychelles. II. Animals. *Phelsuma*, **1:** 30 - 38. URL: http://islandbiodiversity.com/Phelsuma%201-2.pdf. [Abstract]
Gerlach, J. (2003). Sea-skimming by Seychelles fruit bats. *Phelsuma*, **11:** 79 - 80. URL: http://islandbiodiversity.com/Phelsuma%2011-15.pdf.
Gerlach, J. (2004). The bats of Silhouette Island, Seychelles. *Phelsuma*, **12:** 78 - 90. URL: http://islandbiodiversity.com/Phelsuma%2012-4.pdf.
Gerlach, J. (2008). Conservation of the Seychelles sheath-tailed bat *Coleura seychellensis* on Silhouette Island, Seychelles. *Endangered Species Research*, **8:** 5 - 13 (for 2009). doi: 10.3354/esr00151. URL: http://www.int-res.com/articles/esr2009/8/n008p005.pdf.
Gerlach, J. (2009a). Vocalisations of the Seychelles sheath-tailed bat *Coleura seychellensis*. *Le Rhinolophe*, **18:** 17 - 24. URL: http://islandbiodiversity.com/Rhinolophe%202009%20calls.pdf.
Gerlach, J. (2009b). Social vocalisations in the Seychelles sheath-tailed bat *Coleura seychellensis*. *Le Rhinolophe*, **18:** 25 - 30. URL: http://islandbiodiversity.com/Rhinolophe%202009%20social%20calls.pdf.
Gerlach, J. (2011). Conservation of the Seychelles sheath-tailed bat *Coleura seychellensis* from 1997 - 2011 and future prospects. *Phelsuma*, **19:** 54 - 68. URL: http://islandbiodiversity.com/Phelsuma%2019e.pdf.
Gerlach, J., S. Mickleburgh, A. M. Hutson and W. Bergmans (2008). *Coleura seychellensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Gerlach, J. and M. Taylor (2006). Habitat use, roost characteristics and diet of the Seychelles sheath-tailed bat *Coleura seychellensis*. *Acta Chiropterologica*, **8 (1):** 129 - 139.
Germain, M. (1978). *Collection of mammals and arthropods during the epidemic of Haemorrhagic Fever in Zaire.* In Pattyn, S. R. [Ed]: *Ebola Virus Haemorrhagic Fever.* Elsevier / North-Holland Biomedical Press - Amsterdam: 131 - 133.
Gervais, P. (1836). *Dictionnaire pittoresque d'Histiore naturelle.* .
Gervais, P. (1849). *Dictionnaire universale d'Histiore naturelle.* .
Gervais, P. (1854). *Histoire Naturelle des mammifères.* .
Gervais, P. (1855). *Mammifères.* In De Castelnau, F. : *Animaux nouveaux ou rares. Recueillis pendant l'expédition dans les parties centrales de l'Amérique du Sud, de Rio de Janeiro à Lima, et de Lima au Para; exécutée par ordre du gouvernment Français pendant les années 1843 à 1847.* Zool. (Sec. 7), Vol. 1, pt. 2 (Mammifères): 1 - 116.
Geva, M., Y. Yovel and N. Ulanovsky (2010). Signal design of the sonar clicks of *Rousettus aegyptiacus*. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 147 - 148.
Geva-Sagiv, M., L. Las, Y. Yovel and N. Ulanovsky (2015). Spatial cognition in bats and rats: from sensory acquisition to multiscale maps and navigation. *Nature Reviews Neuroscience*, **16 (2):** 94 - 108. doi: 10.1038/nrn3888.
Geva-Sagiv, M., S. Weiss, L. Las and N. Ulanovsky (2014). Switching between sensory modalities and flight directions alters 3-D spatial codes in bat hippocampus. *Journal of Molecular Neuroscience*, **53 (Suppl 1):** S51. doi: 10.1007/s12031-014-0252-4.
Geyr von Schweppenburg, H. (1917). Ins Land der Tuareg. *Journal of Ornithology*, **65 (3):** 241 - 314.
Gharaibeh, B. M. (1997). Systematics, distribution, and zoogeography of mammals of Tunisia. PhD dissertation. Texas Tech University: i - xv; 1 - 354. URL: http://etd.lib.ttu.edu/theses/available/etd-10272008-31295012500426/unrestricted/31295012500426.pdf. [Abstract]
Gharaibeh, B. M. and M. B. Qumsiyeh (1995). *Otonycteris hemprichii*. *Mammalian Species*, **514:** 1 - 4, 3 figs.
Ghazali, M., R. Moratelli and I. Dzeverin (2016). Ecomorph evolution in *Myotis* (Vespertilionidae, Chiroptera). *Journal of Mammalian Evolution*, **24 (4):** 475 - 484 (for 2017). doi: 10.1007/s10914-016-9351-z.
Ghosh, M. K. (2005). Catalogue of Chiroptera in the collection of the Zoological Survey of India, Part I: Megachiroptera. *Records of the zoological Survey of India*, **Occasional Papers 232:** 1 - 143.

Ghosh, M. K. (2008). Catalogue of Chiroptera in the collection of Zoological Survey of India (Part-II: Microchiroptera). *Records of the zoological Survey of India*, **Occasional Papers, 281:** 1 - 339.
Giannini, N. P., F. Cunha Almeida and N. B. Simmons (2009). Chapter 6. Phylogenetic relationships of Harpyionycterine Megabats (Chiroptera: Pteropodidae). In Voss, R.S. and M.D. Carleton : *Systematic Mammalogy*. *Contributions in honor of Guy G. Musser. Bulletin of the American Museum of Natural History*, **331:** 183 - 204.
Giannini, N. P. and N. B. Simmons (2003). A phylogeny of megachiropteran bats (Mammalia: Chiroptera: Pteropodidae) based on direct optimization analysis of one nuclear and four mitochondrial genes. *Cladistics: the International Journal of the Willi Henning Society*, **19 (6):** 496 - 511. doi: 10.1016/j.cladistics.2003.09.002.
Giannini, N. P. and N. B. Simmons (2004a). Megachiropteran phylogeny: solving apparent conflict between molecular and morphological data. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 10.
Giannini, N. P. and N. B. Simmons (2004b). Higher-level phylogeny of Chiroptera based on direct optimization of ten genes. *Bat Research News*, **45 (4):** 221 - 222.
Giannini, N. P. and N. B. Simmons (2005). Conflict and congruence in a combined DNA-morphology analysis of megachiropteran bat relationships (Mammalia: Chiroptera: Pteropodidae). *Cladistics: the International Journal of the Willi Henning Society*, **21 (5):** 411 - 437.
Giannini, N. P., J. R. Wible and N. B. Simmons (2004). Cranial osteology of *Pteropus*. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 6.
Giannini, N. P., J. R. Wible and N. B. Simmons (2006). On the cranial osteology of Chiroptera. I. Pteropus (Megachiroptera: Pteropodidae). *Bulletin of the American Museum of Natural History*, **295:** 134 pp, 50 figs.
Giebel, C. G. (1855). *Die Säugethiere in Zoologischer, anatomischer und palaeontologischer Beziehung umfassend dargestellt.* Verlag Von Ambrosius Abel, Leipzig: 923 - 1006.
Giglioli, E. H. (1888). Note intorno agli animali vertebrati raccolti dal Conte Augusto Boutourline e dal Dr. Leopoldo Traversi ad Assab e nello Scioa negli anni 1884-87. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 6 (O.S. 26):** 5 - 73. [Abstract]
Gill, T. (1872). Arrangement of the families of mammals with analytical tables. *Smithsonian Miscellaneous Collection*, **11 (1):** i - vi; 1 - 98.
Gilson, R. (1979). Observations sur les cheiroptères de la carrière Koegat (Zichen-Commune de Riemst - Province du Limbourg). *Bulletin - Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*213 - 246.
Ginther, O. J. (1967). Local utero-ovarian relationships. *Journal of Animal Science*, **26 (3):** 578 - 585. URL: http://jas.fass.org/content/26/3/578.full.pdf+html.
Gippoliti, S. (2006). Oscar de Beaux: a noteworthy Italian mammalogist and conservationist. *Italian Journal of Zoology*, **73 (3):** 285 - 289. doi: 10.1080/11250000600821361.
Giribet, G., B. L. de Bivort, A. Hitchcock and P. Swart (2013). On *Speleosiro argasiformis* - a troglobitic Cyphophthalmi (Arachnida: Opiliones: Pettalidae) from Table Mountain, South Africa. *Journal of Arachnology*, **41 (3):** 416 - 419. doi: 10.1636/Ha12-78.1.
Glare P. G. W. (1992). *Oxford Latin dictionary*. Clarendon Press, Oxford: xxiv + 2126 pp.
Glass, B. P. (1965). The mammals of eastern Ethiopia. *Zoologica Africana*, **1 (1):** 177 - 179.
Göbbel, L. (2000). The external nasal cartilages in Chiroptera: significance for intraordinal relationships. *Journal of Mammalian Evolution*, **7 (3):** 167 - 201.
Göbbel, L. (2001). Morphology of the external nose in *Hipposideros diadema* and *Lavia frons* with comments on its diversity and evolution among leaf-nosed Microchiroptera. *Cells Tissues Organs*, **170 (for 2002):** 39 - 60.
Göbbel, L. (2002). Ontogenetic and phylogenetic transformations of the lacrimal-conducting apparatus among Microchiroptera. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **67 (6):** 338 - 357. doi: 10.1078/1616-5047-00050.
Godawa-Stormark, J. (1998). Phenetic analysis of Old World *Myotis* (Chiroptera: Vespertilionidae) based on dental characters. *Acta Theriologica*, **43 (1):** 1 - 11. [Abstract]
Goff, M. L. (1982). Two new species of chiggers (Acari: Trombiculidae) from East African bats (Chiroptera). *Journal of medical entomology*, **19 (4):** 376 - 379. [Abstract]
Gogolevsky, K. P., N. S. Vassetzky and D. A. Kramerov (2009). 5S rRNA-derived and tRNA-derived SINEs in fruit bats. *Genomics*, **93:** 494 - 500. doi: 10.1016/j.ygeno.2009.02.001.
Goiti, U., J. R. Aihartza, D. Almenar, E. Salsamendi and I. Garin (2006). Seasonal foraging by *Rhinolophus euryale* (Rhinolophidae) in an Atlantic rural landscape in northern Iberian Peninsula. *Acta Chiropterologica*, **8 (1):** 141 - 155. doi: 10.3161/1733-5329(2006)8[141:SFBRER]2.0.CO;2.
Goiti, U., J. (R.) Aihartza, M. Guiu, E. Salsamendi, D. Almenar, M. Napal and I. Garin (2011). Geoffroy's bat, *Myotis emarginatus*, preys preferentially on spiders in multistratified dense habitats: a study of foraging bats in the Mediterranean. *Folia zoologica: International journal of vertebratology*, **60 (1):** 14 - 24.
Goiti, U., I. Garin, D. Almenar, E. Salsamendi and J. (R.) Aihartza (2008). Foraging by Mediterranean horseshoe bats (*Rhinolophus euryale*) in relation to prey distribution and edge habitat. *Journal of Mammalogy*, **89 (2):** 493 - 502. doi: 10.1644/07-MAMM-A-054R2.1.
Goldberg, T. L., A. J. Bennett, R. Kityo, J. H. Kuhn and C. A. Chapman (2017). Kanyawara virus: a novel Rhabdovirus infecting newly discovered nycteribiid bat flies infesting previously unknown pteropodid bats in Uganda. *Scientific Reports*, **7:** 5287. doi: 10.1038/s41598-017-05236-w.
Golden, C. D. (2005). Eaten to endangerment: mammal hunting and the bushmeat trade in Madagascar's Makira Forest. Unpublished thesis. Harvard College. 131 pp.
Golden, C. D. and J. Comaroff (2015). The human health and conservation relevance of food taboos in northeastern Madagascar. *Ecology and Society*, **20 (2):** 42. doi: 10.5751/ES-07590-200242.
Goldstein, T., S. J. Anthony, A. Gbakima, B. (H.), Bangura, J. Bird, A. Tremeau-Bravard, M. (N.), Wells, H. (L.), Dhanota, J. (K.), Liang, E. Belaganahalli, M. Grodus, R. (K.), Dejesus, V. (A.), Lasso, G. Jangra, B. (R.), Jambai, A. Smith, B. (O.), Kamara, S. Kamara, W. Bangura, C. Monagin, S. Shapira, C. Kreuder Johnson, K. Saylors, E. (M.), Chandran, K. Rubin, W. I. Lipkin and J. (A. K.) Mazet (2019). The discovery of a new Ebolavirus, Bombali virus, adds further support for bats as hosts of Ebolaviruses. *International Journal of Infectious Diseases*, **79 (S1):** 4 - 5. doi: 10.1016/j.ijid.2018.11.030.
Goldstein, T., S. J. Anthony, A. Gbakima, B. H. Bird, J. Bangura, A. Tremeau-Bravard, M. N. Belaganahalli, H. L. Wells, J. K. Dhanota, E. Liang, M. Grodus, R. K. Jangra, V. A. DeJesus, G. Lasso, B. R. Smith, A. Jambai, B. O. Kamara, S. Kamara, W. Bangura, C. Monagin, S. Shapira, C. K. Johnson, K. Saylors, E. M. Rubin, K. Chandran, W. I. Lipkin and J. A. K. Mazet (2018). The discovery of Bombali virus adds further support for bats as hosts of ebolaviruses. *Nature Microbiology*, **3:** 1084 - 1089. doi: 10.1038/s41564-018-0227-2.

Gomard, Y., M. Dietrich, N. Wieseke, B. Ramasindrazana, E. Lagadec, S. M. Goodman, K. Dellagi and P. Tortosa (2016). Malagasy bats shelter a considerable genetic diversity of pathogenic *Leptospira* suggesting notable host-specificity patterns. *FEMS Microbiology Ecology*, **92 (4):** fiw037. doi: 10.1093/femsec/fiw037.

Goodman, S. M. (1993). A reconnaissance of Ile Sainte Marie, Madagascar: the status of the forest, avifauna, lemurs and fruit bats. *Biodiversity and conservation*, **65 (3):** 205 - 212. [Abstract]

Goodman, S. M. (1996). Results of a bat survey of the eastern slopes of the Réserve Naturelle Intégrale d'Andringitra, Madagascar. *Fieldiana: zoology*284 - 288. [Abstract]

Goodman, S. M. (1998). Notes on the bats of the Réserve Spéciale d'Anjanaharibe-Sud, Madagascar. In Goodman, S. M. : *A floral and faunal inventory of the Réserve Spéciale d'Anjanaharibe-Sud, Madagascar: with reference to elevational variation. Fieldiana: zoology*, **90:** 223 - 226. [Abstract]

Goodman, S. M. (1999). Notes on the bats of the Réserve Naturelle Intégrale d'Andohahela and surrounding areas of southeastern Madagascar. In Goodman, S. M. : *A floral and faunal inventory of the Réserve Naturelle Intégrale d'Andohahela, Madagascar: with reference to elevational variation. Fieldiana: zoology*, **94:** 251 - 258.

Goodman, S. M. (2006). Hunting of Microchiroptera in south-western Madagascar. *Oryx*, **40 (2):** 225 - 228. doi: 10.1017/S0030605306000354.

Goodman, S. M. (2007). Final report for the project entitled "Survey of microchiropteran bats of islands in the western Indian Ocean". CABS at Conservation International on 28 August 2007.

Goodman, S. M., D. Andriafidison, R. (A.) Andrianaivoarivelo, S. G. Cardiff, E. Ifticene, R. K. B. Jenkins, A. Kofoky, T. Mbohoahy, D. Rakotondravony, J. Ranivo, F. Ratrimomanarivo, J. Razafimanahaka and P. A. Racey (2005a). The distribution and conservation of bats in the dry regions of Madagascar. *Animal conservation*, **8 (2):** 153 - 165. doi: 10.1017/S136794300500199X.

Goodman, S. M., A. Andrianarimisa, L. E. Olson and V. Soarimalala (1996). Patterns of elevational distribution of birds and small mammals in the humid forests of Montagne d'Ambre, Madagascar. *Ecotropica*, **2 (2):** 87 - 98. [Abstract]

Goodman, S. M., H. M. Bradman, C. P. Maminirina, K. E. Ryan, L. L. Christidis and B. (R.) Appleton (2008a). A new species of *Miniopterus* (Chiroptera: Miniopteridae) from lowland southeastern Madagascar. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **73:** 199 - 213. doi: 10.1016/j.mambio.2007.12.003.

Goodman, S. M., W. Buccas, T. Naidoo, F. Ratrimomanarivo, P. J. Taylor and J. Lamb (2010a). Patterns of morphological and genetic variation in western Indian Ocean members of the *Chaerephon 'pumilus'* complex (Chiroptera: Molossidae), with the description of a new species from Madagascar. *Zootaxa*, **2551:** 1 - 36.

Goodman, S. M. and S. G. Cardiff (2004). A new species of *Chaerephon* (Molossidae) from Madagascar with notes on other members of the family. *Acta Chiropterologica*, **6 (2):** 227 - 248.

Goodman, S. M., S. G. Cardiff, J. Ranivo, A. L. Russell and A. D. Yoder (2006a). A new species of *Emballonura* (Chiroptera: Emballonuridae) from the dry regions of Madagascar. *American Museum Novitates*, **3538:** 1 - 24, 8 figs, 4 tabs.

Goodman, S. M., S. G. Cardiff and F. H. Ratrimomanarivo (2008b). First record of *Coleura* (Chiroptera: Emballonuridae) on Madagascar and identification and diagnosis of members of the genus. *Systematics and Biodiversity*, **6 (2):** 283 - 292.

Goodman, S. M., L. M. Chan, M. D. Nowak and A. D. Yodder (2010b). Phylogeny and biogeography of western Indian Ocean *Rousettus* (Chiroptera: Pteropodidae). *Journal of Mammalogy*, **91 (3):** 593 - 606. doi: 10.1644/09-MAMM-A-283.1.

Goodman, S. M., G. K. Creighton and C. Raxworthy (1991). The food habits of the Madagascar Long-eared Owl *Asio madagascariensis* in southeastern Madagascar. *Bonner zoologische Beitrage*, **42 (1):** 21 - 26. URL: http://zfmk.de/BZB/1991/1991%20Goodman%20S.M.%20u.%20Creighton%20G.K.%20u.%20Raxworthy%20C.%20p21%20orginal.pdf. [Abstract]

Goodman, S. M. and O. Griffiths (2006). A case of exceptionally high predation levels of *Rousettus madagascariensis* by *Tyto alba* (Aves: Tytonidae) in western Madagascar. *Acta Chiropterologica*553 - 556.

Goodman, S. M., B. Jansen van Vuuren, F. Ratrimomanarivo, J.-M. Probst and R. C. K. Bowie (2008c). Specific status of populations in the Mascarene Islands referred to *Mormopterus acetabulosus* (Chiroptera: Molossidae), with description of a new species. *Journal of Mammalogy*, **89 (5):** 1316 - 1327.

Goodman, S. M., R. K. B. Jenkins and F. H. Ratrimomanarivo (2005b). A review of the genus *Scotophilus* (Mammalia, Chiroptera, Vespertilionidae) on Madagascar, with the description of a new species. *Zoosystema*, **27 (4):** 867 - 882.

Goodman, S. M., T. Kearney, M. M. Ratsimbazafy and A. Hassanin (2017a). Description of a new species of *Neoromicia* (Chiroptera: Vespertilionidae) from southern Africa: A name for "*N.* cf. *melckorum*". *Zootaxa*, **4236 (2):** 351 - 374. doi: 10.11646/zootaxa.4236.2.10.

Goodman, S. M. and C. P. Maminirina (2007). Specimen records referred to *Miniopterus majori* Thomas, 1906 (Chiroptera) from the Comoros Islands. *Mammalia*, **71 (4):** 151 - 156. doi: 10.1515/MAMM.2007.029.

Goodman, S. M., C. P. Maminirina, H. M. Bradman, L. Christidis and B. (R.) Appleton (2009c). The use of molecular phylogenetic and morphological tools to identify cryptic and paraphyletic species: Examples from the diminutive Long-fingered Bats (Chiroptera: Miniopteridae: *Miniopterus*) on Madagascar. *American Museum Novitates*, **3669:** 1 - 34.

Goodman, S. M., C. P. Maminirina, H. M. Bradman, L. Christidis and B. R. Appleton (2009b). Patterns of morphological and genetic variation in the endemic Malagasy bat *Miniopterus gleni* (Chiroptera: Miniopteridae), with the description of a new species, *M. griffithsi*. *Journal of Systematics and Evolutionary Research*, **48 (1):** 75 - 86. doi: 10.1111/j.1439-0469.2009.00524.x.

Goodman, S. M., C. P. Maminirina, N. Weyeneth, H. M. Bradman, L. Christidis, M. Ruedi and B. (R.) Appleton (2009a). The use of molecular and morphological characters to resolve the taxonomic identity of cryptic species: the case of *Miniopterus manavi* (Chiroptera, Miniopteridae). *Zoologica Scripta: an international journal of evolutionary zoology*, **38:** 339 - 363. doi: 10.1111/j.1463-6409.2008.00377.x.

Goodman, S. M., S. J. Puechmaille, N. Friedli-Weyeneth, J. Gerlach, M. Ruedi, M. C. Schoeman, W. T. Stanley and E. C. Teeling (2012a). Phylogeny of the Emballonurini (Emballonuridae) with descriptions of a new genus and species from Madagascar. *Journal of Mammalogy*, **93 (6):** 1440 - 1455. doi: 10.1644/11-MAMM-A-271.1.

Goodman, S. M., M. J. Raherilalao, D. Rakotomaiaia, D. Rakotondravony, A. P. Raselimanana, V. R. Razakarivony and V. Soarimalala (2002). Inventaire des vertébrés du Parc National de Tsimanampetsotsa (Toliara). *Ako'ny Ala*, **28:** 1-36.

Goodman, S. M., F. I. Rajemison and O. S. Noroalintseheno Lalarivoniaina (2017b). Morphometric patterns of secondary sexual dimorphism and seasonal differences in *Rousettus madagascariensis* from northern Madagascar. *Acta Chiropterologica*, **19 (1):** 71 - 75. doi: 10.3161/15081109ACC2017.19.1.005.

Goodman, S. M., C. F. Rakotondramanana, B. Ramasindrazana, T. Kearney, A. Monadjem, M. C. Schoeman, P. J. Taylor, K. Naughton and B. Appleton (2015a). An integrative approach to characterize Malagasy bats of the subfamily Vespertilioninae Gray, 1821, with the description of a new species of *Hypsugo*. *Zoological Journal of the Linnean Society*, **173 (4):** 988 - 1018. doi: 10.1111/zoj.12223.

Goodman, S. M., F. Rakotondraparany and A. Kofoky (2007a). The description of a new species of *Myzopoda* (Myzopodidae: Chiroptera) from western Madagascar. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **72 (2):** 65 - 81. doi: 10.1016/j.mambio.2006.08.001.

Goodman, S. M., B. Ramasindrazana, C. P. Maminirina, M. C. Schoeman and B. (R.) Appleton (2011). Morphological, bioacoustical, and genetic variation in *Miniopterus* bats from eastern Madagascar, with the description of a new species. *Zootaxa*, **2880:** 1 - 19. URL: http://www.mapress.com/zootaxa/2011/f/zt02880p019.pdf.

Goodman, S. M., B. Ramasindrazana, K. M. Naughton and B. Appleton (2015b). Description of a new species of the *Miniopterus aelleni* group (Chiroptera: Miniopteridae) from upland areas of central and northern Madagascar. *Zootaxa*, **3936(4):** 538 - 558. doi: 10.11646/zootaxa.3936.4.4.

Goodman, S. M. and J. Ranivo (2004). The taxonomic status of *Neoromicia somalicus malagasyensis*. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **69 (6):** 434 - 438. doi: 10.1078/1616-5047-00166.

Goodman, S. M. and J. Ranivo (2008). A new species of *Triaenops* (Mammalia, Chiroptera, Hipposideridae) from Aldabra Atoll, Picard Island (Seychelles). *Zoosystema*, **30 (3):** 681 - 693.

Goodman, S. M. and J. Ranivo (2009). The geographical origin of the type specimens of *Triaenops rufus* and *T. humbloti* (Chiroptera: Hipposideridae) reputed to be from Madagascar and the description of a replacement species name. *Mammalia*, **73 (1):** 47 - 55. doi: 10.1515/MAMM.2009.011.

Goodman, S. M. and F. H. Ratrimomanarivo (2007). The taxonomic status of *Chaerephon pumilus* from the western Seychelles: resurrection of the name *C. pusillus* for an endemic species. *Acta Chiropterologica*, **9 (2):** 391 - 399.

Goodman, S. M., F. H. Ratrimomanarivo and F. H. Randrianandrianina (2006b). A new species of *Scotophilus* (Chiroptera: Vespertilionidae) from western Madagascar. *Acta Chiropterologica*, **8 (1):** 21 - 37.

Goodman, S. M., R. H. Ratrimomanarivo, J. Ranivo and S. G. Cardiff (2008d). The hunting of microchiropteran bats in different portions of Madagascar. *African Bat Conservation News*, **16:** 4 - 7.

Goodman, S. M., S. V. J. Razakaratrimo and L.-A. Réné de Roland (2015c). An analysis of Bat Hawk *Macheiramphus alcinus* diet in the Melaky Region of lowland western Madagascar. *Ostrich*, **87 (1):** 77 - 80 (for 2016). doi: 10.2989/00306525.2015.1104395.

Goodman, S. M., K. E. Ryan, C. P. Maminirina, J. Fahr, L. Christidis and B. (R.) Appleton (2007b). Specific status of populations on Madagascar referred to *Miniopterus fraterculus* (Chiroptera: Vespertilionidae), with the description of a new species. *Journal of Mammalogy*, **88 (5):** 1216 - 1229.

Goodman, S. M., M. C. Schoeman, A. Rakotoarivelo and S. Willows-Munro (2016). How many species of *Hipposideros* have occurred on Madagascar since the Late Pleistocene? *Zoological Journal of the Linnean Society*, **177 (2):** 428 - 449. doi: 10.1111/zoj.12368.

Goodman, S. M., P. J. Taylor, F. Ratrimomanarivo and S. R. Hoofer (2012b). The genus *Neoromicia* (Family Vespertilionidae) in Madagascar, with the description of a new species. *Zootaxa*, **3250:** 1 - 25.

Goodman, S. M., N. Weyeneth, Y. Ibrahim, I. Said and M. Ruedi (2010c). A review of the bat fauna of the Comoro Archipelago. *Acta Chiropterologica*, **12 (1):** 117 - 141. doi: 10.3161/150811010X504635.

Goodwin, G. G. (1942). Mammals of Honduras. *Bulletin of the American Museum of Natural History*, **79 (2):** 107 - 195.

Goodwin, G. G. (1953). Catalogue of type specimens of recent mammals in the American Museum of Natural History. *Bulletin of the American Museum of Natural History*, **102 (3):** 207 - 412. [Abstract]

Goodwin, R. E. (1979). The bats of Timor: Systematics and ecology. *Bulletin of the American Museum of Natural History*, **163 (2):** 75 - 122, 4 figs, 3 tables.

Gopalakrishna, A. and G. C. Chari (1983). A review of the taxonomic position of *Miniopterus* based on embryological characters. *Current Science, Madras*, **52:** 1176 - 1180.

Gopalakrishna, A. and K. B. Karim (1980). *Female genital anatomy and the morphogenesis of foetal membranes of Chiroptera and their bearing on the phylogenetic relationships of the group.* In Srivastava, U.V. : *National Academy of Sciences, India: Golden Jubilee Commemoration Volume.* Naya Prokash, Allahabad, India, pp. 379 - 428.

Göpfert, M. C., K. G. Heller, M. Volleth and L. T. Wasserthal (1995). Madagascar microchiropteran bats: new records including new species. *Bat Research News*, **36 (4):** 68 - 69.

Göpfert, M. C. and L. T. Wasserthal (1995). Notes on echolocation calls, food and roosting behaviour of the Old World Suker-footed bat *Myzopoda aurita* (Chiroptera, Myzopodidae). *Zeitschrift für Säugetierkunde*, **60:** 1 - 8.

Görföl, T. and G. Csorba (2018). Integrative taxonomy places Asian species of *Falsistrellus* (Chiroptera: Vespertilionidae) into *Hypsugo*. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **93:** 56 - 63. doi: 10.1016/j.mambio.2018.08.004.

Gortazar, C. and J. Segalés (2013). Middle East Respiratory Syndrome (MERS) Coronavirus: a new challenge for veterinarians? *Veterinary Pathology*, **50 (6):** 954 - 955. doi: 10.1177/0300985813506391.

Gotsch, A. F. (1979). *Mammals. Their latin names explained.* Blandford Press, Poole, England, 271 pp.

Götze, S., J. Koblitz, H.-U. Schnitzler and A. Denzinger (2013). 3D-Flight path reconstruction and echolocation behavior in *Pipistrellus pipistrellus* flying together do not indicate jamming avoidance. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 61. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Götze, S., J. C. Koblitz, A. Denzinger and H.-U. Schnitzler (2016). No evidence for spectral jamming avoidance in echolocation behavior of foraging pipistrelle bats. *Scientific Reports*, **6:** 30978. doi: 10.1038/srep30978.

Gough, L. H. (1908). On a new species of *Rhinolophus* from Pondoland. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **1 (1):** 71 - 72.

Gould, E. (1978). Opportunistic feeding by tropical bats. *Biotropica*, **10 (1):** 75 - 76.

Govender, K., A. Shuttleworth, C. T. Downs and S. D. Johnson (2016). The role of volatiles in the dispersal of fig seeds (Moraceae) by frugivorous bats in southern Africa (Abstract). *South African Journal of Botany*, **103:** 315.

Grady, D. (2019). Deadly Ebola Virus is found in Liberian bat, researchers say. The New York Times. URL: https://www.nytimes.com/2019/01/24/health/ebola-bat-liberia-epidemic.html.

Grafitti, G., J. De Waele and P. Blondé (2003). Biospeleological researches in some caves of Zambia (Central South Africa). *Subterranean Biology*, **1:** 65 - 71.

Grandidier, A. (1869). Descriptions de quelques animaux nouveaux découverts, pendant l'année 1869, sur la côte ouest de Madagascar. *Revue et Magazine de Zoologie*, **(2) 21:** 337 - 342.

Grandidier, A. (1870). Description de quelques animaux nouveaux, découverts à Madagascar, en novembre 1869. *Revue et Magazine de Zoologie*, **(2) 22:** 49 - 50.

Grandidier, G. (1912). Une nouvelle chauve-souris de Madagascar, le *Triænops aurita* G. G. *Bulletin du Muséum national d'histoire naturelle de Paris*, **sér 1 18 (1):** 8 - 9.

Grandidier, G. (1929). Nouvelle espèce de Chauve-Souris frugivore *Rousettus madagascariensis* G. Grand. *Bulletin de l'Académie Malgache*, **(N.S.) 11:** 91 - 93 (for 1928).
Grandidier, G. (1937). Mammifères nouveaux de la région de Diego-Suarez (Madagascar). *Bulletin du Musée de Paris*, **(2) 9:** 347 - 353.
Granek, E. (2000a). An analysis of *Pteropus livingstonii* roost habitat: Indicators for forest conservation on Anjouan and Moheli. *Tri News*, **19:** 29 - 32.
Granek, E. (2000b). Conservation des habitats de Roussettes de Livingstone - Les Massifs Forestiers d'Anjouan et Mohéli, Comores: Utilisation d'Indicateurs sociaux et écologiques. *Ya Mkobe*, **6-7:** 131 -137.
Granek, E. (2002). Conservation of *Pteropus livingstonii* based on roost site habitat characteristics on Anjouan and Moheli, Comoros islands. *Biological Conservation*, **108 (1):** 93 - 100. doi: 10.1016/S0006-3207(02)00093-9.
Granjon, L. and M. Traoré (2007). Prey selection by barn owls in relation to small-mammal community and population structure in a Sahelian agro-ecosystem. *Journal of Tropical Ecology*, **23 (2):** 199 - 208. doi: 10.1017/S026646740600383X.
Grant, A. and D. Ingold (2015). Expedition to Botswana's Aha hills to search for caves. *South African Spelaeological Association Bulletin*, **41:** 19 - 27.
Grant, J. A. (1872). IX. Summary of observations on the geography, climate and natural history of the lake region of Equatorial Africa, made by the Speke and Grant Expedition 1860-1863. *Journal of the Royal Geographical Society*, **42:** 243 - 342.
Granvik, H. (1924). On mammals from the eastern slopes of Mount Elgon, Kenya Colony. Mammals collected by the Swedish Mount Elgon Expedition 1920. *Lunds Universitets Ärsskrift*(2) 21 (3). [Abstract]
Grard, G., R. Biek, J.-J. Muyembe Tamfum, J. Fair, N. Wolfe, P. Formenty, J. Paweska and E. Leroy (2011). Emergence of divergent Zaire ebola virus strains in Democratic Republic of the Congo in 2007 and 2008. *The Journal of Infectious Diseases*, **204 (Suppl. 3):** S776 - S784. doi: 10.1093/infdis/jir364.
Gray, J. E. (1821). On the natural arrangement of vertebrose animals. *London Medical Repositories*, **15 (1):** 296 - 310.
Gray, J. E. (1825a). XIII. A list of the species of Vespertilionidæ found in Great Britain. *Zoological Journal*, **2 (5):** 108 - 110. [Abstract]
Gray, J. E. (1825b). An outline of an attempt at the disposition of the Mammalia into tribes and families with a list of the genera apparently appertaining to each tribe. *Annals of Philosophy*, **10 (5):** 337- 344.
Gray, J. E. (1831). Description of some new genera and species of bats. *Zoological Miscellany*, **1:** 37 - 38.
Gray, J. E. (1834). A bat captured in New Holland by George Bennett, Esq., Corr. Memb. Z.S. *Proceedings of the Zoological Society of London*, **1834, II (xviii):** 52 - 53.
Gray, J. E. (1837). XXXIII. On some new or little known Mammalia. *Magazine of Zoology and Botany, Edinburgh*, **2 (9):** 284 - 287.
Gray, J. E. (1838). I. A revision of the genera of bats (Vespertilionidae), and the description of some new genera and species. *Magazine of Zoology and Botany, Edinburgh*, **2 (12):** 483 - 505.
Gray, J. E. (1839). I. Descriptions of some mammalia discovered in Cuba by W.S. MacLeay, Esq. With some account of their habits, extracted from Mr. MacLeay's notes. *Annals of Natural History*, **ser. 1, 4 (21):** 1 - 7. [Abstract]
Gray, J. E. (1842). XXXVII. Descriptions of some new genera and fifty unrecorded species of Mammalia. *Annals and Magazine of Natural History*, **ser. 1, 10 (65):** 255 - 267.
Gray, J. E. (1843a). *Catalogue of the species of mammals of the British Museum.* London.
Gray, J. E. (1843b). Mammalia, in Voy."Sulphur", Zool. *Annals and Magazine of Natural History*, **ser. 1, 11 (72):** 457 - 459.
Gray, J. E. (1847). 2. Characters of six new genera of bats not hitherto distinguished. *Proceedings of the Zoological Society of London*, **1847, XV (clxix):** 14 - 16.
Gray, J. E. (1864). 8. Notes on some mammalia, with the description of a new Golunda, from Western Africa. *Proceedings of the Zoological Society of London*, **1864, I:** 55 - 58.
Gray, J. E. (1866a). IX. Synopsis of the Genera of Vespertilionidæ and Noctilionidæ. *Annals and Magazine of Natural History*, **ser. 3, 17 (98):** 89 - 93.
Gray, J. E. (1866b). A revision of the genera of Rhinolophidae, or Horseshoe Bats. *Proceedings of the Zoological Society of London*, **1866, I (6):** 81 - 83. [Abstract]
Gray, J. E. (1866c). Notice of a new bat (*Scotophilus welwitschii*) from Angola. *Proceedings of the Zoological Society of London*1866, II.
Gray, J. E. (1867?). ?? Title still needs to be checked. ?? *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*1867.
Gray, J. E. (1870). Catalogue of Monkeys, Lemurs and Fruit-eating bats in the collection of the British Museum London. .
Gray, P. A., M. B. Fenton and V. Van Cakenberghe (1999). *Nycteris thebaica*. *Mammalian Species*, **612:** 1 - 8, 2 figs.
Green, A. A. (1983). Rodents and bats of Arli and Pendjari national parks, Upper Volta and Benin. *The Nigerian Field*, **47 (4):** 185 - 194. [Abstract]
Greenbaum, E. and J. L. Carr (2005). The herpetofauna of Upper Niger National Park, Guinea, West Africa. *Scientific Papers Natural History Museum, University of Kansas*, **37:** 1 - 21.
Gregorin, R. and A. Cirranello (2015). Phylogeny of Molossidae Gervais (Mammalia: Chiroptera) inferred by morphological data. *Cladistics: the International Journal of the Willi Henning Society*, **32 (1):** 2 - 35 (for 2016). doi: 10.1111/cla.12117.
Greiman, S. E., J. A. Vaughan, R. Elmahy, P. Adisakwattana, N. Van Ha, T. J. Fayton, A. I. Khalil and V. V. Tkach (2016). Real-time PCR detection and phylogenetic relationships of *Neorickettsia* spp. In digeneans from Egypt, Philippines, Thailand, Vietnam and the United States. *Parasitology International*, **66 (1):** 1003 - 1007 (for 2017). doi: 10.1016/j.parint.2016.08.002.
Greville, L. J., A. Ceballos-Vasquez, R. Valdizón-Rodríguez, J. R. Caldwell and P. A. Faure (2018). Wound healing in wing membranes of the Egyptian fruit bat (*Rousettus aegyptiacus*) and big brown bat (*Eptesicus fuscus*). *Journal of Mammalogy*, **99 (4):** 974 - 982. doi: 10.1093/jmammal/gyy050.
Griffin, D. R., A. Novick and M. Kornfield (1958). The sensitivity of echolocation in the fruit bat, *Rousettus*. *Biology Bulletin*, **115 (1):** 107 - 113. doi: 10.2307/1539097. [Abstract]
Griffin, M. (1998). The species diversity, distribution and conservation of Namibian mammals. *Biodiversity and conservation*, **7(4):** 483 - 494.
Griffin, M. (1999). *Checklist and provisional national conservation status of Amphibians, Reptiles and Mammals known or expected to occur in Namibia (9th revision).* Biodiversity Inventory, Ministry of Environment and Tourism - Windhoek, Namibia: 49 pp.
Griffin, M. (2004a). *Scotophilus leucogaster*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Griffin, M. (2004b). *Scotophilus dinganii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Griffin, M. (2004c). *Scotophilus viridis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Griffin, M. (2008a). *Scotophilus dinganii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Griffin, M. (2008b). *Scotophilus leucogaster*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Griffin, M. (2008c). *Scotophilus viridis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Griffin, M. and H. J. W. Grobler (1991). Wetland-associated mammals of Namibia - a national review. *Madoqua: Tydskrif vir natuurbewarings- en Woestynnavoring = Journal of nature conservation and desert research*, **17 (2):** 233 - 237. [Abstract]
Griffin, M. and D. Jacobs (2008). *Cistugo seabrae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Griffiths, T. A. (1994). Phylogenetic systematics of Slit-faced bats (Chiroptera, Nycteridae), based on hyoid and other morphology. *American Museum Novitates*, **3090:** 1 - 17; 7 figs, 2 tabs. [Abstract]
Griffiths, T. A. (1997). Phylogenetic position of the bat *Nycteris javanica* (Chiroptera: Nycteridae). *Journal of Mammalogy*, **78 (1):** 106 - 116. [Abstract]
Griffiths, T. A. and D. Klingerer [Eds] (1991). Contributions to Mammalogy in honor of Karl F. Koopman. *Bulletin of the American Museum of Natural History*, **206:** 1 - 432.
Griffiths, T. A., K. F. Koopman and A. Starrett (1991). The systematic relationship of *Emballonura nigrescens* to other species of *Emballonura* and to *Coleura* (Chiroptera: Emballonuridae). *American Museum Novitates*, **2996:** 1 - 6, 10 illustrations, 1 table. [Abstract]
Griffiths, T. A. and A. L. Smith (1991). Systematics of Emballonuroid bats (Chiroptera: Emballonuridae and Rhinopomatidae) based on hyoid morphology. In Griffiths, T. A. and D. Klingener : *Contributions to mammalogy in honor of Karl F. Koopman. Bulletin of the American Museum of Natural History*, **206:** 62 - 83. [Abstract]
Griffiths, T. A., A. Truckenbrod and P. J. Sponholtz (1992). Systematics of Megadermatid bats (Chiroptera, Megadermatidae), based on hyoid morphology. *American Museum Novitates*, **3041:** 1 - 21, 11 figs, 1 table. [Abstract]
Grimmberger, E. (2004). Beitrag zum Paarungsverhhalten des Gambia-Epauletten-Flughundes - *Epomophorus gambianus* (Ogilby, 1835). *Nyctalus (Neue Form), Berlin*, **9 (4):** 405 - 407.
Grimshaw, J. M., N. J. Cordeiro and C. A. H. Foley (1995). The mammals of Kilimanjaro. *Journal of East African Natural History*, **84 (2):** 105 - 139. doi: 10.2982/0012-8317(1995)84[105:TMOK]2.0.CO;2. [Abstract]
Grobler, J. H. and H. H. Braack (1984). A note on the mammals of the Addo Elephant National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **27 (1):** 145 - 146. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/560.
Groombridge, B. (1994). *1994 IUCN Red List of Threatened Animals.* IUCN, Gland, Switzerland.
Groseth, A., H. Feldmann and J. E. Strong (2007). The ecology of Ebola virus. *Trends in Microbiology*, **15 (9):** 408 - 416. doi: 10.1016/j.tim.2007.08.001.
Grubb, P. (1971). Further records of mammals from Ghana, based on the collections of Angus Booth. *Revue de zoologie et de botanique africaines*, **84 (1-2):** 192 - 201. [Abstract]
Grubb, P. (1978). Patterns of speciation in African mammals. *Bulletin of the Carnegie Museum of Natural History*, **6:** 152 - 167. [Abstract]
Grubb, P. (1983). The biogeographic significance of forest mammals in eastern Africa. In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 75 - 85. [Abstract]
Grubb, P. (2004). Controversial scientific names of African mammals. *African Zoology*, **39 (1):** 91 - 109.
Grubb, P., T. S. Jones, A. G. Davies, E. Edberg, E. D. Starin and J. E. Hill (1998). *Mammals of Ghana, Sierra Leone and The Gambia.* The Trendrine Press - Zennor, St. Ives, Cornwall: i - vi; 1 - 265 + maps.
Grubb, P., O. Sandrock, O. Kullmer, T. M. Kaiser and F. Schrenk (2000). *17. Relationships between eastern and southern African mammal faunas.* In Bromage, T. and F. Schrenk : *African biogeography, climate change and early Hominid evolution.* Oxford University Press, New York: 253 - 267.
Grünmeier, R. (1990). Pollination by bats and non-flying mammals of the African tree *Parkia bicolor* (Mimosaceae). In Gottsberger, G. and G.T. Prance [Eds]: *Biology and evolution of tropical woody Angiosperms. Memoirs of the New York Botanical Garden*, **55:** 83-104.
Grünmeier, R. (1992). Untersuchungen zur Chiropterophilie zweier Leguminosen Kameruns, Parkia bicolor und Mucuna flagellipes, sowie zum Verhalten und Nahrungsspektrum der bestäubenden Flughunde (Megachiroptera, Pteropodidae). University of Mainz, Germany.
Grünmeier, R. (1993). *Bestäubung der Fabaceae Mucuna flagellipes durch Flughunde in Kamerun.* In Barthlott, W., Naumann, C.M., Schmidt-Loske, K., Schuchmann, K.-L. : *Animal-plant interaction in tropical environments.* Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany: 29 - 39. [Abstract]
Grünmeier, R. (1996). Flower-visiting bats and their role as pollinators in the African Rain Forest. Abstract. VIIth European Bat Research Symposium: 12 - 16 August 1996 - Veldhoven, The Netherlands: 22. [Abstract]
Gu, S. H., B. K. Lim, B. Kadjo, S. Arai, J.-A. Kim, V. Nicolas, A. Lalis, C. Denys, J. A. Cook, S. R. Dominguez, K. V. Holmes, L. Urushadze, K. Sidamonidze, D. Putkaradze, I. V. Kuzmin, M. Y. Kosoy, J.-W. Song and R. Yanagihara (2014). Molecular phylogeny of hantaviruses harbored by insectivorous bats in Côte d'Ivoire and Vietnam. *Viruses*, **6 (5):** 1897 - 1910. doi: 10.3390/v6051897.
Gubarev (1939). ?? Title still needs to be checked. ?? .
Guernier, V., E. Lagadec, C. Cordonin, G. Le Minter, Y. Gomard, F. Pagès, M.-C. Jaffar-Bandjee, A. Michault, P. Tortosa and K. Dellagi (2016). Human Leptospirosis on Reunion Island, Indian Ocean: are rodents the (only) ones to blame? *PLoS Neglected Tropical Diseases*, **10 (6):** e0004733. doi: 10.1371/journal.pntd.0004733.
Guillen, A., J. Juste B. and C. Ibáñez (2000). Variation in the frequency of the echolocation calls of *Hipposideros ruber* in the Gulf of Guinea: an exploration of the adaptive meaning of the constant frequency value in Rhinolophid CF bats. *Journal of Evolutionary Biology*, **13 (1):** 70 - 80. doi: 10.1046/j.1420-9101.2000.00155.x.

Guillén-Servent, T., C. M. C. M. Francis and R. E. Ricklefs (2003). *Phylogeny and biogeography of the horseshoe bats.* In Csorba, G., P. Ujhelyi and N. Thomas : *Horseshoe bats of the world (Chiroptera: Rhinolophidae).* Alana Books, Shropshire, U.K.: xii - xxiv.

Gumusova, S., M. Sunbul and H. Leblebicioglu (2015). Ebola virus disease and the veterinary perspective. *Annals of Clinical Microbiology and Antimicrobials*, **14:** 30. doi: 10.1186/s12941-015-0089-x.

Gunnell, G. (F.) (2010a). Cenozoic African bat communities. 70th Anniversary Meeting Society of Vertebrate Paleontology. Pittsburgh, Pennsylvania USA, October 10-13, 2010: 99. URL: http://www.vertpaleo.org/meetings/documents/SVP10Abstracts_WEB.pdf.

Gunnell, G. F. (2010b). *Chiroptera.* In Werdelin, L. and W.L. Sanders : *Cenozoic Mammals of Africa* . Univ. of California Press, Berkeley. xxi + 986 pp.: 587 - 603.

Gunnell, G. F., P. M. Butler, M. Greenwood and N. B. Simmons (2015a). Bats (Chiroptera) from Olduvai Gorge, Early Pleistocene, Bed I (Tanzania). *American Museum Novitates*, **3846:** 1 - 35. doi: 10.1206/3846.1.

Gunnell, G. F., T. P. Eiting and D. Geraads (2011). New late Pliocene bats (Chiroptera) from Ahl al Oughlam, Morocco. *Neues Jahrbuch für Geologie und Paläontologie. Abhandlungen.*, **260 (1):** 55 - 71. doi: 10.1127/0077-7749/2011/0128.

Gunnell, G. F., T. P. Eiting and E. L. Simons (2012). *African Vespertilionoidea (Chiroptera) and the antiquity of Myotinae.* In Gunnell, G.F. and N.B. Simmons : *Evolutionary History of Bats. Fossils, Molecules and Morphology*. Cambridge University Press, New York: 252 - 266.

Gunnell, G. F., B. F. Jacobs, P. S. Herendeen, J. J. Head, E. Kowalski, C. P. Msuya, F. A. Mizambwa, T. Harrison, J. Habersetzer and G. Storch (2003). Oldest placental mammal from sub-saharan Africa: Eocene microbat from Tanzania - Evidence for early evolution of sophisticated echolocation. *Palaeontologia Electronica*, **5 (3):** 1 - 10.

Gunnell, G. F. and N. B. Simmons (2005). Fossil evidence and the origin of bats. *Journal of Mammalogy*, **12 (1/2):** 209 - 246. doi: 10.1007/s10914-005-6945-2.

Gunnell, G. (F.) and N. (B.) Simmons (2013). Are Eocene megabats masquerading as primates? 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 63. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Gunnell, G. F., N. B. Simmons and E. R. Seiffert (2014). New Myzopodidae (Chiroptera) from the Late Paleogene of Egypt: Emended Family Diagnosis and Biogeographic Origins of Noctilionoidea. *PLoS ONE*, **9 (2):** e86712. doi: 10.1371/journal.pone.0086712.

Gunnell, G. F., E. L. Simons and E. R. Seiffert (2008). New bats (Mammalia: Chiroptera) from the late ecocene and early Oligocene, Fayum depression, Egypt. *Journal of Vertebrate Paleontology*, **28 (1):** 1 - 11.

Gunnell, G. F., R. Smith and T. Smith (2017). 33 million year old *Myotis* (Chiroptera, Vespertilionidae) and the rapid global radiation of modern bats. *PLoS ONE*, **12 (3):** e0172621. doi: 10.1371/journal.pone.0172621.

Gunnell, G. F., A. J. Winkler, E. R. Miller, J. J. Head, A. N. El-Barkooky, M. A. Gawad, W. J. Sanders and P. D. Gingerich (2015b). Small vertebrates from Khasm El-Raqaba, late Middle Miocene, Eastern Desert, Egypt. *Historical Biology*, **28 (1 - 2):** 159 - 171 (for 2016). doi: 10.1080/08912963.2015.1014354.

Gunnell, G. F., S. R. Worsham, E. R. Seiffert and E. L. Simons (2009). *Vampyravus orientalis* Schlosser (Chiroptera) from the Early Oligocene (Rupelian), Fayum, Egypt - body mass, humeral morphology and affinities. *Acta Chiropterologica*, **11 (2):** 271 - 278. doi: 10.3161/150811009X485512.

Günther, A. (1880). 6. Notice of a collection of mammals and reptiles from Cyprus. *Proceedings of the Zoological Society of London*, **1879, IV:** 741.

Gunther, K. (1970). Die Tierwelt Madagascars und die Zoogeographische Frage dem Gondwana-Land. *Sitzungsberichte Gesellschaft naturforschenden Freunde Berlin*, **10 (1-2):** 79 - 92.

Gürün, K., A. Furman, J. Juste, M. J. Ramos-Pereira, J. M. Palmeirim, S. J. Puechmaille, P. Hulva, A. Karatas and R. Bilgin (2017). An investigation of the social structure, species boundaries, hybridization and phylogeography of three *Miniopterus* species (Mammalia: Chiroptera) (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 101. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.

Gürün, K., J. Juste, S. J. Puechmaille, P. Hulva, C. Ibañez, P. Presetnik, S. Gazaryan, P. Georgiakakis, M. João Ramos Pereira, J. Palmeirim, D. Hamidovic, B. Allegrini, Z. L. Nagy, M. Uhrin, M. Abu-Said, H. Nicolou, D. Scaravelli and R. Bilgin (2014). An investigation of the phylogeography and the evolutionary history of *Miniopterus schreibersii* (Mammalia: Chiroptera) using nuclear microsatellites. In Lina, P.H.C., Hutson, A.M., Kipson, M., Zrncic, V., Hamidovic, D. : *Book of Abstracts.* XIIIth European Bat Research Symposium. 1 - 5 September 2014, Šibenik, Croatia: 73. URL: http://13ebrs2014.com/wp-content/uploads/2014/10/13EBRS_Croatia2014_Abstracts.pdf.

Gustafson, Y. and H.-U. Schnitzler (1979). Echolocation and obstacle avoidance in the Hipposiderid bat *Asellia tridens*. *Journal of Comparative Physiology*, **A 131 (2):** 161 - 167. doi: 10.1007/BF00619076. [Abstract]

Guyton, J. A. and C. E. Brook (2014). African Bats: Conservation in the time of Ebola. *Therya*, **6 (1):** 69 - 88. doi: 10.12933/therya-15-244.

Gyldenstolpe, N. (1928). Zoological results of the Swedish Expedition to Central Africa 1921. Vertebrata. 5. Mammals from the Birunga Volcanoes, north of Lake Kivu. *Arkiv för zoologi, Stockholm*, **20A (4):** 1 - 76. [Abstract]

Haagner, A. (1920). *South African mammals. A short manual for the use of field naturalists, sportsmen and travelers.* H. F. & G. Witherby, London and T. Maskew Miller, Cape Town: i - xx; 1 - 248.

Habersetzer, J. (1981). Adaptive echolocation sounds in the bat *Rhinopoma hardwickei*. *Journal of Comparative Physiology*, **A 144 (4):** 559 - 566. doi: 10.1007/BF01326841. [Abstract]

Habersetzer, J., S. Engels, G. Gunnell and N. Simmons (2013). Is *Tanzanycteris* actually a Hipposiderid? 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 64. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Habibi, K. (2003). Mammals of Afghanistan. Zoo Outreach Organisation/ USFWS, Coimbatore, India: 168 pp.

Hackett, T. D., M. W. Holderied and C. Korine (2016). Echolocation call description of 15 species of Middle-Eastern desert dwelling insectivorous bats,. *Bioacoustics. The International Journal of Animal Sound and its Recording*, **26 (3):** 217 - 235 (for 2017). doi: 10.1080/09524622.2016.1247386.

Hackett, T. D., C. Korine and M. W. Holderied (2013). The importance of *Acacia* trees for insectivorous bats and arthropods in the Arava Desert. *PLoS ONE*, **8 (2):** e52999. doi: 10.1371/journal.pone.0052999.

Hackett, T. D., C. Korine and M. W. Holderied (2014). A whispering bat that screams: bimodal switch of foraging guild from gleaning to aerial hawking in the desert long-eared bat. *Journal of experimental biology*, **217 (17):** 3028 - 3032. doi: 10.1242/jeb.100362.

Hadjisterkotis, E. (2006). The destruction and conservation of the Egyptian fruit bat *Rousettus aegyptiacus* in Cyprus: A historic review. *European Journal of Wildlife Research*, **52 (4):** 282 - 287. doi: 10.1007/s10344-006-0041-7.

Haeckel, E. (1866). *Generelle Morphologie der Organismen. Allgemeine Grundzüge der organischen Formen-Wissenchaft: mechanisch begründet durch die von Charles Darwin reformirte Descendenz-Theorie. Zweiter Band: Allgemeine Entwicklungsgeschichte der Organismen.* Georg Reimer - Berlin: xvii - clx; 1 - 462.

Haelewaters, D., T. Hiller and C. W. Dick (2018). Bats, bat flies, and fungi: a case of hyperparasitism. *Trends in Parasitology*, **34 (9):** 784 - 799. doi: 10.1016/j.pt.2018.06.006.

Haelewaters, D., W. P. Pfliegler, T. Szentiványi, M. Földvári, A. D. Sándor, L. Barti, J. J. Camacho, G. Gort, P. Estók, T. Hiller, C. W. Dick and D. H. Pfister (2017). Parasites of parasites of bats: Laboulbeniales (Fungi: Ascomycota) on bat flies (Diptera: Nycteribiidae) in central Europe. *Parasites & Vectors*, **10:** 96. doi: 10.1186/s13071-017-2022-y.

Haeselbarth, E., J. Sererman and F. Zumpt (1966). The arthropod parasites of vertebrates in Africa south of the Sahara (Ethiopian Region). Volume III. Insecta excl. Phthiraptera. *South African Institute for Medical Research*, **13 (52):** 1-283.

Haffner, M. (1995). The possibilities of scent marking in the Mouse-eared bat *Myotis myotis* (Borkhausen, 1797) and the Noctule bat *Nyctalus noctula* (Schreber, 1774) (Mammalia, Chiroptera). *Zeitschrift für Säugetierkunde*, **60:** Abstract.

Haffner, M. and V. Ziswiler (1989). Tasthaare als diagnostisches Merkmal bei mitteleuropäischen Vespertilionidae (Mammalia, Chiroptera). *Revue suisse de zoologie*, **96 (3):** 663 - 672. [Abstract]

Hafner, M. S., W. L. Gannon, J. Salazar-Bravo and S. T. Alvarez-Castañeda (1997). *Mammal collections in the Western hemisphere.* American Society of Mammalogists: i - ii; 1 - 93.

Haft, J. (2002). Beobachtungen zu Balzverhalten und Jugentwicklung beim Zwerg-Epualettenflughund, *Micropteropus pusillus* Peters, 1868 (Mammalia: Megachiroptera: Epomophorini). *Zoologische Garten*, **72:** 61 - 67.

Hahn, M. W. and L. Nakhleh (2015). Irrational exuberance for resolved species trees. *Evolution*, **70 (1):** 7 - 17 (for 2016). doi: 10.1111/evo.12832.

Haiduk, M. W. (1983). Evolution in the family Pteropodidae (Chiroptera: Megachiroptera) as indicated by chromosomal and immunoelectrophoretic analyses. Ph.D. dissertation - Texas Tech University: i - viii; 1 - 93. URL: http://repositories.tdl.org/ttu-ir/handle/2346/16509.

Haiduk, M. W., R. J. Baker, L. W. Robbins and D. A. Schlitter (1981). Chromosomal evolution in African Megachiroptera: G- and C-band assessment of the magnitude of change in similar standard karyotypes. *Cytogenetics and cell genetics*, **29:** 221 - 232. doi: 10.1159/000131573. [Abstract]

Haiduk, M. W., L. W. Robbins, R. L. Robbins and D. A. Schlitter (1980). Karyotypic studies of seven species of African Megachiropterans (Mammalia: Pteropodidae). *Annals of Carnegie Museum*, **49 (12):** 181 - 191. [Abstract]

Haiduk, M. W., L. W. Robbins and D. A. Schlitter (1983). Chromosomal banding studies and their systematic implications in African fruit bats (Chiroptera: Pteropodidae). In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 1 - 8. [Abstract]

Hall, E. R. (1981). *The Mammals of North America. Volume 1. Second Edition.* John Wiley & Sons - New York: 1: xv + 1 - 600 + 1 - 9.

Hall, E. R. and K. R. Kelson (1959). *The Mammals of North America. Volume 1.* The Ronald Press Company. New York - New York: v - xxx; 1 - 546; *1 - 79*.

Hall, N. J., M. A. R. Udell, N. R. Dorey, A. L. Walsh and C. D. L. Wynne (2011). Megachiropteran bats (*Pteropus*) utilize human referential stimuli to locate hidden food. *Journal of Comparative Psychology*, **125 (3):** 341 - 346. doi: 10.1037/a0023680.

Hallowell, E. (1846). Description of a new species of bat from Western Africa. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **3:** 52 - 53.

Hammer, M. and R. Arlettaz (1998). A case of snake predation upon bats in northern Morocco: some implications for designing bat grilles. *Journal of Zoology*, **245 (2):** 211 - 212. [Abstract]

Hammond, R. G., X. Tan and M. A. Johnson (2017). SARS-unique fold in the *Rousettus* bat coronavirus HKU9. *Protein Science*, **26 (9):** 1726 - 1737. doi: 10.1002/pro.3208.

Han, B. A., J. P. Schmidt, L. W. Alexander, S. E. Bowden, D. T. S. Hayman and J. M. Drake (2016). Undiscovered bat hosts of Filoviruses. *PLoS Neglected Tropical Diseases*, **10 (7):** e0004815. doi: 10.1371/journal.pntd.0004815.

Han, H.-J., H.-L. Wen, J.-W. Liu, X.-R. Qin, M. Zhao, L.-J. Wang, L.-M. Luo, C.-M. Zhou, Y.-L. Zhu, R. Qi, W.-Q. Li, H. Yu and X.-J. Yu (2018). Pathogenic *Leptospira* species in insectivorous bats, China, 2015. *Emerging Infectious Diseases*, **24 (6):** 1123 - 1126. doi: 10.3201/eid2406.171585.

Han, H.-J., H.-L. Wen, L. Zhao, J.-W. Liu, L.-M. Luo, C.-M. Zhou, X.-R. Qin, Y.-L. Zhu, M.-M. Liu, R. Qi, W.-Q. Li, H. Yu and X.-J. Yu (2017). Novel coronaviruses, astroviruses, adenoviruses and circoviruses in insectivorous bats from northern China. *Zoonoses and Public Health*, **64 (8):** 636 - 646. doi: 10.1111/zph.12358.

Han, J. E., D. K. Gomez, J. H. Kim, C. H. Jr. Choresca, S. P. Shin and S. C. Park (2010). Isolation of a zoonotic pathogen *Kluyvera ascorbata* from Egyptian Fruit-bat *Rousettus aegyptiacus*. *Journal of Veterenary Medical Science*, **72 (1):** 85 - 87.

Hanák, V. (1964). Zur Kenntnis der Fledermausfauna Albaniens. *Acta Societatis Zoologicae Bohemoslovacae / Bohemicae*, **28 (1):** 68 - 88. [Abstract]

Hanák, V. (1966). Zur Systematik und Verbreitung der Gattung *Plecotus* Geoffroy, 1818 (Mammalia, Chiroptera). *Lynx (Praha)*, **6:** 57 - 66. [Abstract]

Hanák, V. and A. Elgadi (1984). On the bat fauna (Chiroptera) of Libya. *Vestnik ceskoslovenské Spolecnosti zoologické*, **48:** 165 - 187. [Abstract]

Hanák, V. and J. Gaisler (1983). *Nyctalus leisleri* (Kühl, 1818), une espèce nouvelle pour le continent africain. *Mammalia*, **47 (4):** 585 - 587. doi: 10.1515/mamm.1983.47.4.583.

Hanák, V., I. Horácek and P. Benda (2016). Vzpomínka na klícové osobnosti výzkumu netopýru: Kurt Bauer, Benedetto Lanza, Petr P. Strelkov a György Topál. *Vespertilio*, **18:** 171 - 182.

Hand, S. J. (1985). New Miocene megadermatids (Chiroptera: Megadermatidae) from Australia with comments on megadermatid systematics. *Australian Mammalogy*, **8:** 5-43.

Hand, S. J. (1996). New Miocene and Pliocene megadermatids (Mammalia, Microchiroptera) from Australia, with comments on broader aspects of megadermatid evolution. *Geobios*, **29:** 365-377.

Hand, S. J. and M. Archer (2005). A new Hipposiderid genus (Microchiroptera) from an early Miocene bat community in Australia. *Palaeontology*, **48 (2):** 371 - 383.

Hand, S. J., R. M. D. Beck, M. Archer, N. B. Simmons, G. F. Gunnell, R. P. Scofield, A. J. D. Tennyson, V. L. De Pietri, S. W. Salisbury and T. H. Worthy (2018). A new, large-bodied omnivorous bat (Noctilionoidea: Mystacinidae) reveals lost

morphological and ecological diversity since the Miocene in New Zealand. *Scientific Reports*, **8:** 235. doi: 10.1038/s41598-017-18403-w.
Hand, S. J. and J. A. W. Kirsch (1998). *A Southern origin for the Hipposideridae (Microchiroptera)? Evidence from the Australian Fossil Record.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 72 - 90.
Hand, S. J. and J. A. W. Kirsch (2003). *Archerops*, a new annectent hipposiderid genus (Mammalia: Microchiroptera) from the Australian Milocene. *Journal of Paleontology*, **77 (6):** 1139 - 1151.
Hand, S. J., B. Sigé, M. Archer and K. H. Black (2016). An evening bat (Chiroptera: Vespertilionidae) from the late Early Eocene of France, with comments on the antiquity of modern bats. *Palaeovertebrata, Montpelier*, **40 (2):** e2. doi: 10.18563/pv.40.2.e2.
Handa, S. M. and S. Kaur (1979). Chromosomes of *Rhinopoma microphyllum kinneari* (Rhinopomatidae). *Microbios. Letters*, **12:** 153 - 155.
Handley, C. O. Jr. (1980). *Inconsistencies in formation of family-group and subfamily-group names in Chiroptera.* In Wilson, D. E. and A. L. Gardner [Eds]: *Proceedings Fifth International Bat Research Conference.* Texas Tech Univ. Press, Lubbock: 3 - 19.
Happold, D. C. D. (1967). The natural history of Khartoum Province: Mammals. *Sudan Notes and Records*, **48:** 111 - 132. [Abstract]
Happold, D. C. D. (1981). Geographical ecology of Nigerian mammals. Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 38. [Abstract]
Happold, D. C. D. (1984). *Chapter 17. Small Mammals.* In Cloudsley-Thompson, J. L. : *Key Environments: Sahara Desert.* Pergamon Press - Oxford: 251 - 275. [Abstract]
Happold, D. C. D. (1985). Geographical ecology of Nigerian mammals. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **246:** 1 - 49. [Abstract]
Happold, D. C. D. (1987). *The mammals of Nigeria.* Clarendon Press - Oxford: 402 pp.
Happold, D. C. D. (1999). Ecology of African Small Mammals. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 100.
Happold, D. C. D. (2001). *Ecology of African Small Mammals.* In Denys, C., L. Granjon and A. Poulet : *African Small Mammals / Petits mammifères africains..* Institut de Recherche pour le Développement collection - Colloques et séminaires Paris: 377 - 414.
Happold, D. C. D. (2013a). *Megaloglossus woermanni Woermann's Long-tongued Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 266 - 268.
Happold, D. C. D. and M. Happold (1978a). The fruit bats of western Nigeria. *The Nigerian Field*, **43 (1):** 30 - 34.
Happold, D. C. D. and M. Happold (1978b). The fruit bats of western Nigeria. Part 2. *The Nigerian Field*, **43 (2):** 72 - 77.
Happold, D. C. D. and M. Happold (1978c). The fruit bats of western Nigeria. Part 3. *The Nigerian Field*, **43 (3):** 121 - 127.
Happold, D. C. D. and M. Happold (1988). Renal form and function in relation to the ecology of bats (Chiroptera) from Malawi, Central Africa. *Journal of Zoology*, **215 (4):** 629 - 655. doi: 10.1111/j.1469-7998.1988.tb02400.x. [Abstract]
Happold, D. C. D. and M. Happold (1989a). The bats (Chiroptera) of Malawi, Central Africa: Checklist and keys for identification. *Nyala*, **14 (2):** 89 - 112. [Abstract]
Happold, D. C. D. and M. Happold (1989b). Reproduction of Angola free-tailed bats (*Tadarida condylura*) and little free-tailed bats (*Tadarida pumila*) in Malawi (Central Africa) and elsewhere in Africa. *Journal of Reproduction and Fertility*, **85:** 133 - 149. [Abstract]
Happold, D. C. D. and M. Happold (1989c). The bats of Malawi. Abstract. Eigth International Bat Research Conference, Sydney, Australia, 9 - 15 July 1989. *Macroderma*, **5:** 12. [Abstract]
Happold, D. C. D. and M. Happold (1990a). The domiciles, reproduction, social organisation and sex ratios of the Banana Bat *Pipistrellus nanus* (Chiroptera, Vespertilionidae) in Malawi, Central Africa. *Zeitschrift für Säugetierkunde*, **55 (3):** 145 - 160. [Abstract]
Happold, D. C. D. and M. Happold (1990b). Reproductive strategies of bats in Africa. *Journal of Zoology*, **222:** 557-583.
Happold, D. C. D. and M. Happold (1996). The social organization and population dynamics of leaf-roosting banana bats, *Pipistrellus nanus* (Chiroptera, Vespertilionidae), in Malawi, east-central Africa. *Mammalia*, **60 (4):** 517 - 544. [Abstract]
Happold, D. C. D. and M. Happold (1997a). Conservation of mammals on a tobacco farm on the Highlands of Malawi. *Biodiversity and conservation*, **6:** 837 - 852. [Abstract]
Happold, D. C. D. and M. Happold (1998a). Effects of bat-bands and banding on a population of *Pipistrellus nanus* (Chiroptera: Vespertilionidae) in Malawi. *Zeitschrift für Säugetierkunde*, **63 (2):** 65 - 78. [Abstract]
Happold, D. C. D. and M. Happold (2013a). *Appendix: New Taxa 2005 - 2010.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 736.
Happold, D. C. D., M. Happold and J. E. Hill (1988). The bats of Malawi. *Mammalia*, **51 (3):** 337 - 414 (for 1987). [Abstract]
Happold, M. (2003). Case 3240. *Vespertilio nanus* Peters, 1852 (currently *Pipistrellus nanus*; Mammalia, Chiroptera): proposed conservation of the specific name. *Bulletin of Zoological Nomenclature*, **60 (1):** 42 - 44.
Happold, M. (2005). A new species of *Myotis* (Chiroptera: Vespertilionidae) from central Africa. *Acta Chiropterologica*, **7 (1):** 9 - 21.
Happold, M. (2008). *Myotis dieteri*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Happold, M. (2013b). *Order Chiroptera.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 198 - 222.
Happold, M. (2013c). *Family Pteropodidae Fruit bats (Old World Fruit Bats).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 223 - 228.
Happold, M. (2013d). *Genus Casinycteris Short-palated Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 229 - 230.
Happold, M. (2013e). *Casinycteris argynnis Short-palated Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 230 - 231.
Happold, M. (2013f). *Genus Eidolon Straw-coloured Fruit Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 231.
Happold, M. (2013g). *Genus Epomophorus Epauletted Fruit Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 234 - 237.
Happold, M. (2013h). *Epomophorus crypturus Peters's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 240 - 242.

Happold, M. (2013i). *Epomophorus gambianus Gambian Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 242 - 244.
Happold, M. (2013j). *Epomophorus grandis Sanborn's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 244 - 245.
Happold, M. (2013k). *Epomophorus labiatus Little Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 245 - 247.
Happold, M. (2013l). *Epomophorus minimus Least Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats. Epomophorus minimus* Least Epauletted Fruit Bat.
Happold, M. (2013m). *Epomophorus wahlbergi Wahlberg's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 249 - 251.
Happold, M. (2013n). *Genus Epomops Singing Epauletted Fruit Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 252 - 253.
Happold, M. (2013o). *Epomops dobsonii Dobson's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 255 - 256.
Happold, M. (2013p). *Epomops franqueti Franquet's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 256 - 258.
Happold, M. (2013q). *Genus Hypsignathus Hammer-headed Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 259 - 260.
Happold, M. (2013r). *Hypsignathus monstrosus Hammer-headed Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 260 - 262.
Happold, M. (2013s). *Genus Lissonycteris Angolan Soft-furred Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 262 - 263.
Happold, M. (2013t). *Lissonycteris angolensis Angolan Soft-furred Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 263 - 265.
Happold, M. (2013u). *Genus Micropteropus Lesser Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 268 - 269.
Happold, M. (2013v). *Micropteropus intermedius Hayman's Lesser Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 269 - 270.
Happold, M. (2013w). *Genus Myonycteris Collared Fruit Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 272 - 273.
Happold, M. (2013x). *Genus Plerotes Anchieta's Broad-faced Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 280 - 281.
Happold, M. (2013y). *Plerotes anchietae Anchieta's Broad-faced Fruit Bat (Benguela Fruit Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 281 - 282.
Happold, M. (2013z). *Genus Pteropus Flying-foxes.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 282 - 284.
Happold, M. (2013aa). *Pteropus seychellensis Seychelles Flying-fox.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 284 - 286.
Happold, M. (2013ab). *Genus Rousettus Rousettes.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 288 - 289.
Happold, M. (2013ac). *Rousettus aegyptiacus Egyptian Rousette.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 289 - 292.
Happold, M. (2013ad). *Rousettus lanosus Long-haired Rousette.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 292 - 293.
Happold, M. (2013ae). *Genus Rhinolophus Horseshoe Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 304 - 309.
Happold, M. (2013af). *Rhinolophus adami Adam's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 309 - 310.
Happold, M. (2013ag). *Rhinolophus alcyone Halcyon Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 311 - 312.
Happold, M. (2013ah). *Rhinolophus blasii Blasius's Horseshoe Bat (Peak-saddle Horseshoe Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 312 - 314.
Happold, M. (2013ai). *Rhinolophus deckenii Decken's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 320 - 321.
Happold, M. (2013aj). *Rhinolophus landeri Lander's Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 340 - 341.
Happold, M. (2013ak). *Rhinolophus maendeleo Maendeleo Horseshoe Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 343 - 344.
Happold, M. (2013al). *Family Hipposideridae Old World Leaf-nosed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 357 - 359.
Happold, M. (2013am). *Genus Cloeotis Percival's Trident Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 364.
Happold, M. (2013an). *Genus Hipposideros Old World Leaf-nosed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 367 - 371.
Happold, M. (2013ao). *Hipposideros abae Aba Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 372 - 373.
Happold, M. (2013ap). *Hipposideros beatus Benito Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 373 - 375.
Happold, M. (2013aq). *Hipposideros camerunensis Cameroon Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 378 - 379.
Happold, M. (2013ar). *Hipposideros curtus Short-tailed Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 379 - 380.
Happold, M. (2013as). *Hipposideros gigas Giant Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 385 - 387.

Happold, M. (2013at). *Hipposideros megalotis Large-eared Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 392 - 393.
Happold, M. (2013au). *Hipposideros ruber Noack's Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 393 - 395.
Happold, M. (2013av). *Hipposideros vittatus Striped Leaf-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 395 - 398.
Happold, M. (2013aw). *Genus Triaenops Trident Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 398 - 399.
Happold, M. (2013ax). *Triaenops afer African Trident Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 399 - 400.
Happold, M. (2013ay). *Family Megadermatidae False Vampire Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 401 - 402.
Happold, M. (2013az). *Genus Cardioderma Heart-nosed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 403.
Happold, M. (2013ba). *Cardioderma cor Heart-nosed Bat (African False Vampire Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 404 - 405.
Happold, M. (2013bb). *Genus Lavia Yellow-winged Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 406.
Happold, M. (2013bc). *Lavia frons Yellow-winged Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 406 - 408.
Happold, M. (2013bd). *Family Emballonuridae Sheath-tailed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 418 - 421.
Happold, M. (2013be). *Subfamily Emballonurinae Sheath-tailed Bats, Sac-winged Bats, Ghost Bats and others.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 421.
Happold, M. (2013bf). *Genus Coleura African Sheath-tailed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 421.
Happold, M. (2013bg). *Coleura afra African Sheath-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 422 - 424.
Happold, M. (2013bh). *Subfamily Taphozoinae Pouched Bats and Tomb Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 424.
Happold, M. (2013bi). *Genus Saccolaimus Pouched Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 424.
Happold, M. (2013bj). *Genus Taphozous Tomb Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 427 - 428.
Happold, M. (2013bk). *Taphozous hamiltoni Hamilton's Tomb Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 428 - 429.
Happold, M. (2013bl). *Taphozous mauritianus Mauritian Tomb Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 431 - 434.
Happold, M. (2013bm). *Taphozous nudiventris Naked-rumped Tomb Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 434 - 435.
Happold, M. (2013bn). *Family Nycteridae Slit-faced Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 438 - 439.
Happold, M. (2013bo). *Genus Nycteris Slit-faced Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 440 - 442.
Happold, M. (2013bp). *Nycteris gambiensis Gambian Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 445 - 446.
Happold, M. (2013bq). *Nycteris grandis Large Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 446 - 448.
Happold, M. (2013br). *Nycteris hispida Hairy Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 448 - 449.
Happold, M. (2013bs). *Nycteris vinsoni Vinson's Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 460 - 461.
Happold, M. (2013bt). *Genus Mormopterus Little Mastiff Bats and others.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 472 - 473.
Happold, M. (2013bu). *Mormopterus acetabulosus and M. francoismoutoui Mauritian Little Mastiff Bat and Réunion Little Mastiff Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 473 - 475.
Happold, M. (2013bv). *Genus Otomops Giant Mastiff Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 479 - 480.
Happold, M. (2013bw). *Genus Platymops Peters's Flat-headed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 483.
Happold, M. (2013bx). *Platymops setiger Peters's Flat-headed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 483 - 485.
Happold, M. (2013by). *Genus Sauromys Roberts's Flat-headed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 485 - 486.
Happold, M. (2013bz). *Genus Tadarida Tadarine Free-tailed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 487 - 491.
Happold, M. (2013ca). *Tadarida brachytera Short-winged Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 501 - 502.
Happold, M. (2013cb). *Tadarida condylura Angolan Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 505 - 507.
Happold, M. (2013cc). *Tadarida major Lappet-eared Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 516 - 518.
Happold, M. (2013cd). *Tadarida nanula Dwarf Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 520 - 522.

Happold, M. (2013ce). *Tadarida niangarae Niangara Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 522 - 523.
Happold, M. (2013cf). *Tadarida petersoni Peterson's Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 526 - 527.
Happold, M. (2013cg). *Tadarida pumila Little Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 528 - 530.
Happold, M. (2013ch). *Tadarida russata Russet Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 530 - 532.
Happold, M. (2013ci). *Tadarida spurrelli Spurrell's Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 532 - 533.
Happold, M. (2013cj). *Tadarida thersites Railer Free-tailed Bat (Railer Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 535 - 537.
Happold, M. (2013ck). *Tadarida trevori Trevor's Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 537 - 538.
Happold, M. (2013cl). *Family Vespertilionidae Vesper Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 541 - 544.
Happold, M. (2013cm). *Subfamily Vespertilioninae Barbastelles, Serotines, Butterfly Bats, Long-eared Bats, Noctules, Pipistrelles, House Bats and others.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 545 - 546.
Happold, M. (2013cn). *Genus Barbastella Barbastelles.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 546 - 547.
Happold, M. (2013co). *Barbastella leucomelas Eastern Barbastelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 549 - 550.
Happold, M. (2013cp). *Genus Glauconycteris Butterfly Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 560 - 563.
Happold, M. (2013cq). *Glauconycteris alboguttata Striped Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 563 - 564.
Happold, M. (2013cr). *Glauconycteris argentata Common Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 564 - 566.
Happold, M. (2013cs). *Glauconycteris beatrix Beatrix Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 566 - 567.
Happold, M. (2013ct). *Glauconycteris egeria Bibundi Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 568 - 569.
Happold, M. (2013cu). *Glauconycteris gleni Glen's Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 569 - 570.
Happold, M. (2013cv). *Glauconycteris humeralis Spotted Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 570 - 571.
Happold, M. (2013cw). *Glauconycteris kenyacola Kenyacola Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 572.
Happold, M. (2013cx). *Glauconycteris machadoi Machado's Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 573.
Happold, M. (2013cy). *Glauconyteris poensis Abo Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 574 - 575.
Happold, M. (2013cz). *Glauconycteris variegata Variegated Butterfly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 576 - 578.
Happold, M. (2013da). *Genus Mimetillus Moloney's Mimic Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 585.
Happold, M. (2013db). *Genus Nycticeinops Schlieffen's Twilight Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 594 - 595.
Happold, M. (2013dc). *Nycticeinops schlieffeni Schlieffen's Twilight Bat (Schlieffen's Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 595 - 597.
Happold, M. (2013dd). *Genus Otonycteris Hemprich's Desert Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 597 - 598.
Happold, M. (2013de). *Pipistrellus nanus Banana Pipistrelle (Banana Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 639 - 642.
Happold, M. (2013df). *Pipistrellus rueppellii Rüppell's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 647 - 649.
Happold, M. (2013dg). *Genus Scotoecus Lesser House Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 666 - 667.
Happold, M. (2013dh). *Scotoecus albofuscus Light-winged Lesser House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 667 - 669.
Happold, M. (2013di). *Scotoecus hirundo Dark-winged Lesser House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 669 - 671.
Happold, M. (2013dj). *Scotophilus dinganii Yellow-bellied House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 674 - 676.
Happold, M. (2013dk). *Scotophilus nigrita Giant House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 678 - 679.
Happold, M. (2013dl). *Subfamily Myotinae Wing-gland Bats and Myotines.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 684 - 685.
Happold, M. (2013dm). *Genus Myotis Myotines (Mouse-eared Bats, Hairy Bats).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 688 - 692.
Happold, M. (2013dn). *Myotis bocagii Rufous Myotis (Rufous Mouse-eared Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 692 - 694.
Happold, M. (2013do). *Myotis dieteri Dieter's Myotis.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 696 - 697.

Happold, M. (2013dp). *Myotis welwitschii Welwitsch's Myotis.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 708 - 710.
Happold, M. (2013dq). *Subfamily Miniopterinae Long-fingered Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 710 - 711.
Happold, M. (2013dr). *Genus Miniopterus Long-fingered Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 711 - 712.
Happold, M. (2013ds). *Miniopterus inflatus Greater Long-fingered Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 714 - 716.
Happold, M. (2013dt). *Miniopterus minor Least Long-fingered Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 716 - 718.
Happold, M. (2013du). *Subfamily Kerivoulinae Woolly Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 723.
Happold, M. (2013dv). *Genus Kerivoula Woolly Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 723 - 725.
Happold, M. (2013dw). *Kerivoula africana Tanzanian Woolly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 725.
Happold, M. (2013dx). *Genus Phoniscus Trumpet-eared Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 734.
Happold, M. (2013dy). *Phoniscus aerosa Dubious Trumpet-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 734 - 735.
Happold, M. and F. P. D. Cotterill (2013a). *Family Rhinolophidae Horseshoe Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 300 - 303.
Happold, M. and F. P. D. Cotterill (2013b). *Family Molossidae Free-tailed Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 464 - 472.
Happold, M. and F. P. D. Cotterill (2013c). *Tadarida chapini Pale Free-tailed Bat (Chapin's Free-tailed Bat, Long-crested Free-tailed Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 503 - 504.
Happold, M. and D. C. D. Happold (1997b). New records of bats (Chiroptera: Mammalia) from Malawi, east-central Africa, with an assessment of their status and conservation. *Journal of natural history*, **31 (5):** 805 - 836. [Abstract]
Happold, M. and D. C. D. Happold (1998b). New distribution records for bats and other mammals of Malawi. *Nyala*, **20:** 17 -2 4. [Abstract]
Happold, M. and D. C. D. Happold (2013b). *Mammals of Africa Volume IV: Hedgehogs, shrews, and bats.* Bloomsbury Publishing, London: 800 pp.
Happold, M. and D. C. D. Happold (2013c). *Genus Megaloglossus Woermann's Long-tongued Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 266.
Happold, M. and D. C. D. Happold (2013d). *Pteropus voeltzkowi Pemba Flying-fox.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 286 - 287.
Happold, M. and V. Van Cakenberghe (2013). *Pipistrellus cf. helios Samburu Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 627 - 629.
Happold, M., V. Van Cakenberghe and T. Kearney (2013). *Pipistrellus zuluensis Zulu Pipistrelle (Aloe Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 657 - 659.
Haquart, A. , Rombaut, D. (1995). Contribution a l'inventaire des chiroptères du Parc National et de la Zone Cynégétique de la Pendjari. Unpublished Report - Campagne d'Etude - Benin: 52 pp, Plates a-q. Appendix i - vii.
Harmsen, R. and I. Jabbal (1968). Distribution and host-specificity of a number of fleas collected in South and Central Kenya (including the collection of the University College, Naitorib, Mount Kenya Expedition, March 1966). *Journal of the East African Natural History Society and National Museum*, **27 (2) (117):** 157 - 161. [Abstract]
Harper, G. J., M. K. Steininger, Tucker C. J., D. Juhn and A. F. A. Hawkins (2007). Fifty years of deforestation and fragmentation in Madagascar. 34: 1 - 9.
Harris, B. J. and H. G. Baker (1959). Pollination of flowers by bats in Ghana. *The Nigerian Field*, **24 (4):** 151 - 159.
Harris, D. J., A. Halajian, J. L. Santos, L. H. Swanepoel, P. J. Taylor and R. Xavier (2018). Diversity of haemoprotozoan parasites infecting the wildlife of South Africa. *Folia parasitologica*, **65:** 015. doi: 10.14411/fp.2018.015.
Harrison, D. L. (1953). Some systematic notes on the Long-fingered Bats of the genus *Miniopterus* Bonaparte occurring in South Africa and Madagascar. *Durban Museum Novitates*, **4 (5):** 65 - 75. [Abstract]
Harrison, D. L. (1956a). On a collection of mammals from Oman, Arabia, with the description of two new bats. *Annals and Magazine of Natural History*, **ser. 12, 8 (for 1955) (96):** 897 - 910. [Abstract]
Harrison, D. L. (1956c). Mammals from Kurdistan, Iraq, with description of a new bat. *Journal of Mammalogy*, **37 (2):** 257 - 263. [Abstract]
Harrison, D. L. (1956d). A key to the identification of the bats (Chiroptera) of the Arabian Peninsula. *Proceedings of the Zoological Society of London*, **127:** 447 - 452. [Abstract]
Harrison, D. L. (1956e). A new flat-headed bat of the genus *Platymops* Thomas from S.E. Sudan. *Annals and Magazine of Natural History*, **ser. 12, 9 (104):** 549 - 552. [Abstract]
Harrison, D. L. (1957a). Some systematic notes on the trident bats (*Asellia tridens* E. Geoffroy) of Arabia. *Mammalia*, **21 (1):** 1 - 8. doi: 10.1515/mamm.1957.21.1.1. [Abstract]
Harrison, D. L. (1957b). A note of the occurrence of the Woolly Bat, *Kerivoula cuprosa* Thomas in Kenya. *Revue de zoologie et de botanique africaines*, **55 (1-2):** 47 - 48.
Harrison, D. L. (1957c). Notes on African Bats. 1. Some systematic and anatomical notes of the African bats of the genus *Otomops* Thomas. 2. Some observations on the relationship between the African slit-faced bats *Nycteris hispida* Schreber and *Nycteris aurita* K. Andersen. *Durban Museum Novitates*, **5 (2):** 17 - 26. [Abstract]
Harrison, D. L. (1958a). Two bats (Microchiroptera) new to the fauna of Tanganyika Territory. *Durban Museum Novitates*, **5 (7):** 95 - 98.
Harrison, D. L. (1958b). A new race of tomb bat *Taphozous perforatus* E. Geoffroy, 1818 from northern Nigeria, with some observations on its breeding biology. *Durban Museum Novitates*, **5 (11):** 143 - 149. [Abstract]
Harrison, D. L. (1959a). A new subspecies of Lesser Long-winged bat *Miniopterus minor* Peters, 1867, from the Comoro Islands. *Durban Museum Novitates*, **5 (15):** 191 - 196.

Harrison, D. L. (1959b). Report on the bats (Chiroptera) in the collection of the National Museum of Southern Rhodesia, Bulawayo. *Occasional Papers of the National Museums of Southern Rhodesia*, **23 B:** 217 - 231. [Abstract]
Harrison, D. L. (1960a). A new species of Pipistrelle bat (Chiroptera: *Pipistrellus*) from South-Israel. *Durban Museum Novitates*, **5 (19):** 261 - 267.
Harrison, D. L. (1960b). Notes on some Central and East African bats. 1. The occurrence of Bocage's fruit bat *Rousettus (Lissonycteris) angolensis* Bocage, 1898, in Southern Rhodesia. *Durban Museum Novitates*, **6 (5):** 65 - 67.
Harrison, D. L. (1960c). Notes on some central and East African bats. 2. Anchieta's fruit bat *Plerotes anchietae* Seabra, 1900, in Northern Rhodesia, with a description of the tongue of the species. *Durban Museum Novitates*, **6 (5):** 68 - 74.
Harrison, D. L. (1960d). Notes on some central and East African bats. 3. The free-tailed bat *Tadarida fulminans* Thomas, 1903, in Kenya colony. *Durban Museum Novitates*, **6 (5):** 74 - 78.
Harrison, D. L. (1960e). A checklist of the bats (Chiroptera) of Kenya Colony. *Journal of the East African Natural History Society and National Museum*, **23 (7) (104):** 286 - 295. [Abstract]
Harrison, D. L. (1961a). On Savi's Pipistrelle (*Pipistrellus savii* Bonaparte, 1837) in the Middle East, and a second record of *Nycticeius schlieffeni* Peters, 1859 from Egypt. *Senckenbergiana biologica*, **42 (1-2):** 41 - 44. [Abstract]
Harrison, D. L. (1961b). Notes on Southern and East African bats. 1. On a tomb bat *Taphozous perforatus* E. Geoffroy, 1818, new for Tanganyika Territory. 2. Notes on a mutant *Scotophilus* from Southern Rhodesia. *Durban Museum Novitates*, **6 (12):** 149 - 152.
Harrison, D. L. (1962). On bats collected on the Limpopo river, with the description of a new race of the Tomb rat, *Taphozous sudani* Thomas, 1915. I. Systematic notes. *Occasional Papers of the National Museums of Southern Rhodesia*, **26B:** 755 - 769. [Abstract]
Harrison, D. L. (1963a). Some observations on *Myotis dogalensis* Monticelli, 1887 (Mammalia: Chiroptera). *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **73:** 325 - 332. [Abstract]
Harrison, D. L. (1963b). Observations on the north African serotine bat, *Eptesicus serotinus isabellinus* (Temminck, 1840) (Mammalia: Chiroptera). *Zoologische Mededelingen*, **38 (12):** 207 - 212. [Abstract]
Harrison, D. L. (1963c). A note on the occurrence of the forest bat, *Kerivoula smithii* Thomas, 1880, in Kenya. *Mammalia*, **27 (2):** 307 - 310.
Harrison, D. L. (1963d). On the occurrence of the Leaf-nosed bat *Triaenops afer*, Peters, 1877, in Mozambique. *Durban Museum Novitates*, **7 (3):** 71 - 72.
Harrison, D. L. (1963e). A new bat for Israel, *Eptesicus innesi* Lataste, 1887, with some notes on the affinities of this species. *Zeitschrift für Säugetierkunde*, **28 (1):** 107 - 110.
Harrison, D. L. (1964a). *The mammals of Arabia. Vol I. Insectivora, Chiroptera, Primates.* E. Benn - London: xx + 192 pp.
Harrison, D. L. (1964b). Notes of some Southern Rhodesian Microchiroptera. *Arnoldia (Rhodesia)*, **1 (3):** 1 - 3. [Abstract]
Harrison, D. L. (1965a). A note on the occurrence of the large free-tailed bat, *Otomops martiensseni* Matschie, 1897 (Chiroptera: Molossidae) in Rhodesia. *Arnoldia (Rhodesia)*, **2 (4):** 1 - 3. [Abstract]
Harrison, D. L. (1965b). Remarks on some trident leaf-nosed bats, (genus *Asellia* Gray, 1838), obtained by the Israel South Red Sea expedition, 1962. *Sea Fishery Research Station Haifa*, **38:** 3 - 5. [Abstract]
Harrison, D. L. (1966). A note on the occurrence of Sundevall's Free-tailed bat, *Tadarida* (*Mops*) *midas* Sundevall, 1843 (Chiroptera: Molossidae) in Bechuanaland. *Arnoldia (Rhodesia)*, **2 (30):** 1 - 2.
Harrison, D. L. (1967). A note on the capture of a southern sheath-tailed bat, *Coleura afra gallarum* Thomas, 1915 (Chiroptera: Emballonuridae), on a ship at sea. *Mammalia*, **31 (1):** 165 - 168. doi: 10.1515/mamm.1967.31.1.165.
Harrison, D. L. (1968a). On three mammals new to the fauna of Oman, Arabia, with the description of a new subspecies of bat. *Mammalia*, **32 (2):** 317 - 325. [Abstract]
Harrison, D. L. (1968b). Further notes on African Microchiroptera. *Arnoldia (Rhodesia)*, **3 (30):** 1 - 4. [Abstract]
Harrison, D. L. (1972). A note on the occurrence of the giant African free-tailed bat, *Tadarida africana* (Dobson, 1876), in Tanzania, with some observations on the characters of the species. *Arnoldia (Rhodesia)*, **5:** 1 - 5.
Harrison, D. L. (1973). Checklist: Saudi Arabian mammals. *Journal of the Saudi Arabian Natural History Society*, **7:** 22 - 55. [Abstract]
Harrison, D. L. (1975a). A new species of African Free-tailed bat (Chiroptera: Molossidae) obtained by the Zaire River Expedition. *Mammalia*, **39 (2):** 313 - 318. doi: 10.1515/mamm.1975.39.2.313. [Abstract]
Harrison, D. L. (1975b). Scientific results of the Oman flora and fauna survey, 1975. Description of a new subspecies of Botta's Serotine (*Eptesicus bottae* Peters, 1869, Chiroptera: Vespertilionidae) from Oman. *Mammalia*, **39 (3):** 415 - 418. [Abstract]
Harrison, D. L. (1975c). *Macrophyllum macrophyllum*. *Mammalian Species*, **62:** 1 - 3, 4 figs.
Harrison, D. L. (1979). A new species of pipistrelle bat (*Pipistrellus*: Vespertilionidae) from Oman, Arabia. *Mammalia*, **41 (4):** 573 - 576. [Abstract]
Harrison, D. L. (1982a). Observations on some rare Arabian *Pipistrellus* (Chiroptera: Vespertilionidae) with special reference to the external male genitalia. *Bonner zoologische Beitrage*, **33 (2-4):** 187 - 190. [Abstract]
Harrison, D. L. (1982b). Two bats (Chiroptera) new to the fauna of Malawi. *Nyala*, **8 (2):** 99 - 100. [Abstract]
Harrison, D. L. (1983). The mammal fauna of Oman, with special reference to conservation and the Oman flora and fauna surveys. *Journal of Oman Studies Special Report*, **6 (2):** 329 - 339. [Abstract]
Harrison, D. L. and P. J. J. Bates (1989). Observations on two mammal species new to the Sultanate of Oman, *Vulpes cana* Blanford, 1877 (Carnivora: Canidae) and *Nycteris thebaica* Geoffroy, 1818 (Chiroptera: Nycteridae). *Bonner zoologische Beitrage*, **40 (2):** 73 - 77. [Abstract]
Harrison, D. L. and P. J. J. Bates (1991). *The mammals of Arabia. Second edition.* Harrison Zoological Museum Publication - Sevenoaks: i - xv; 1 - 354. [Abstract]
Harrison, D. L. and I. P. Brownlow (1978). A comparative study of the baculum in bats of the genus *Scotophilus* (Chiroptera: Vespertilionidae). *Mammalia*, **42 (1):** 123 - 130. [Abstract]
Harrison, D. L. and P. A. Clancey (1952). Notes on Bats (Microchiroptera) from a cave in the Pietermaritzburg District of Natal. *Annals of the Natal Museum / Annale van die Natal museum*, **12 (2):** 177 - 183.
Harrison, D. L. and J. D. L. Fleetwood (1958). Welwitsch's bat *Myotis welwitschii* Gray, a species new to the fauna of Kenya Colony. *Durban Museum Novitates*, **5 (9):** 111 - 114.
Harrison, D. L. and J. D. L. Fleetwood (1960). A new race of the flat-headed bat *Platymops barbatogularis* Harrison from Kenya Colony, with observations on the anatomy of the gular sac and genitalia. *Durban Museum Novitates*, **5 (20):** 269. [Abstract]
Harrison, D. L. and R. E. Lewis (1961). The large mouse-eared bats of the Middle East, with description of a new subspecies. *Journal of Mammalogy*, **42 (3):** 372 - 380. [Abstract]

Harten, L., H. Navon and Y. Yovel (2014). Dynamics and underlying factors of social foraging strategy choice in the Egyptian fruit bat. *Journal of Molecular Neuroscience*, **53 (Suppl 1):** S62. doi: 10.1007/s12031-014-0252-4.

Harten, L., Y. Prat, S. Ben Cohen, R. Dor and Y. Yovel (2019). Food for sex in bats revealed as producer males reproduce with scrounging females. *Current Biology*, **29 (11):** 1895 - 1900. doi: 10.1016/j.cub.2019.04.066.

Hartmann, R. (1863). *Reise des Freiherrn Adalbert von Barnim durch Nord-Ost-Afrika in den Jahren 1859 und 1860.* Berlin.

Hartmann, R. (1868). Geographische Verbreitung der im Nordöstlichen Afrika wild lebenden Säugethiere. *Zeitschrift der Gesellschaft für Erdkunde*, **3 (28/29):** 420 pp.

Hashim, I. M. and K. S. Mahgoub (2007). Abundance, habitat preference and distribution of small mammals in Dinder National Park, Sudan. *African Journal of Ecology*, **46 (3):** 452 - 455 (for 2008). doi: 10.1111/j.1365-2028.2007.00871.x.

Hassanin, A. (2014). Description of a new bat species of the tribe Scotonycterini (Chiroptera, Pteropodidae) from southwestern Cameroon. *Comptes Rendus Biologies*, **337 (2):** 134 - 142. doi: 10.1016/j.crvi.2013.12.006.

Hassanin, A., R. Colombo, G.-C. Gembu, M. Merle, V. T. Tu, T. Görföl, P. Musaba Akawa, G. Csorba, T. Kearney, A. Monadjem and R. K. Ing (2017). Multilocus phylogeny and species delimitation within the genus *Glauconycteris* (Chiroptera, Vespertilionidae), with the description of a new bat species from the Tshopo Province of the Democratic Republic of the Congo. *Journal of Systematics and Evolutionary Research*, **56 (1):** 1 - 22 (for_2018). doi: 10.1111/jzs.12176.

Hassanin, A., S. Khouider, G.-C. Gembu, S. M. Goodman, B. Kadjo, N. Nesi, X. Pourrut, E. Nakouné and C. Bonillo (2015). The comparative phylogeography of fruit bats of the tribe Scotonycterini (Chiroptera, Pteropodidae) reveals cryptic species diversity related to African Pleistocene forest refugia. *Comptes Rendus Biologies*, **338 (3):** 197 - 211. doi: 10.1016/j.crvi.2014.12.003.

Hassanin, A., N. Nesi, J. Marin, B. Kadjo, X. Pourrut, E. Leroy, G-C. Gembu, P. M. Musaba Akawa, C. Ngoagouni, E. Nakouné, M. Ruedi, D. Tshikung, C. Pongembo Shongo and C. Bonillo (2016). Comparative phylogeography of African fruit bats (Chiroptera, Pteropodidae) provide new insights into the outbreak of Ebola virus disease in West Africa, 2014-2016. *Comptes Rendus Biologies*, **339 (11-12):** 517 - 528. doi: 10.1016/j.crvi.2016.09.005.

Hastriter, M. W. (2009). A description of four new species of fleas (Insecta, Siphonaptera) from Angola, Ethiopia, Papua New Guinea, and Peru. *ZooKeys*, **8:** 39 - 61. doi: 10.3897/zookeys.572.7823.

Hastriter, M. W. (2016). Description of two new species of bat fleas of the genus *Araeopsylla* (Siphonaptera) from Kenya and Madagascar with notes on miscellaneous bat fleas. *ZooKeys*, **572:** 7 - 21. doi: 10.3897/zookeys.572.7823.

Hatt, R. T. (1928). Note sur un chéiroptère nouveau du Soudan français (note presentée par M. Th. Monod). I. Introduction (par Th. Monod); II. *Chaerophon* (*Lophomops*) *nigri* sp. n. *Bulletin de la Société zoologique de France*, **53:** 374 - 376. [Abstract]

Hatt, R. T. (1940). Mammals collected by the Rockefeller-Murphy Expedition to Tanganyika Territory and the eastern Belgian Congo. *American Museum Novitates*, **1070:** 1 - 8.

Hauge, K. B. (2010). Bat (Chiroptera) activity and community composition in contrasting agricultural landscapes and the adjacent Budongo forest reserve, Uganda. Masters Thesis; University of Bergen: 1 - 42; i - iii. URL: https://bora.uib.no/bitstream/1956/4326/1/71960966.pdf.

Häussler, U., A. Nagel, M. Braun and A. Arnold (1999). External characters discriminating sibling species of European pipistrelles, *Pipistrellus pipistrellus* (Schreber, 1774) and *P. pygmaeus* (Leach, 1825). *Myotis*, **37:** 27 - 40.

Häussler, U., A. Nagel, G. Herzig and M. Braun (1998). *Pipistrellus "pygmaeus/mediterraneus"* in SW-Deutschland: ein fast perfekter Doppelgänger der Zwergfledermaus *Pipistrellus pipistrellus*. *Der Flatterman*, **21:** 13 - 19.

Hawkins, J. A., M. E. Kaczmarek, M. A. Müller, C. Drosten, W. H. Press and S. L. Sawyer (2019). A metaanalysis of bat phylogenetics and positive selection based on genomes and transcriptomes from 18 species. *Proceedings of the National Academy of Sciences, U.S.A.*, **116 (23):** 11351 - 11360. doi: 10.1073/pnas.1814995116.

Hayman, D. T. S. (2015). Biannual birth pulses allow filoviruses to persist in bat populations. *Proceedings of the Zoological Society of London*, **B 282:** 20142591. doi: 10.1098/rspb.2014.2591.

Hayman, D. T. S., A. C. Banyard, P. R. Wakeley, G. Harkess, D. Marston, J. L. N. Wood, A. A. Cunningham and A. R. Fooks (2011a). A universal real-time assay for the detection of *Lyssaviruses*. *Journal of Virological Methods*, **177 (1):** 87 - 93. doi: 10.1016/j.jviromet.2011.07.002.

Hayman, D. T. S., R. A. Bowen, P. M. Cryan, G. F. McCracken, T. J. O'Shea, A. J. Peel, A. Gilbert, C. T. Webb and J. L. N. Wood (2012a). Ecology of zoonotic infectious diseases in bats: current knowledge and future directions. *Zoonoses and Public Health*, **60 (1):** 2 - 21 (for 2013). doi: 10.1111/zph.12000.

Hayman, D. T. S., P. Emmerich, M. Yu, L.-F. Wang, R. Suu-Ire, A. R. Fooks, A. A. Cunningham and J. L. N. Wood (2010). Long-term survival of an urban fruit bat seropositive for Ebola and Lagos Bat Viruses. *PLoS ONE*, **5 (8):** e11978. doi: 10.1371/journal.pone.0011978.

Hayman, D. T. S., A. R. Fooks, D. Horton, R. Suu-Ire, A. C. Breed, A. A. Cunningham and J. L. N. Wood (2008a). Antibodies against Lagos bat virus in Megachiroptera from West Africa. *Emerging Infectious Diseases*, **14 (6):** 926 - 928.

Hayman, D. T. S., A. R. Fooks, D. A. Marston and J. C. Garcia-R (2016). The global phylogeography of *Lyssaviruses* - Challenging the 'Out of Africa' hypothesis. *PLoS Neglected Tropical Diseases*, **10(12):** e0005266. doi: 10.1371/JOURNAL.PNTD.0005266.

Hayman, D. T. S., A. R. Fooks, J. M. Rowcliffe, R. McCrea, O. Restif, K. S. Baker, D. L. Horton, R. Suuire, A. A. Cunningham and J. L. N. Wood (2012b). Endemic Lagos bat virus infection in *Eidolon helvum*. *Epidemiology and Infection*, **140 (12):** 2163 - 2171. doi: 10.1017/S0950268812000167.

Hayman, D. T. S., A. D. Luis, O. Restif, K. S. Baker, A. R. Fooks, C. Leach, D. L. Horton, R. Suu-Ire, A. A. Cunningham, J. L. N. Wood and C. T. Webb (2018). Maternal antibody and the maintenance of a lyssavirus in populations of seasonally breeding African bats. *PLoS ONE*, **13 (6):** e0198563.H. doi: 10.1371/journal.pone.0198563.

Hayman, D. T. S., R. McCrea, O. Restif, R. Suu-Ire, A. R. Fooks, J. L. N. Wood, A. A. Cunningham and J. M. Rowcliffe (2012c). Demography of straw-colored fruit bats in Ghana. *Journal of Mammalogy*, **93 (5):** 1393 - 1404. doi: 10.1644/11-MAMM-A-270.1.

Hayman, D. T. S. and A. J. Peel (2016). Can survival analyses detect hunting pressure in a highly connected species? Lessons from straw-coloured fruit bats. *Biological Conservation*, **200:** 131 - 139. doi: 10.1016/j.biocon.2016.06.003.

Hayman, D. T. S., R. Suu-Ire, A. C. Breed, J. A. McEachern, L. Wang, J. L. N. Wood and A. A. Cunningham (2008b). Evidence of henipavirus infection in West African fruit bats. *PLoS ONE*, **3 (7):** e2739.

Hayman, D. T. S., L.-F. Wang, J. Barr, K. S. Baker, R. Suu-Ire, C. C. Broder, A. A. Cunningham and J. L. N. Wood (2011b). Antibodies to Henipavirus or Henipa-like viruses in domestic pigs in Ghana, West Africa. *PLoS ONE*, **6 (9) e25256:** 1 - 4. doi: 10.1371/journal.pone.0025256.

Hayman, D. T. S., M. , Crameri, G. Yu, L.-F. Wang, R. Suu-Ire, J. L. N. Wood and A. A. Cunningham (2012d). Ebola virus antibodies in fruit bats, Ghana, West Africa. *Emerging Infectious Diseases*, **18 (7):** 1207 - 1209. doi: 10.3201/eid1807.111654.
Hayman, R. W. (1935a). A note on *Hipposideros cyclops* Temminck and its synonym *Hipposideros langi* Allen. *Annals and Magazine of Natural History*, **ser. 10, 15 (85):** 47 - 50. doi: 10.1080/00222933508654943.
Hayman, R. W. (1935b). On a collection of mammals from the Gold Coast. *Proceedings of the Zoological Society of London*, **56:** 915 - 937. [Abstract]
Hayman, R. W. (1937). Postscript. In St. Leger, J. : *Mammals collected by the Lake Rudolf Rift Valley Expedition. Annals and Magazine of Natural History*, **ser. 10, 19 (113):** 530 - 531. [Abstract]
Hayman, R. W. (1938). A new Crested bat (*Chærephon*). *Annals and Magazine of Natural History*, **ser. 11, 1 (4):** 383 - 386. doi: 10.1080/00222933808526783. [Abstract]
Hayman, R. W. (1939). Two new mammals from the Belgian Congo. *Annals and Magazine of Natural History*, **ser. 11, 3 (14):** 219 - 224. doi: 10.1080/03745481.1939.9723594.
Hayman, R. W. (1940). Field notes. In Sanderson, I.T. : *VII. The mammals of the north Cameroons forest area. Being the results of the Percy Sladen Expedition to the Mamfe Division of the British Cameroons. Transactions of the Zoological Society of London*, **24 (7) 1:** 623 - 725; 22 pls. doi: 10.1111/j.1096-3642.1940.tb00342.x.
Hayman, R. W. (1941). *British Expedition to South-west Arabia. 1. Mammalia: Chiroptera.* London. [Abstract]
Hayman, R. W. (1946). A new *Scotonycteris*, with notes on other Gold Coast bats. *Annals and Magazine of Natural History*, **ser. 11, 12 (for 1945) (95):** 766 - 775. doi: 10.1080/00222934508654781. [Abstract]
Hayman, R. W. (1947a). ?? Title still needs to be checked. ?? *Annals and Magazine of Natural History*ser. 11, 13 (103).
Hayman, R. W. (1947b). A new race of *Scotonycteris zenkeri* from the Gold Coast. *Annals and Magazine of Natural History*, **ser. 11, 13 (104):** 503 - 504 (for 1946). [Abstract]
Hayman, R. W. (1947c). A new race of *Glauconycteris superba* from West Africa. *Annals and Magazine of Natural History*, **ser. 11, 13 (104):** 547 - 550 (for 1946).
Hayman, R. W. (1947d). A new *Hipposideros* from Sierra Leone. *Annals and Magazine of Natural History*, **ser. 11, 14 (109):** 71 - 73. [Abstract]
Hayman, R. W. (1948). The Armstrong College Zoological Expedition to Siwa Oasis (Libyan Desert) 1935: Mammalia. *Proceedings of the Egyptian Academy of Sciences*, **4:** 38 - 42.
Hayman, R. W. (1950). Notes on some mammals newly recorded from Arabia. *Annals and Magazine of Natural History*, **ser. 12, 3 (29):** 417 - 419.
Hayman, R. W. (1951). A new African molossid bat. *Revue de zoologie et de botanique africaines*, **45 (1-2):** 82 - 83. [Abstract]
Hayman, R. W. (1952). ?? Title still needs to be checked. ?? *Bulletin of the British Museum (Natural History): Zoology*1.
Hayman, R. W. (1954). Notes on some African bats, mainly from the Belgian Congo. *Revue de zoologie et de botanique africaines*, **50 (3-4):** 277 - 295. [Abstract]
Hayman, R. W. (1957). Further notes on African bats. *Revue de zoologie et de botanique africaines*, **56 (1-2):** 41 - 45. [Abstract]
Hayman, R. W. (1960a). A note on the bat *Cloeotis percivali* Thomas. *Revue de zoologie et de botanique africaines*, **61 (3-4):** 167 - 172. [Abstract]
Hayman, R. W. (1960b). A note on *Rhinolophus ruwenzorii* Hill. *Revue de zoologie et de botanique africaines*, **61 (3-4):** 266 - 270.
Hayman, R. W. (1960c). Notes on some small African mammals. *Revue de zoologie et de botanique africaines*, **62 (1-2):** 59 - 65. [Abstract]
Hayman, R. W. (1963). Mammals from Angola, mainly from the Lunda District. *Publicaçoes culturais - Companhia de Diamantes Angola. Serviços Culturais*, **66:** 85 - 139. [Abstract]
Hayman, R. W. (1964). Notes on a West African bat *Hipposideros jonesi*. *Mammalia*, **28 (1):** 76 - 82. [Abstract]
Hayman, R. W. (1966). ?? Title still needs to be checked. ?? *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*(8) 154.
Hayman, R. W. and D. L. Harrison (1966). A note on *Tadarida* (*Chaerophon*) *bivittata* Heuglin. *Zeitschrift für Säugetierkunde*, **31 (3):** 219 - 226. [Abstract]
Hayman, R. W. and J. E. Hill (1971). *Order Chiroptera.* In Meester, J. and H. W. Setzer : *The mammals of Africa. An Identification manual. Part 2.* Smithsonian Institution Press - Washington, D.C.: 1 - 73. [Abstract]
Hayman, R. W. and T. S. Jones (1950). A note on pattern variation in the Vespertilionid Bat *Glauconycteris poensis* (Gray). *Annals and Magazine of Natural History*, **ser. 12, 3 (33):** 761 - 763. doi: 10.1080/00222935008654104.
Hayman, R. W., X. Misonne and W. N. Verheyen (1966). The bats of the Congo and of Rwanda and Burundi. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 154:** 1 - 191. [Abstract]
Hayssen, V., A. van Tienhoven and A. van Tienhoven (1993). *Asdell's patterns of mammalian reproduction: A compendium of species-specific data.* Cornell University Press, Ithaca, New York, USA: i - viii; 1 - 1014.
Hazevoet, C. J. (1995). *The birds of the Cape Verde islands.* British Ornithologist's Union, Tring. 192 pp.
Heard, D. J., J. L. De Young, B. Goodyear and G. A. Ellis (1979). Comparative rectal bacterial flora of four species of flying fox (*Pteropus* sp.). *Journal of Zoo and Wildlife Medicine*, **28:** 471 - 475.
Heard, D. J. and D. A. Whittier (1997). Hematologic and plasma biochemical reference values for three flying fox species (*Pteropus* sp.). *Journal of Zoo and Wildlife Medicine*, **28:** 464-470.
Hecht, A., K. Tsangaras, A. Greenwood and G. Czirják (2013). Molecular analysis of B- and T-lymphocyte cell markers in different bat species. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 66 - 67. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Hedrick, B. P. and E. R. Dumont (2018). Putting the leaf-nosed bats in context: a geometric morphometric analysis of three of the largest families of bats. *Journal of Mammalogy*, **99 (5):** 1042 - 1054. doi: 10.1093/jmammal/gyy101.
Heffner, R. S., G. Koay and H. E. Heffner (2006). Hearing in large (*Eidolon helvum*) and small (*Cynopterus brachyotis*) non-echolocating fruit bats. *Hearing Research*, **22 (1-2):** 17 - 25. doi: 10.1016/j.heares.2006.06.008.
Heffner, R. S., G. Koay and H. E. Heffner (2010). Use of binaural cues for sound localization in large and small non-echolocating bats: *Eidolon helvum* and *Cynopterus brachyotis*. *Journal of the Acoustical Society of America*, **127 (6):** 3837 - 3845. doi: 10.1121/1.3372717.
Heideman, P. D. (2000). *11. Environmental regulation of reproduction.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 469 - 499.
Heim de Balsac, H. (1934a). Mission Saharienne Augiéras-Draper 1927-1928. Mammifères. *Bulletin du Muséum national d'histoire naturelle de Paris*, **(2) 6 (6):** 482 - 489. [Abstract]

Heim de Balsac, H. (1934b). ?? Title still needs to be checked. ?? *Bulletin du Muséum national d'histoire naturelle de Paris*(2) 7.
Heim de Balsac, H. (1936). Biogéographie des Mammifères et des Oisaux de l'Afrique du Nord. *Suppléments au Bulletin Biologique de France et de Belgique*.
Heim de Balsac, H. (1937). *Plecotus auritus saharae* Laurent, 1936, n'est autre que *Otonycteris hemprichii* Peters, 1859. *Bulletin de la Société d'histoire naturelle de l'Afrique du nord*, **28:** 321 - 324.
Heim de Balsac, H. (1949). Etat actuel de nos connaissances concernant la faune des mammifères du Maroc. *Bulletin de la Société des sciences naturelles et physiques du Maroc*, **vol. jub. 1920-1945:** 289 - 303.
Heim de Balsac, H. (1965). Quelques enseignements d'order faunistique tirés de l'étude du régime alimentaire de *Tyto alba* dans l'ouest de l'afrique. *Alauda*, **33:** 309 - 322.
Heinrich, G. (1936). Ueber die von mir im Jahre 1935 in Bulgarien gesammelten Säugetiere. *Mitteilungen des K. Naturwissenschaftliches Institut, Sofia*, **9:** 33 - 48.
Heist, T. A. and W. J. , Jr. Schaldach (1965). On the terminal caudal vertebra of *Nycteris* (Chiroptera, Nycteridae). *Säugetierkundlige Mitteilungen*, **13 (1/2):** 26 - 27.
Helbig, M., T. Datzmann, F. Mayer and J. Fahr (2010). Molecular phylogeny of African "pipistrelle" bats (Vespertilionidae) suggests new clades, rearrangement of genera, and extensive cryptic diversity within species. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 168 - 169.
Helbig-Bonitz, M., S. W. Ferger, K. Böhning-Gaese, M. Tschapka, K. Howell and E. K. V. Kalko (2015). Bats are not birds - different responses to human land-use on a tropical mountain. *Biotropica*, **47 (4):** 497 - 508. doi: 10.1111/btp.12221.
Helbig-Bonitz, M., G. Rutten and E. K. V. Kalko (2013). Fruit bats can disperse figs over different land-use types on Mount Kilimanjaro, Tanzania. *African Journal of Ecology*, **52 (1):** 122 - 125 (for 2014). doi: 10.1111/aje.12090.
Held, J., M. Gmeiner, B. Mordmüller, P-B. Matsiégui, J. Schaer, I. Eckerle, N. Weber, K. Matuschewski, S. Bletz and F. Schaumburg (2016). Bats are rare reservoirs of *Staphylococcus aureus* complex in Gabon. *Infection, Genetics and Evolution*, **47:** 118 - 120 (for 2017). doi: 10.1016/j.meegid.2016.11.022.
Helgen, K. M. (2002). Guillaume Grandidier's mammal collections from Madagascar. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **67 (6):** 381 - 383.
Helgen, K. M. and T. L. McFadden (2001). Type specimens of recent mammals in the Museum of Comparative Zoology. *Bulletin of the Museum of Comparative Zoology*, **157 (2):** 93 - 181.
Heller, E. (1912). New races of Insectivores, Bats, and Lemurs from British East Africa. *Smithsonian Miscellaneous Collection*, **60 (12):** 1 - 13. [Abstract]
Heller, K. G. (1992). *The echolocation calls of Hipposideros ruber and Hipposideros caffer.* In Horácek, I. and V. Vohralík : *Prague Studies in Mammalogy*. Charles University Press: 75 - 77. [Abstract]
Heller, K. G. and M. Volleth (1984). Taxonomic position of "*Pipistrellus societatis*" Hill, 1972 and the karyological characteristics of the genus *Eptesicus* (Chiroptera: Vespertilionidae). *Zeitschrift für zoologischen Systematik und Evolutions-forschung*, **22:** 65 - 77. [Abstract]
Heller, K. G. and M. Volleth (1995). Community structure and evolution of insectivorous bats in the Palaeotropics and Neotropics. *Journal of Tropical Ecology*, **11:** 429 - 442. [Abstract]
Heller, K. G. and M. Volleth (2016). Note on the echolocation call frequency of *Hipposideros beatus* Andersen, 1906. *African Bat Conservation News*, **43:** 3 - 5.
Heller, K. G., M. Volleth and D. Kock (1994). Notes on some vespertilionid bats from the Kivu region, Central Africa (Mammalia: Chiroptera). *Senckenbergiana biologica*, **74 (1/2):** 1 - 8. [Abstract]
Helmick, K. E., D. J. Heard, L. Richey, M. Finnegan, G. A. Ellis, L. Tucker and R. S. Weyant (2004). A *Pasteurella*-like bacterium associated with pneumonia in captive Megachiropterans. *Journal of Zoo and Wildlife Medicine*, **35 (1):** 88 - 93. doi: 10.1638/01-083.
Hemming, F. (1960). Karl Jordan (1861 - 1959). *Bulletin of Zoological Nomenclature*, **17 (9 - 11):** 259 - 266.
Henry, M., P. Barrière, A. Gautier-Hion and M. Colyn (2004). Species composition, abundance and vertical stratification of a bat community (Megachiroptera: Pteropodidae) in a West African rain forest. *Journal of Tropical Ecology*, **20:** 21 - 29. doi: 10.1017/80266467404006145.
Herbert, V. H. (1985). Echoortungsverhalten des Flugundes *Rousettus aegyptiacus* (Megachiroptera). *Zeitschrift für Säugetierkunde*, **50:** 141 - 152.
Herdina, A. N., P. Hulva, I. Horácek, P. Benda, C. Mayer, H. Hilgers and B. Metscher (2013). The *Pipistrellus* baculum: individual and phylogeographic variation and cryptic species discrimination. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 68. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Herdina, A. N., P. Hulva, I. Horácek, P. Benda, C. Mayer, H. Hilgers and B. D. Metscher (2014). MicroCT imaging reveals morphometric baculum differences for discriminating the cryptic species *Pipistrellus pipistrellus* and *P. pygmaeus*. *Acta Chiropterologica*, **16 (1):** 157 - 168. doi: 10.3161/150811014X683372.
Herholdt, E. M. (1989). A new distribution record for the Botswana long-eared bat in South Africa. *South African Journal of Wildlife Research*, **19 (2):** 86 - 87. [Abstract]
Herkt, K. M. B., G. Barnikel, A. K. Skidmore and J. Fahr (2015). A high-resolution model of bat diversity and endemism for continental Africa. *Ecological Modeling*, **320:** 9 - 28 (for 2016). doi: 10.1016/j.ecolmodel.2015.09.009.
Herkt, K. M. B., G. Barnikel, M. Wegmann, E. K. V. Kalko and J. Fahr (2010). Modelling continental species richness of African bats at high resolution. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 170.
Herkt, K. M. B., A. K. Skidmore and J. Fahr (2017). Macroecological conclusions based on IUCN expert maps: A call for caution. *Global Ecology and Biogeography*, **26 (8):** 930 - 941. doi: 10.1111/geb.12601.
Herlant, M. (1953). Etude comparative sur l'activité génitale des cheiroptères. *Annalen van de Koninklijke Vereniging voor Dierkunde*, **84:** 87 - 116. [Abstract]
Hermann, J. (1804). *Observationes zoologicae, quibus novae complures, aliaeque animalium species describuntur et illustrantur. Observationes zoologicae*, **Opus posthumum edidit Fridericus Ludovicus Hammer. - Strasbourg:** A.Koenig, & Paris: [Author], viii + 332 pp.
Hernández Fernández, M. and E. S. Vrba (2005). Rapoport effect and biomic specialization in African mammals: revisiting the climatic variability hypothesis. *Journal of Biogeography*, **32:** 903 - 918. doi: 10.1111/j.1365-2699.2004.01188.x.
Herreid, C. F. and R. B. Davis (1966). Flight patterns of bats. *Journal of Mammalogy*, **47 (1):** 78 - 87. [Abstract]

Herrera M. , L. G., A. P. Cruz-Neto, M. S. Wojciechowski, P. Larrain, B. Pinshow and C. Korine (2015). The relationships between food and energy intakes, salt content and sugar types in Egyptian fruit bats. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **80 (5):** 409 - 413. doi: 10.1016/j.mambio.2015.05.007.

Herrera M, L. G., C. Korine, T. H. Fleming and Z. Arad (2008). Dietary implications of intrapopulation variation in nitrogen isotope composition of an Old World fruit bat. *Journal of Mammalogy*, **89 (5):** 1184 - 1190. doi: 10.1644/07-MAMM-A-263.1.

Herselman, J. C. and P. M. Norton (1985). The distribution and status of bats (Mammalia: Chiroptera) in the Cape Province. *Annals of the Cape Provincial Museums (Natural History)*, **16 (4):** 73 - 124. [Abstract]

Herzig-Straschil, B. and G. A. Robinson (1978). On the ecology of the fruit bat, *Rousettus aegyptiacus leachi* (A. Smith, 1829) in the Tsitsikama Coastal National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **21 (1):** 101 - 110. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/965. [Abstract]

Heuglin, Th. von (1861). Beiträge zur Fauna der Säugethiere NO.-Afrikas. I. Chiroptera. *Nova Acta Academie Cæsareae Leopoldina-Carolinensis*, **29 (8):** 1 - 18.

Heuglin, Th. von (1864). Ueber einige Chiroptera Central-Afrika's. *Nova Acta Academie Cæsareae Leopoldina-Carolinensis*, **31 (7):** 12 - 15.

Heuglin, Th. von (1865). Weitere Einsendung an die Kaiserl. Leopold.-carol. deutsche Akademie der Wissenschaften, mit zoologischen Notizen aus Afrika. *Leopoldina: Mitteilungen der Deuschen Akademei der Naturforsher Leopoldina (Halle)*, **5 (3 & 4):** 32 - 36.

Heuglin, Th. von (1877). *Reise in Nordost-Afrika. Schilderungen aus dem Gebiete der Beni Amer und Habab nebst zoologischen Skizzen und einem Führer für Jagdreisende. Zweiter Band.* G. Westerman - Braunschweig: i - vii; 1 - 304.

Heuglin, Th. von and L. J. Fitzinger (1866). Systematische Uebersicht der Säugethiere Nord-Ost Afrika's, mit Einschluss der arabischen Küste, des rothen Meeres, des Somáli- und der Nilquellen-Lander, südwärts bis zum vierten Grade nördlicher Breite. *Sitzungsberichte der Akademie für Wissenschaften aus Wien, mathematisch naturwissenschaftliche Klasse*, **54 (6 - 10):** 537 - 611. [Abstract]

Heuts, M. J. and N. Leleup (1954). La géographie et l'écologie des grottes du Bas-Congo. Les habitats de *Caecobarbus Geertsi* Boulenger. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **35 (1):** 71.

Hewitt, J. (1913). Note on a variety of Rhinolophus swinnyi Gough from Pirie, E. Cape Colony. *Records of the Albany Museum*, **2:** 402 - 403.

Hewitt, J. (1931). *A guide to the Vertebrate fauna of the Eastern Cape Province. Part 1. Mammals and Birds.* Albany Museum - Grahamstown.

Heyneman, D. and R. W. Macy (1962). Helminths reported from bats (Chiroptera) in Egypt with an illustrated key to the common flukes. *Journal of the Egyptian Public Health Association*, **37 (4):** 109 - 139.

Heys, J. G., K. M. MacLeod, C. F. Moss and M. E. Hasselmo (2013). Bat and rat neurons differ in theta-frequency resonance despite similar coding of space. *Science*, **340 (6130):** 363 - 367. doi: 10.1126/science.1233831.

Hickey, A. J. R., M. Jüllig, J. Aitken, K. Loomes, M. E. Hauber and A. R. J. Phillips (2011). Birds and longevity: Does flight driven aerobicity provide an oxidative sink? *Ageing Research Reviews*, **11 (2):** 242 - 253 (for 2012). doi: 10.1016/j.arr.2011.12.002.

Hickey, M. B. C. and J. M. Dunlop (2000). *Nycteris grandis*. *Mammalian Species*, **632:** 1 - 4, 3 figs.

Hickey, M. B. C. and M. B. Fenton (1987). Scent-dispersing hairs (osmetrichia) in some Pteropodidae and Molossidae (Chiroptera). *Journal of Mammalogy*, **68 (2):** 381 - 384.

Hikufe, E. H., C. M. Freuling, R. Athingo, A. Shilongo, E.-E. Ndevaetela, M. Helao, M. Shiindi, R. Hassel, A. Bishi, S. Khaiseb, J. Kabajani, J. van der Westhuizen, G. Torres, A. Britton, M. Letshwenyo, K. Schwabenbauer, T. C. Mettenleiter, N. Denzin, S. Amler, F. J. Conraths, T. Müller and A. Maseke (2019). Ecology and epidemiology of rabies in humans, domestic animals and wildlife in Namibia, 2011 - 2017. *PLoS Neglected Tropical Diseases*, **13 (4):** e0007355. doi: 10.1371/journal.pntd.0007355.

Hildebrand, E. A., S. A. Brandt and J. Lesur-Gebremariam (2010). The Holocene archaeology of southwest Ethiopia: New insights from the Kafa archaeological project. *African Archaeological Review*, **27 (4):** 255 - 289. doi: 10.1007/s10437-010-9079-8. URL: http://www.springerlink.com/content/ju73627425j88v21/fulltext.pdf .

Hill, J. E. (1963a). A revision of the genus *Hipposideros*. *Bulletin of the British Museum (Natural History): Zoology*, **11 (1):** 1 - 129. doi: 10.5962/bhl.part.4716. [Abstract]

Hill, J. E. (1963b). Some notes on the *Pipistrellus ceylonicus* group, with the description of a new subspecies. *Mammalia*, **27 (4):** 532 - 536. [Abstract]

Hill, J. E. (1964). Notes on a collection of bats from Figuig, Morocco. *Mammalia*, **28 (1):** 83 - 87. [Abstract]

Hill, J. E. (1965). Asiatic bats of the genera *Kerivoula* and *Phoniscus* (Vespertilionidae), with a note on *Kerivoula aerosa* Tomes. *Mammalia*, **29 (4):** 524 - 556. doi: 10.1515/mamm.1965.29.4.524. [Abstract]

Hill, J. E. (1966). The status of *Pipistrellus regulus* Thomas (Chiroptera, Vespertilionidae). *Mammalia*, **30 (2):** 302 - 307. [Abstract]

Hill, J. E. (1968). Bats from the Cameroons, with the description of a new species of *Pipistrellus*. *Bonner zoologische Beitrage*, **19 (1/2):** 43 - 48. [Abstract]

Hill, J. E. (1970). The status of *Myopterus senegalensis* Oken, 1816 (Chiroptera, Molossidae). *Mammalia*, **33 (4):** 727 - 729 (for 1969).

Hill, J. E. (1971a). The bats of the Aldabra atoll, Western Indian Ocean. *Philosophical transactions of the Royal Society of London*, ***Series B, Biological Sciences*** **260:** 573 - 576.

Hill, J. E. (1971b). ?? Title still needs to be checked. ?? *Bulletin of the British Museum (Natural History): Zoology*21.

Hill, J. E. (1974a). A review of *Laephotis* Thomas, 1901 (Chiroptera: Vespertilionidae). *Bulletin of the British Museum (Natural History): Zoology*, **27 (2):** 73 - 82. [Abstract]

Hill, J. E. (1974b). A review of *Scotoecus* Thomas, 1901 (Chiroptera: Vespertilionidae). *Bulletin of the British Museum (Natural History): Zoology*, **27 (4):** 167 - 188. [Abstract]

Hill, J. E. (1975). Occurrence of *Nycteris parisii* (de Beaux, 1923) (Chiroptera: Nycteridae) in Ethiopia. *Mammalia*, **39 (3):** 506 - 508.

Hill, J. E. (1976). A note on *Pipistrellus rusticus* (Tomes, 1861) (Chiroptera, Vespertilionidae). *Revue de zoologie africaine*, **90 (3):** 626 - 633. [Abstract]

Hill, J. E. (1977a). A review of the Rhinopomatidae (Mammalia: Chiroptera). *Bulletin of the British Museum (Natural History): Zoology*, **32 (2):** 29 - 43. [Abstract]

Hill, J. E. (1977b). African bats allied to *Kerivoula lanosa* (A. Smith, 1847) (Chiroptera: Vespertilionidae). *Revue de zoologie africaine*, **91 (3):** 623 - 633. [Abstract]

Hill, J. E. (1980). The status of *Vespertilio borbonicus* E. Geoffroy, 1803 (Chiroptera: Vespertilionidae). *Zoologische Mededelingen*, **55 (24):** 287 - 295. [Abstract]
Hill, J. E. (1982a). Records of bats from Mount Nimba, Liberia. *Mammalia*, **46 (1):** 116 - 120. [Abstract]
Hill, J. E. (1982b). A review of the leaf-nosed bats *Rhinonycteris*, *Cloeotis* and *Triaenops* (Chiroptera: Hipposideridae). *Bonner zoologische Beitrage*, **33 (2 - 4):** 165 - 186. URL: http://zfmk.de/BZB/1982/1982%20Hill%20J.E.%20p165%20orginal.pdf. [Abstract]
Hill, J. E. (1983). Further records of bats from the Central African Republic (Mammalia: Chiroptera). *Annals of Carnegie Museum*, **52 (3):** 55 - 58. [Abstract]
Hill, J. E. (1990). *A memoir and bibliography of Michael Rogers Oldfield Thomas, F.R.S.* Bulletin of the British Museum of Natural History (History Series), 18 (2): 25 - 113.
Hill, J. E. (1993). Long-fingered bats of the genus *Miniopterus* (Chiroptera: Vespertilionidae) from Madagascar. *Mammalia*, **57 (3):** 401 - 405. [Abstract]
Hill, J. E. and D. L. Harrison (1987). The baculum in the Vespertilioninae (Chiroptera: Vespertilionidae) with a systematic review, a synopsis of *Pipistrellus* and *Eptesicus*, and the description of a new genus and subgenus. *Bulletin of the British Museum (Natural History): Zoology*, **52 (7):** 225 - 305. [Abstract]
Hill, J. E., D. L. Harrison and T. S. Jones (1988). New records of bats (Microchiroptera) from Nigeria. *Mammalia*, **52 (4):** 590 - 592. [Abstract]
Hill, J. E. and P. Morris (1971). Bats from Ethiopia collected by the Great Abbai expedition, 1968. *Bulletin of the British Museum (Natural History): Zoology*, **21 (2):** 27 - 49, 3 plates. [Abstract]
Hill, J. E. and J. D. Smith (1984). *Bats: a natural history.* University of Texas Press, Austin: 243 pp.
Hill, J. Eric (1937). Two new bats, *Eptesicus* and *Mops*, from Angola. *American Museum Novitates*, **916:** 1 - 3. [Abstract]
Hill, J. Eric (1941). A collection of mammals from Dondi, Angola. *Journal of Mammalogy*, **22 (1):** 81 - 85.
Hill, J. Eric (1942). A new bat of the *Rhinolophus philippinensis* group from mount Ruwenzori, Africa. *American Museum Novitates*, **1180:** 1 - 2. [Abstract]
Hill, J. Eric and T. D. Carter (1941). The mammals of Angola, Africa. *Bulletin of the American Museum of Natural History*, **78 (1):** 1 - 211. [Abstract]
Hill, K., M. C. Schoeman and D. Vosloo (2018). The brains of bats foraging at wastewater treatment works accumulate arsenic, and have low non-enzymatic antioxidant capacities. *NeuroToxicology*, **69:** 232 - 241 (for 2018). doi: 10.1016/j.neuro.2017.12.004.
Hill, K., S. van Aswegen, M. C. Schoeman, S. Claassens, P. Jansen van Rensburg, S. Naidoo and D. Vosloo (2016). Foraging at wastewater treatment works affects brown adipose tissue fatty acid profiles in banana bats. *Biology Open*, **5 (2):** 92 - 99. doi: 10.1242/bio.013524.
Hilton-Taylor, C (2000). *2000 IUCN Red List of Threatened Species.* IUCN, Gland, Switzerland and Cambridge, UK.
Hinton, M. A. C. (1920). XXIX. Three new mammals from Northern Rhodesia. *Annals and Magazine of Natural History*, **ser. 9, 6 (32):** 239 - 242.
Hirst, S. (1923). 47. On some new or little-known species of Acari. *Proceedings of the Zoological Society of London*, **1923, IV:** 971 - 1000.
Hizem, M. W. and B. Allegrini (2009). Contribution à la connaissance des chiroptères du Parc National de Bou Hedma (Tunisie). *Poiretia*, **1:** 5 - 9.
Hoarau, F., G. Le Minter, L. Joffrin, M. C. Schoeman, E. Lagadec, B. Ramasindrazana, A. Dos Santos, S. M. Goodman, E. S. Gudo, P. Mavingui and C. Lebarbenchon (2018). Bat Astrovirus in Mozambique. *Virology Journal*, **15:** 104. doi: 10.1186/s12985-018-1011-x.
Hockman, D., C. J. Cretekos, M. K. Mason, R. R. Behringer, D. S. Jacobs and N. Illing (2009). A second wave of *Sonic hedgehog* expression during the development of the bat limb. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 17. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.
Hockman, D., C. J. Cretekos, M. K. Mason, R. R. Behringer, Jacobs, D. S. and N. Illing (2008). A second wave of Sonic hedgehog expression during the development of the bat limb. *Proceedings of the National Academy of Sciences, U.S.A.*, **105 (44):** 16982 - 16987. doi: 10.1073_pnas.0805308105.
Hodgson, B. H. (1835). Synopsis of the Vespertilionidae of Nipal. *Journal of the Asiatic Society of Bengal*, **4 (8):** 699 - 700. [Abstract]
Hodgson, B. H. (1855). ?? Title still needs to be checked. ?? In Horsfield, T. : *Brief notices of several new or little-known species of Mammalia, lately discovered and collected in Nepal, by Brian Houghton Hodgson. Annals and Magazine of Natural History*, **ser. 2, 16 (92):** 101 - 114.
Hoenerhoff, M. and K. Williams (2004). Copper-associated hepatopathy in a Mexican fruit bat (*Artibeus jamaicensis*) and establishment of a reference range for hepatic copper in bats. *Journal of Veterinary Diagnosis and Investigation*, **16 (6):** 590 - 593. URL: http://vdi.sagepub.com/content/16/6/590.full.pdf.
Hoesch, W. and E. von Lehmann (1956). Zur Säugetier-Fauna Südwestafrikas. *Bonner zoologische Beitrage*, **7 (1-3):** 857. [Abstract]
Hoffer, S. R., R. A. Van den Bussche and I. Horácek (2006). Genetic status of the American *Pipistrellus* (Vespertilionidae) with description of new genus. *Journal of Mammalogy*, **87 (5):** 981 - 992.
Hoffmann, A. (1999). Spatial and temporal patterns in *M. cf. natalensis* revealed by radiotracking. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 101.
Hoffmann, F. G. and R. J. Baker (2001). Systematics of bats of the genus *Glossophaga* (Chiroptera: Phyllostomidae) and phylogeography in *G. soricina* based on the cytochrome-*b* gene. *Journal of Mammalogy*, **82 (4):** 1092 - 1101.
Hoffmann, M., P. Grubb, C. P. Groves, R. Hutterer, E. van der Straeten, N. Simmons and W. Bergmans (2009). A synthesis of African and western Indian Ocean Island mammal taxa (Class: Mammalia) described between 1988 and 2008: an update to Allen (1939) and Ansell (1989). *Zootaxa*, **2205:** 1 - 36.
Hoffmann, M., M. A. Müller, J. F. Drexler, J. Glende, M. Erdt, T. Gützkow, C. Losemann, T. Binger, H. Deng, C. Schwegmann-Weßels, K.-H. Esser, C. Drosten and G. Herrler (2013). Differential sensitivity of bat cells to infection by enveloped RNA viruses: coronaviruses, paramyxoviruses, filoviruses, and influenza viruses. *PLoS ONE*, **8 (8):** e72942. doi: 10.1371/journal.pone.0072942.
Hoffmann, M., I. Nehlmeier, C. Brinkmann, V. Krähling, L. Behner, A.-S. Moldenhauer, N. Krüger, J. Nehls, M. Schindler, T. Hoenen, A. Maisner, S. Becker and S. Pöhlmann (2019). Tetherin inhibits Nipah virus but not Ebola virus replication in fruit bat cells. *Journal of Virology*, **93 (3):** e01821-18. doi: 10.1128/JVI.01821-18.

Hoffmaster, E. and J. Vonk (2016). Dynamic duos? Jamaican fruit bats (*Artibeus jamaicensis*) do not show prosocial behavior in a release paradigm. *Behavioral Sciences*, **6:** 25. doi: 10.3390/bs6040025.
Höhne, K., B. Loose and H. P. R. Seeliger (1975). Isolation of *Listeria monocytogenes* in slaughter animals and bats of Togo (West Africa). *Annales de Microbiologie de l'Institut Pasteur*, **126 A:** 501 - 507. [Abstract]
Holderied, M., C. Korine and T. Moritz (2010). Hemprich's long-eared bat (*Otonycteris hemprichii*) as a predator of scorpions: Whispering echolocation, passive gleaning and prey selection. *Journal of Comparative Physiology*, **A 197 (5):** 425 - 433 (for 2011). doi: 10.1007/s00359-010-0608-3.
Holland, R. and D. A. Walters (2005). Echolocation signals and pinnae movement in the fruit bat *Rousettus aegyptiacus*. *Acta Chiropterologica*, **7 (1):** 83 - 90. doi: 10.3161/1733-5329(2005)7[83:ESAPMI]2.0.CO;2.
Holland, R. A., D. A. Waters and J. M. V. Rayner (2004a). Echolocation signal structure in the megachiropteran bat *Rousettus aegyptiacus* Geoffroy 1810. *Journal of Evolutionary Biology*, **207 (25):** 4361 - 4369. doi: 10.1242/jeb.01288.
Holland, R.(A.), P. Winter and D. A. Waters (2004b). Sensory systems and spatial memory in the Megachiropteran bat *Rousettus aegyptiacus*. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 13.
Holland, R. A., P. Winter and D. A. Waters (2005). Sensory systems and spatial memory in the fruit bat *Rousettus aegyptiacus*. *Ethology*, **111 (8):** 715 - 725.
Hollar, L. J. and M. S. Springer (1997). Old world fruitbat phylogeny: Evidence for convergent evolution and an endemic African clade. *Proceedings of the National Academy of Sciences of the USA*, **94:** 5716 - 5721. [Abstract]
Hollister, N. (1916). Description of a new genus and eight new species and subspecies of African mammals. *Smithsonian Miscellaneous Collection*, **66 (1) (2406):** 1 - 8.
Hollister, N. (1918). East African mammals in the United States National Museum. I. Insectivora, Carnivora and Chiroptera. *Bulletin of the United States National Museums*, **99:** 1 - 194, 3 figs, 55 pls. [Abstract]
Holmes, E. C., G. Dudas, A. Rambaut and K. G. Andersen (2016). The evolution of Ebola virus: Insights from the 2013 - 2016 epidemic. *Nature*, **538 (7624):** 193–200. doi: 10.1038/nature19790.
Homan, J. A. and J. K. Jones (1975a). *Monophyllus redmani*. *Mammalian Species*, **57:** 1 - 3, 4 figs.
Homan, J. A. and J. K. Jones (1975b). *Monophyllus plethodon*. *Mammalian Species*, **58:** 1 - 2, 3 figs.
Honacki, J. H., K. E. Kinman and J. W. Koeppl (1982). *Mammal species of the world: A taxonomic and geographic reference.* Allen Press, Inc. and The Association of Systematics Collection - Lawrence, Kansas, USA: i - ix; 1 - 694.
Hood, C. S. (1989). Comparative morphology and evolution of the female reproductive tract in macroglossine bats (Mammalia, Chiroptera). *Journal of Morphology*, **199:** 207-221.
Hood, C. S. (2000). Geometric morphometric approaches to the study of sexual size dimorphism in mammals. *Hystrix*, **(n.s.) 11 (1):** 77 - 90.
Hood, C. S. and R. J. Baker (1986). G- and C-banding chromosomal studies of bats of the family Emballonuridae. *Journal of Mammalogy*, **67 (4):** 705 - 711. [Abstract]
Hood, W. R., T. H. Kunz, O. T. Oftedal, S. J. Iverson, D. LeBlanc and J. Seyjagat (2001). Interspecific and intraspecific variation in proximate, mineral, and fatty acid compositon of milk in Old World fruit bats (Chiroptera: Pteropodidae). *Physiological and Biochemical Zoology*, **74 (1):** 134 - 146.
Hoofer, S. R., S. A. Reeder, E. W. Hansen and R. A. Van Den Bussche (2003). Molecular phylogentics and taxonomic review of noctilionid and vespertilionid bats (Chiroptera: Yangochiroptera). *Journal of Mammalogy*, **84 (3):** 809 - 821. doi: 10.1644/BWG-034.
Hoofer, S. R. and R. A. Van Den Bussche (2001). Phylogenetic relationships of plecotine bats and allies based on mitochondrial ribosomal sequences. *Journal of Mammalogy*, **82 (1):** 131 - 137.
Hoofer, S. R. and R. A. Van Den Bussche (2003). Molecular phylogenetics of the chiropteran family Vespertilionidae. *Acta Chiropterologica*, **5 (Suppl.):** 1 - 63. doi: 10.3161/001.005.s101.
Hoofer, S. R., R. A. Van Den Bussche and I. Horácek (2006). Generic status of the American Pipistrelles (Vespertilionidae) with description of a new genus. *Journal of Mammalogy*, **87 (5):** 981 - 992. doi: 10.1644/05-MAMM-A-425R1.1.
Hoogstraal, H. (1956). *African Ixodoidea. I. Ticks of the Sudan. (With special reference to Equatoria Province and with preliminary reviews of the genera Boophilus, Margaropus and Hyalomma).* Research Report NM 005 050.29.07; 372 figures on 103 plates. [Abstract]
Hoogstraal, H. (1962). A brief review of the contemporary land mammals of Egypt (including Sinai). 1. Insectivora and Chiroptera. *Journal of the Egyptian Public Health Association*, **37 (4):** 143 - 162.
Hoogstraal, H. and G. M. Kohls (1967). Bat ticks of the genus *Argas* (Ixodoidea, Argasidae). 7. *A.* (*Chiropterargas*) *cordiformis*, new species, a heart-shaped parasite from South-West Africa. *Annals of the Entomological Society of America*, **60 (1):** 63 - 67. [Abstract]
Hoogstraal, H. and R. Traub (1963). The fleas (Siphonaptera) of Egypt. Host-parasite relationships of Insectivora and Chiroptera. *Journal of the Egyptian Public Health Association*, **38 (3):** 111 - 130. [Abstract]
Hoogstraal, H., K. Wassif and M. N. Kaiser (1957). Results of the Namru-3 Southeastern Egypt Expedition, 1954. *Bulletin of the Zoological Society of Egypt*, **13 (for 1955-1956):** 51 - 75. [Abstract]
Hopkins, G. H. E. and M Rothschild (1956). *An illustrated catalogue of the Rothschild collection of fleas in the British Museum (Nat. Hist.). Vol. II. Coplopsyllidae, Vermipsyllidae, Stephanocicidae [Macropsyllidae], Ischnopsyllidae, Hypsophthalmidae and Xiphiopsyllidae.* British Museum (Nat. Hist.), XII+446pp.
Hopwood, A. T. (1947). The generic names of the mandrill and baboons, with notes on some of the genera of Brisson, 1762. *Proceedings of the Zoological Society of London*, **117:** 533 - 536.
Horácek, I. (1990). Enigma of *Otonycteris*: Relationship, phylogeny, ecology. Abstract. Fifth European Bat Research Symposium: 20 - 25 august 1990 - Nyborg Strand, Denmark: no 33. [Abstract]
Horácek, I. (1991). Enigma of *Otonycteris*: Ecology, Relationship, Classification. *Myotis*, **29:** 17 - 30.
Horácek, I. (2013). *Otonycteris hemprichii Hemprich's Desert Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 598 - 599.
Horácek, I. and P. Benda (2004). *Hypsugo savii (Bonaparte, 1837).* In Krapp, F. : *Handbuch der Säugetiere Europas, Band 4: Fledertiere. Teil II: Chiroptera. Vespertilionidae 2, Molossidae, Nycteridae.* AULA-Verlag, Wiebelsheim: 911 - 914.
Horácek, I. and P. Benda [Eds] (2010). *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 1 - 356.
Horácek, I., P. Benda, P. Hulva, R. Bilgin, M. Abi-Said, R. Karanouh, N. Asan, I. Albayrak, A. Karatas, H. Nicolaou, T. Bartonicka and R. K. Lucan (2010). *Rousettus aegyptiacus* in the Mediterranean: Distribution, chorology and perspecives. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 174 - 175.

Horácek, I., P. Benda, R. Lucan, T. Bartonicka, P. Vallo and P. Hulva (2013a). Paleobiogeography of the Mediterranean fruit bats: an unresolvable issue? 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 71. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Horácek, I., P. Benda, R. Sadek, S. Karkabi, M. Abi-Said, R. Lucan, P. Hulva and R. Karanouh (2008). Bats of Lebanon. State of knowledge and perspectives. 14: 52 - 67.
Horácek, I., O. Fejfar and P. Hulva (2006). A new genus of vespertilionid bat from Early Miocene of Jebel Zelten, Libya, with comments on *Scotophilus* and early history of vespertilionid bats (Chiroptera). *Lynx (Praha)*, **37:** 131 - 150.
Horácek, I. and J. Gaisler (1985). Mating systems in *Myotis blythi* (Tomes, 1857). *Bat Research News*, **26 (4):** 62.
Horácek, I., J. Gaisler and V. Hanák (1999). Bats of the Palearctic region: a taxonomic, zoogeographical and ecological review. Abstract. VIIIth European Bat Research Symposium - Krakow, Poland: 25 - 26.
Horácek, I. and V. Hanák (1985). Generic status of *Pipistrellus savii* (Bonaparte, 1837) and remarks on systematics of the genus *Pipistrellus*. *Bat Research News*, **26 (4):** 62.
Horácek, I. and V. Hanák (1986). Generic status of *Pipistrellus savii* and comments on classification of the genus *Pipistrellus* (Chiroptera, Vespertilionidae). *Myotis*, **23-24:** 9 - 16. [Abstract]
Horácek, I., V. Hanák and J. Gaisler (2000). *Bats of the Palearctic region: a taxonomic and biogeographic review.* In Woloszyn, B. W. [Ed]: *Proceedings of the VIIIth EBRS. Vol I. Approaches to biogeography and ecology of bats.* Publication of CIC ISEZ PAN: 11 - 157.
Horácek, I., L. C. Maul, K. T. Smith, R. Barkai and A. Gopher (2013b). Bat remains (Mammalia, Chiroptera) from the Middle Pleistocene site of Qesem Cave, Israel, with the first Pleistocene record of fruit bats in the Mediterranean region. *Palaeontologia Electronica*, **16 (3):** 23A; 19 pp. URL: www.palaeo-electronica.org/content/2013/513-qesem-bats.
Horácek, I., E. Travnickova and P. Hulva (2017). When the extant bats arose? Fossil record and molecules illuminate the history of the bat fauna in western palearctics (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 112. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.
Hornok, S., J. Kontschán, D. Kováts, R. Kovács, D. Angyal, T. Görföl, Z. Polacsek, Z. Kalmár and A. D. Mihalca (2014). Bat ticks revisited: *Ixodes ariadnae* sp. nov. and allopatric genotypes of *I. vespertilionis* in caves of Hungary. *Parasites & Vectors*, **7:** 202. doi: 10.1186/1756-3305-7-202.
Hornok, S., K. Szoke, S. A. Boldogh, A. D. Sándor, J. Kontschán, V. T. Tu, A. Halajian, N. Takács, T. Görföl and P. Estók (2017a). Phylogenetic analyses of bat-associated bugs (Hemiptera: Cimicidae: Cimicinae and Cacodminae) indicate two new species close to *Cimex lectularius*. *Parasites & Vectors*, **10:** 439. doi: 10.1186/s13071-017-2376-1.
Hornok, S., K. Szoke, M. L. Meli, A. D. Sándor, T. Görföl, P. Estók, Y. Wang, V. T. Tu, D. Kováts, S. A. Boldogh, A. Corduneanu, K. M. Sulyok, M. Gyuranecz, J. Kontschán, N. Takács, A. Halajian, S. Epis and R. Hofmann-Lehmann (2019). Molecular detection of vector-borne bacteria in bat ticks (Acari: Ixodidae, Argasidae) from eight countries of the Old and New Worlds. *Parasites & Vectors*, **12:** 50. doi: 10.1186/s13071-019-3303-4.
Hornok, S., K. Szoke, V. T. Tu, J. Kontschán, N. Takács, A. D. Sándor, A. Halajian, G. Földvári, P. Estók, O. Plantard, S. Epis and T. Görföl (2017b). Mitochondrial gene heterogeneity of the bat soft tick *Argas vespertilionis* (Ixodida: Argasidae) in the Palaearctic. *Parasites & Vectors*, **10:** 109. doi: 10.1186/s13071-017-2037-4.
Horsfield, T. (1823). Zoological Research in Java. .
Horton, D. L., A. C. Banyard, D. A. Marston, E. Wise, D. Selden, A. Nunez, D. Hicks, T. Lembo, S. Cleaveland, A. J. Peel, I. V. Kuzmin, C. E. Rupprecht and A. R. Fooks (2014). Antigenic and genetic characterization of a divergent African virus, Ikoma lyssavirus. *Journal of general virology*, **95 (5):** 1025 - 1032. doi: 10.1099/vir.0.061952-0.
Hosken, D. J. (1998). Testes mass in megachiropteran bats varies in accordance with sperm competition theory. *Behavioral ecology and sociobiology*, **44 (3):** 169 - 177. [Abstract]
Hosken, D. J., K. E. Jones, K. Chipperfield and A. Dixson (2001). Is the bat os penis sexually selected? *Behavioral ecology and sociobiology*, **50 (5):** 450 - 460. doi: 10.1007/s002650100389.
Houck, B. A., S. Chock and A. Mccammond (2004). Play behavior in captive *Pteropus rodricensis*, the Rodrigues fruit bat. *Bat Research News*, **45 (4):** 228.
Howard, C. W. (1908). A list of the ticks of South Africa, with descriptions and keys to all the forms known. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **1 (2):** 73 - 169. [Abstract]
Howell, F. C. and Y. Coppens (1974). *Eidolon* sp. from the late Pliocene of Ethiopia. *Comptes Rendus de l'Académie des Sciences, Paris*, **278:** 2421 - 2427.
Howell, K. M. (1974). Bats collected at Lake Rudolf. *East African natural History Society Bulletin*14.
Howell, K. M. (1979). Natural destruction of Kaolin mine bat roosts in Tanzania. *Bat Research News*, **20 (1):** 8.
Howell, K. M. (1980). Abnormal white colouration in three species of insectivorous bats. *Journal of Zoology*, **191:** 424 - 427.
Howell, K. M. and J. R. Mainoya (1974). An albino bat, *Hipposideros ruber* Noack, from Tanzania. *East African Wildlife Journal*, **12 (2):** 155. doi: 10.1111/j.1365-2028.1974.tb01031.x.
Howell, K. M., C. A. Msuya and P. M. Kihaule (2000). A preliminary biodiversity (fauna) assessment of the Rufiji floodplain and delta. Rufiji Environment Management Project: Technical Report. No. 9 - Dar es Salaam: 68 pp.
Howell, K. M. and R. Wrangham (1974). First record of the Dwarf Slit-faced bat *Nycteris nana* in Tanzania. *East African natural History Society Bulletin*36.
Hu, B., X. Ge, L.-F. Wang and Z. Shi (2015). Bat origin of human coronaviruses. *Virology Journal*, **12:** 221. doi: 10.1186/s12985-015-0422-1.
Hubert, B. and W. Böhme (1978). Karyotype of *Gerbillus pyramidum* I. Geoffroy (Rodentia, Gerbillidae). *Bulletin of the Carnegie Museum of Natural History*, **6:** 38 - 40. [Abstract]
Huggel, H.-J. (1959). La pression sanguine du système veineux autonome de l'aile de la Roussette *Eidolon helvum* Kerr (Macrochiroptera). *Revue suisse de zoologie*, **66 (2) 16:** 315 - 321.
Hughes, K., F. Constantino-Casas, V. A. Haverson and S. J. Philp (2018). Pathology in practice. *Journal of the American Veterinary Medical Association*, **253 (7):** 865 - 868.
Hugueney, M., O. Maridet, P. Mein, C. Mourer-Chauviré and J. Priéto (2015). *Lartetium africanum* (Lavocat, 1961) (Eulipotyphla · Soricidae) from Beni-Mellal (Morocco), the oldest African shrew: new descriptions, palaeoenvironment and comments on biochronological context. *Palaeobiodiversity and Palaeoenvironments*, **95 (3):** 465 - 476. doi: 10.1007/s12549-015-0197-9.
Huhndorf, M. , Kaleme, P. (2008). *Chapter 3: Small mammal surveys of Misotshi-Kabogo.* In Plumptre, A.J., D. Kujirakwinja, J. Matunguru, C. Kahindo, P. Kaleme, B. Marks and M. Huhndorf : *Biodiversity surveys in the Misotshi-Kabogo and Marungu regions of eastern Democratic Republic of Congo with a focus on chimpanzees.* Albertine Rift Technical Reports No. 5: 25 - 28.

Hulva, P., P. Benda, V. Hanák, A. Evin and I. Horácek (2007a). New mitochondrial lineages within the *Pipistrellus pipistrellus* complex from Mediterranean Europe. *Folia zoologica: International journal of vertebratology*, **56 (4):** 378 - 388.
Hulva, P., C. Dundarova, T. Maresová, R. Bilgin, P. Benda, T. Bartonicka and I. Horácek (2011). Genetic structure of Egyptian fruit bat in northern distribution limits. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 31. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.
Hulva, P., A. Fornùsková, A. Chudárková, A. Evin, B. Allegrini, P. Benda and J. Bryja (2010). Mechanisms of radiation in a bat group from the genus *Pipistrellus* inferred by phylogeography, demography and population genetics. *Molecular Ecology*, **19 (24):** 5417 - 5431. doi: 10.1111/j.1365-294X.2010.04899.x. URL: _http://onlinelibrary.wiley.com/doi/10.1111/j.1365-294X.2010.04899.x/pdf_.
Hulva, P., I. Horácek and P. Benda (2007b). Molecules, morphometrics and new fossils provide an integrated view of the evolutionary history of Rhinopomatidae (Mammalia: Chiroptera). *BMC Evolutionary Biology*, **7 (165):** 15 pp. doi: 10.1186/1471-2148-7-165.
Hulva, P., I. Horácek, P. P. Strelkov and P. Benda (2004). Molecular architecture of *Pipistrellus pipistrellus*/*Pipistrellus pygmaeus* complex (Chiroptera: Vespertilionidae): further cryptic species and Mediterranean origin of the divergence. *Molecular phylogenetics and evolution*, **32 (3):** 1023 - 1035. doi: 10.1016/j.ympev.2004.04.007.
Hulva, P., T. Marešová, H. Dundarova, R. Bilgin, P. Benda, T. Bartonicka and I. Horácek (2012). Environmental margin and island evolution in Middle Eastern populations of the Egyptian fruit bat. *Molecular Ecology*, **21 (24):** 6104 - 6116. doi: 10.1111/mec.12078.
Hulva, P., T. Marešová, H. Dundarova, R. Bilgin, P. Benda, T. Bartonicka and I. Horácek (2013). Environmental margin, island evolution, and anthropogenic impact in Middle Eastern populations of the Egyptian fruit bat. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 74. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Hume, J. and G. Middleton (2011). A preliminary vertebrate palaeontological cave survey of the Comoros Islands. *Phelsuma*, **19:** 27 - 40.
Huntley, J. W., K. D. Keith, A. A. Castellanos, L. J. Musher and G. Voelker (2019). Underestimated and cryptic diversification patterns across Afro-tropical lowland forests. *Journal of Biogeography*, **46 (2):** 381 - 391. doi: 10.1111/jbi.13505.
Hurka, K. (1982). On the insect bat ectoparasites of Coastal Libya (Cimicidae, Nycteribiidae, Streblidae, Ischnopsyllidae). *Vestnik ceskoslovenské Spolecnosti zoologické*, **46:** 85 - 91.
Husemann, M., T. Schmitt, F. E. Zachos, W. Ulrich and J. C. Habel (2013). Palaearctic biogeography revisited: evidence for the existence of a North African refugium for Western Palaearctic biota. *Journal of Biogeography*, **41 (1):** 81 - 94 (for 2014). doi: 10.1111/jbi.12180.
Hutcheon, J. M. and T. Garland Jr. (2004). Are megabats big?. *Journal of Mammalian Evolution*, **11 (3-4):** 257 - 277.
Hutcheon, J. M. and J. A. (W.) Kirsch (2004a). A moveable face: deconstructing microbat phylogeny. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 10.
Hutcheon, J. M. and J. A. W. Kirsch (2004b). Camping in a different tree: Results of molecular systematic studies of bats using DNA-DNA hybridization. *Journal of Mammalian Evolution*, **11 (1):** 17 - 47.
Hutcheon, J. M. and J. A. W. Kirsch (2006). A moveable face: deconstructing the Microchiroptera and a new classification of extant bats. *Acta Chiropterologica*, **8 (1):** 1 - 10. doi: 10.3161/1733-5329(2006)8[1:AMFDTM]2.0.CO;2.
Hutcheon, J. M., J. A. W. Kirsch and J. D. Pettigrew (1998). Base-compositional biases and the bat problem. III. The queston of microchiropteran monophyly. *Philosophical transactions of the Royal Society of London*, **B 353:** 607 - 617. [Abstract]
Hutson, A. M. (1999). *Tadarida teniotis (Rafinesque, 1814).* In Mitchell-Jones, A. .J., G. Amori, W. Bogdanowicz, B. Krystufek, P. J. H. Reijnders, F. Spitzenberger, M. Stubbe, B. J. M. Thissen, V. Vohralík and J. Zima : *The atlas of European mammals.* Academic Press, London: 156 - 157.
Hutson, A. M. (2002). A feasibility study on additional bats Agreements under CMS submitted to the 11th Meeting of the CMS Scientific Council (UNEP/ScC11/Doc.7): 59 pp. In Anonymus, : *Twelfth Meeting of the CMS Scientific Council - Glasgow, Scotland, United Kingdom, 31 March-3 April 2004: 68 pp.* . URL: http://www.cms.int/bodies/ScC/12th_scientific_council/pdf/English/Doc_13_Bats_Study_combined_E.pdf.
Hutson, A. M. (2004a). The bats of Aldabra atoll, Seychelles. *Phelsuma*, **12:** 126 - 132. URL: http://islandbiodiversity.com/Phelsuma%2012-6.pdf.
Hutson, A. M. (2004b). Update to: A feasibility study on additional bats Agreements under CMS - Update of UNEP/ScC11/Doc.7: 8 pp. In Anonymus : *Twelfth Meeting of the CMS Scientific Council - Glasgow, Scotland, United Kingdom, 31 March-3 April 2004: 68 pp.* . URL: http://www.cms.int/bodies/ScC/12th_scientific_council/pdf/English/Doc_13_Bats_Study_combined_E.pdf.
Hutson, A. M., J. T. Alcaldé, J. Juste, A. Karatas, J. Palmeirim and M. Paunovic (2008a). *Nyctalus lasiopterus.* In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., S. Aulagnier, P. Benda, A. Karatas, J. Palmeirim and M. Paunovic (2008c). *Miniopterus schreibersii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., S. Aulagnier, J. Juste, A. Karatas, J. Palmeirim and M. Paunovic (2008d). *Plecotus kolombatovici*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., S. Aulagnier and F. Spitzenberger (2008b). *Barbastella barbastellus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., S. Aulagnier and F. Spitzenberger (2008e). *Myotis nattereri*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. (M.) and W. Bergmans (2004). *Mormopterus acetabulosus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Hutson, A. M. and W. Bergmans (2008). *Mormopterus acetabulosus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M. and P. H. C. Lina [Eds] (2011). *XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania.* 1 - 100. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.
Hutson, A. M. and S. Mickleburgh (1994). An action plan for Microchiroptera. Abstract. Symposium on Current problems of bat protection in Central and Eastern Europe - Bonn.
Hutson, A. M., S. P. Mickleburgh and P. A. Racey (2001). *Global status survey and conservation action plan: Microchiropteran bats.* IUCN/SSC Chiroptera Specialist Group - Gland, Switzerland and Cambridge: i - x; 1 - 259.
Hutson, A. M., P. Racey, J. Ravino, S. Mickleburgh, W. Bergmans and J. Fahr (2008f). *Taphozous mauritianus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Hutson, A. M., P. A. Racey, S. Goodman and D. Jacobs (2008g). *Pipistrellus nanus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., P. A. Racey and J. Ravino (2008q). *Nycteris madagascariensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, S. Aulagnier, J. T. Alcaldé, G. Csorba, S. Bumrungsri, C. Francis, P. (J. J.) Bates, M. Gumal, T. Kingston and P. Benda (2008h). *Eptesicus serotinus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, S. Aulagnier and I. Coroiu (2008r). *Myotis mystacinus*. IUCN Red List of Threatened Species. Version 2009.2.
Hutson, A. M., F. Spitzenberger, S. Aulagnier, I. Coroiu, A. Karatas, J. Juste, M. Paunovic, J. Palmeirim and P. Benda (2008l). *Pipistrellus pipistrellus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, S. Aulagnier, J. Juste, A. Karatas, J. Palmeirim and M. Paunovic (2008j). *Myotis blythii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, S. Aulagnier, J. Juste, A. Karatas, J. Palmeirim and M. Paunovic (2008k). *Myotis capaccinii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, S. Aulagnier, J. Juste, A. Karatas, J. Palmeirim and M. Paunovic (2008l). *Nyctalus leisleri*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, S. Aulagnier and Z. Nagy (2008m). *Myotis emarginatus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, J. Juste, S. Aulagnier, J. T. Alcaldé, J. Palmeirim, M. Paunovic, P. Benda and A. Karatas (2008n). *Rhinolophus mehelyi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, J. Juste, S. Aulagnier, J. T. Alcaldé, J. Palmeirim, M. Paunovic and A. Karatas (2008o). *Rhinolophus euryale*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutson, A. M., F. Spitzenberger, J. Juste, S. Aulagnier, J. Palmeirim, M. Paunovic and A. Karatas (2008p). *Pipistrellus savii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Hutterer, R. (1984). *I. Säugetiere. Bonner zoologische Monographiens*9 - 48. [Abstract]
Hutterer, R., F. Dieterlen and G. Nikolaus (1992). Small mammals from forest islands of eastern Nigeria and adjacent Cameroon, with systematical and biogeographical notes. *Bonner zoologische Beitrage*, **43 (3):** 393 - 414. [Abstract]
Hutterer, R. and U. Joger (1982). Kleinsäuger aus dem Hochland von Adamaoua, Kamerun. *Bonner zoologische Beitrage*, **33 (2-4):** 119 - 132. [Abstract]
Hutterer, R. and G. Peters (2010). Type specimens of mammals (Mammalia) in the collections of the Zoologisches Forschungsmuseum Alexander Koenig, Bonn. *Bonner zoologische Beitrage*, **59:** 3 - 27. URL: http://zfmk.de/BZB/Band_59/01_hutterer_BZB_59_20101205.pdf.
Hutterer, R. and J. C. Ray (1997). Bat predation by small carnivores in a central African rainforest. *Zeitschrift für Säugetierkunde*, **62 (2):** 86 - 92. [Abstract]
Hutton, J. M. (1986). The status and distribution of bats in Zimbabwe. *Cimbebasia*, **(A) 8 (26):** 219 - 236. [Abstract]
Ibáñez, C. (1988). Notes on bats from Morocco. *Mammalia*, **52 (2):** 278 - 281. [Abstract]
Ibáñez, C. (2013). *Nyctalus lasiopterus Giant Noctule.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 590 - 592.
Ibáñez, C. and M. Arlettaz (2013). *Tadarida teniotis European Free-tailed Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 533 - 535.
Ibáñez, C. and R. Fernández (1985a). Murciélagos (Mammalia, Chiroptera) de las Islas Canarias. *Doñana, Acta Vertebrata*, **12 (2):** 307 - 315. [Abstract]
Ibañez, C. and R. Fernández (1985b). Systematic status of the long-eared bat *Plecocus teneriffae* Barret-Hamilton, 1907 (Chiroptera; Vespertilionidae). *Säugetierkundlige Mitteilungen*, **32:** 143 - 149.
Ibáñez, C. and R. Fernández (1989). *Catalogo de murcielagos de las colecciones del museo nacional de ciencias naturales.* Museo Nacional de ciencias naturales - Madrid: 54 pp. [Abstract]
Ibañez, C., J. L. Gracia-Mudarra, M. Ruedi, B. Staadelmann and J. Juste (2006). The Iberian contribution to cryptic diversity in European bats. *Acta Chiropterologica*, **8 (2):** 277 - 297.
Ibáñez, C., R. Novella-Fernandez, P. Alonso and P. T. Agirre-Mendi (2018). New longevity record for the Mediterranean horseshoe bat (*Rhinolophus euryale* Blasius, 1853). *Journal of Bat Research and Conservation*, **11 (1):** 80 - 82. doi: 10.14709/BarbJ.11.1.2018.09.
Ibáñez, C. and J. A. Valverde (1985). Taxonomic status of *Eptesicus platyops* (Thomas, 1901) (Chiroptera, Vespertilionidae). *Zeitschrift für Säugetierkunde*, **50 (4):** 241 - 242.
Ibouroi, M. T., A. Cheha, V. Arnal, E. Lagadec, P. Tortosa, G. Le Minter, S. A. O. Dhurham, C. Montgelard and A. Besnard (2018a). The contrasting genetic patterns of two sympatric flying fox species from the Comoros and the implications for conservation. *Conservation Genetics*, **19:** 1425 - 1437. doi: 10.1007/s10592-018-1111-6.
Ibouroi, M. T., A. Cheha, G. Astruc, S. A. O. Dhurham and A. Besnard (2018b). A habitat suitability analysis at multi-spatial scale of two sympatric flying fox species reveals the urgent need for conservation action. *Biodiversity and conservation*, **27 (9):** 2395 - 2423. doi: 10.1007/s10531-018-1544-8.
Ibraheem, N. N. and M. Shelfeh (2008). A histological study of the digestive system of *Pipistrellus Kuhli* (In Arabian with English summary). *Tishreen University Journal for Research and Scientific Studies - Biological Sciences Series*, **30 (4):** 45 - 58. URL: http://www.tishreen.edu.sy/sites/default/files/Tishreen_Magazine/3_15.pdf.
ICZN, (1998). OPINION 1894: *Regnum Animale* ..., Ed. 2 (M.J. Brisson, 1762): rejected for nomenciatural purposes, with the conservation of the mammalian generic names *Philander* (Marsupialia), *Pteropus* (Chiroptera), *Glis, Cuniculus* and *Hydrochoerus* (Rodentia), *Meles, Lutra* and *Hyaena* (Carnivora), *Tapirus* (Perissodactyla), *Tragulus* and *Giraffa* (Artiodactyla). *Bulletin of Zoological Nomenclature*, **55 (1):** 64 - 71.
Identité et Développement Economique ou "IDEE", (2006). Profile environnemental - Région Ihorombe. Ministère de l'Environnement, des Eaux et Forêts. Office national pour l'environnement. Fianarantsoa: 110 pp. URL: http://www.pnae.mg/ie/profil/Profil_court_IHBE_06.pdf.
Iehlé, C., G. Razafitrimo, J. Razainirina, N. Andriaholinirina, S. M. Goodman, C. Faure, M-C. Georges-Courbot, D. Rousset and J-M. Reynes (2007). Henipavirus and Tioman virus antibodies in Pteropodid bats, Madagascar. *Emerging Infectious Diseases*, **13 (1):** 159 - 161.

Ifticene, E., J. H. Razafimanahaka and S. M. Goodman (2005). *Les Chiroptères.* In Ratsirarson, J. and S.M. Goodman : *Suivi de la biodiversit, de la Forêt Littorale de Tampolo.* Recherches pour le Developpment - Antananarivo, Madagascar: 81 - 88.
Ifuta, N. B. (1985). Observations sur quelques groupements interspécifiques de Microchiroptères des forêts ombrophiles de Kisangani (Zaïre). *Annales de la Faculté des Sciences de l'Université de Kisangani*, **3:** 93 - 100. [Abstract]
Ifuta, N. B. and H. Gevaerts (1986). Données préliminaires sur la reproduction d' *Epomops franqueti* (Chiroptera: Pteropodidae) recoltées à Kisangani et environs. *Annales de la Faculté des Sciences de l'Université de Kisangani*, **Numéro spéciale:** 35 - 38. [Abstract]
Ifuta, N. B., H. Gevaerts and E. R. Kuhn (1988). Thyroid hormones, testosterone, and estradiol-17ß in plasma of *Epomops frangueti* (Tomes, 1860) (Chiroptera) in the Rain Forest of the Equator. *General & Comparative Endocrinology*, **69 (3):** 378 - 380. doi: 10.1016/0016-6480(88)90028-7. [Abstract]
Ifuta, N. B., G. B. Katuala and M. L. Bola (1987). Etude du régime alimentaire de quelques espèces des Mégachiroptères de la région de Kisangani (Zaïre). *Annales de la Faculté des Sciences de l'Université de Kisangani*, **4:** 111 - 120. [Abstract]
Igado, O. O., T. O. Omobowale, R. A. Ajadi and H. O. Nottidge (2012). Craniofacial morphometrics and macro-neurometrics of the fruit bat (*Eidolon Helvum*). *European Journal of Anatomy*, **16 (3):** 172 - 176.
Igado, O. O., T. O. Omobowale, R. A. Ajadi and H. O. Nottidge (2015). Gross morphometric studies on the tongue, buccal cavity and hard palate of the fruit bat (*Eidolon helvum*). *Anatomia Histologia Embryologia*, **44 (4):** 283 - 287. doi: 10.1111/ahe.12138.
Ilchenko, G. G., E. I. Kozhurina, E. M. Astrakhova and A. Selivanova (1999). Daily activity of Egyptian fruit bats, *Rousettus aegyptiacus*, in captivity. Abstract. *Plecotus et al.*, **2:** 127.
Ilchenko, O. G. and E. I. Kozhurina (2002). Dynamics of body mass in Egyptian rousettes *Rousettus aegyptiacus* breeding in captivity. *Plecotus et al.*, **pars spec:** 46 - 52.
Iliopoulou-Georgudaki, J. (1986). The relationship between climatic factors and forearm length of bats: evidence from the chiropterofauna of Lesvos island (Greece- East Aegean). *Mammalia*, **50 (4):** 475 - 482. doi: 10.1515/mamm.1986.50.4.475. [Abstract]
Iliopoulou-Georgudaki, J. and E. B. Giagia (1986). The chromosomes of Kuhl's pipistrelle bat *Pipistrellus kuhli* (Kuhl, 1819) from Greece. *Säugetierkundlige Mitteilungen*, **33:** 245 - 248. [Abstract]
Iliopoulou-Georgudaki, J. and J. C. Ondrias (1986). The greater horseshoe bat, *Rhinolophus ferrumequinum* (Schreber, 1774), in Greece, with description of a new subspecies. *Occasional Papers of the Museum, Texas Tech University*, **102:** 1 - 8.
Illiger (1804). ?? Title still needs to be checked. ?? *Abhandlungen der Koninglichen Preussischen Akademie für Wissenschaften Berlin*78, 4 (1815).
Ing, R. K., R. Colombo, G-C. Gembu, Y. Bas, J-F. Julien, Y. Gager and A. Hassanin (2016). Echolocation calls and flight behaviour of the elusive Pied Butterfly Bat (*Glauconycteris superba*), and new data on its morphology and ecology. *Acta Chiropterologica*, **18 (2):** 477 - 488. doi: 10.3161/15081109ACC2016.18.2.014.
Ingles, J. M. (1965). Zambian Mammals collected for the British Museum (Natural History) in 1962. *The Puku*, **3:** 75 - 86.
Ingoldby, C. M. (1929). On the mammals of the Gold Coast. *Annals and Magazine of Natural History*, **ser. 10, 3 (17):** 511 - 529. [Abstract]
Institute Pasteur (1985). Internal reports of Centre Collaborateurs OMS de Reference et Recherche Pour les Arbovirus. Dakar (Senegal). . URL: http://www.pasteur.fr/recherche/.
Iredale, T. and E. Le G. Troughton (1934a). A check-list of the mammals recorded from Australia. *The Australian Museum, Sidney. Memoir*, **6:** i - xii; 1 - 111. [Abstract]
Irish, J., J. Martini and E. Marais (2000). Cave investigations in Namibia VI. The desert caves in and around the Namib-Naukluft Park. *Cimbebasia*, **16:** 177 - 193.
Irwin, N. R. and J. R. Speakman (2003). Azorean bats *Nyctalus azoreum*, cluster as they emerge from roosts, despite the lack of avian predators. *Acta Chiropterologica*, **5 (2):** 185 - 192. doi: 10.3161/001.005.0203.
Ishii, A., K. Ueno, Y. Orba, M. Sasaki, L. Moonga, B. M. Hang'ombe, A. S. Mweene, T. Umemura, K. Ito, W. W. Hall and H. Sawa (2014). A nairovirus isolated from African bats causes haemorrhagic gastroenteritis and severe hepatic disease in mice. *Nature Communications*, **5:** 5651. doi: 10.1038/ncomms6651.
Issartel, G. (2004). Contribution à une meilleure connaissance des chiroptères de l'île de La Réunion. Société française d'Etude et de Protection des Mammifères, Direction Régionale de l'Environment, La Réunion, France.
Ithete, N. L., S. Stoffberg, V. M. Corman, V. M. Cottontail, L. R. Richards, M. C. Schoeman, C. Drosten, J. F. Drexler and W. Wolfgang Preiser (2013). Close relative of human Middle East respiratory syndrome coronavirus in bat, South Africa. *Emerging Infectious Diseases*, **19 (10):** 1697 - 1699. doi: 10.3201/eid1910.130946.
IUCN (2003). *The 2003 IUCN Red List of Threatened Species.* Gland: IUCN. Http://www.redlist.org IUCN, Conservation International, and NatureServe.
IUCN (2004). 2004 IUCN Red List of Threatened Species. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
IUCN (2009). IUCN Red List of Threatened Species. Version 2009.1.
IUCN (2012). Amendment of Articles 8, 9, 10, 21 and 78 of the *International Code of Zoological Nomenclature* to expand and refine methods of publication. *Zootaxa*, **3450:** 1 - 7.
IUCN (2013). The IUCN Red List of Threatened Species. Mammals. Version 2013.1. URL: http://www.iucnredlist.org.
IUCN Conservation Monitoring Centre (1986). 1986 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland and Cambridge, UK.
Izhaki, I., C. Korine and Z. Arad (1995). The effect of bat (*Rousettus aegyptiacus*) dispersal on seed germination in eastern Mediterranean habitats. *Oecologia*, **101 (3):** 335 - 342. doi: 10.1007/BF00328820. [Abstract]
Jackowiak, H., J. Trzcielinska-Lorych and S. Godynicki (2009). The microstructure of lingual papillae in the Egyptian Fruit Bat (*Rousettus aegyptiacus*) as observed by light microscopy and scanning electron microscopy. *Archives of Histology and Cytology*, **72 (1):** 13 - 21.
Jackson, H. D. (1973). Faunal notes from the Chimanimani mountains, based on a collection of birds and mammals from the Mucrera river, Mozambique. *Durban Museum Novitates*, **10 (2):** 23 - 42. [Abstract]
Jackson, S. and C. Groves (2015). *Taxonomy of Australian mammals.* CSIRO Publishing, Clayton South, Australia: i - vi; 1 - 523.
Jacobs, A., D. Msimang and E. Venter (2017a). First survey of the fungi from the Bakwena Cave in South Africa suggests low human disturbance. *Journal of Cave and Karst Studies*, **79 (2):** 89 - 94. doi: 10.4311/2016MB0146.
Jacobs, D. S. (1996). Morphological divergence in an insular bat, *Lasiurus cinereus semotus*. *Functional Ecology*, **10 (5):** 622 - 630. [Abstract]

Jacobs, D. S. (1999). Intraspecific variation in wingspan and echolocation call flexibility might explain the use of different habitats by the insectivorous bat: *Miniopterus schreibersii* (Vespertilionidae: Miniopterinae). *Acta Chiropterologica*, **1 (1):** 93 - 103.
Jacobs, D. S. (2000). Community level support for the allotonic frequency hypothesis. *Acta Chiropterologica*, **2 (2):** 197 - 207.
Jacobs, D. S. (2004a). *Cistugo seabrai*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004b). *Cistugo lesueuri*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004c). *Neoromicia somalicus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004d). *Neoromicia nanus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004e). *Myotis tricolor*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004f). *Myotis bocagii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004g). *Scotoecus hirundo*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004h). *Scotoecus albofuscus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004i). *Rhinolophus hildebrandti*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004j). *Neoromicia melckorum*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. (2004k). *Myotis anjouanensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. (S.) (2008a). In memory of Lloyd R. Wingate (1947-2007). *African Bat Conservation News*, **17:** 2.
Jacobs, D. (S.) (2008b). *Cistugo lesueuri*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.) (2008c). *Myotis anjouanensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.) (2008d). *Myotis bocagii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.) (2008e). *Myotis tricolor*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.) (2008f). *Pipistrellus melckorum*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.) (2008g). *Pipistrellus somalicus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.) (2008h). *Rhinolophus hildebrandti*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.) (2008l). *Scotoecus albofuscus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. S. (2013). *Cloeotis percivali Percival's Trident Bat (Short-eared Trident Bat).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 365 - 366.
Jacobs, D. (S.) (2016). *Evolution's Chimera. Bats and the marvel of evolutionary adaptation.* UCT Press - Cape Town, South Africa: 154 pp.
Jacobs, D. S., H. Babiker, A. Bastian, T. Kearney, R. van Eeden and J. M. Bishop (2013a). Phenotypic convergence in genetically distinct lineages of a *Rhinolophus* species complex (Mammalia, Chiroptera). *PLoS ONE*, **8 (12):** e82614. doi: 10.1371/journal.pone.0082614.
Jacobs, D. S., R. M. R. Barclay and M. C. Schoeman (2005). Foraging and roosting ecology of a rare insectivorous bat species, *Laephotis wintoni* (Thomas, 1901), Vespertilionidae. *Acta Chiropterologica*, **7 (1):** 101 - 109.
Jacobs, D. S., R. M. R. Barclay and M. H. Walker (2007a). The allometery of echolocation call frequencies of insectivorous bats: Why do some species deviate from the pattern?. *Oecologia*, **152:** 583 - 594.
Jacobs, D. S. and A. Bastian (2018). High duty cycle echolocation may constrain the evolution of diversity within horseshoe bats (family: Rhinolophidae). *Diversity*, **10 (3):** 85. doi: 10.3390/d10030085.
Jacobs, D. S., A. Bastian and L. Bam (2014). The influence of feeding on the evolution of sensory signals: a comparative test of an evolutionary trade-off between masticatory and sensory functions of skulls in southern African Horseshoe bats (Rhinolophidae). *Journal of Evolutionary Biology*, **27 (12):** 2829 - 2840. doi: 10.1111/jeb.12548.
Jacobs, D. S., S. Catto, G. L. Mutumi, N. Finger and P. W. Webala (2017b). Testing the sensory drive hypothesis: geographic variation in echolocation frequencies of Geoffroy's horseshoe bat (Rhinolophidae: *Rhinolophus clivosus*). *PLoS ONE*, **12 (11):** e0187769. doi: 10.1371/journal.pone.0187769.
Jacobs, D. (S.), L. Cohen, K. (L.) MacEwan, A. Monadjem, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016a). *A conservation assessment of Laephotis namibensis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Jacobs, D. (S.), L. Cohen, L. R. Richards, A. Monadjem, (M.) C. Schoeman, K. (L.) MacEwan, T. Sethusa and P. J. Taylor (2016b). *A conservation assessment of Rhinolophus blasii.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Jacobs, D. (S.), L. Cohen, L. R. Richards, A. Monadjem, (M.) C. Schoeman, K. (L.) MacEwan, T. Sethusa and P. J. Taylor (2016c). *A conservation assessment of Rhinolophus capensis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Jacobs, D. (S.), L. Cohen, L. R. Richards, A. Monadjem, (M.) C. Schoeman, K. (L.) MacEwan, T. Sethusa and P. J. Taylor (2016d). *A conservation assessment of Rhinolophus clivosus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D.

Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Jacobs, D. (S.) and F. P. D. Cotterill (2008a). *Eptesicus hottentotus*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.) and F. P. D. Cotterill (2008b). *Pipistrellus zuluensis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill, P. Taylor and A. Monadjem (2008b). *Nycticeinops schlieffeni*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008c). *Glauconycteris alboguttata*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008d). *Glauconycteris argentata*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008e). *Glauconycteris beatrix*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008f). *Glauconycteris egeria*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008g). *Glauconycteris gleni*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008h). *Glauconycteris kenyacola*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008i). *Glauconycteris poensis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008j). *Glauconycteris variegata*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008k). *Kerivoula argentata*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J Taylor (2008l). *Kerivoula lanosa*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008m). *Laephotis angolensis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008n). *Miniopterus minor*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008o). *Myotis morrisi*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008p). *Myotis welwitschii*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008q). *Pipistrellus aero*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008r). *Pipistrellus capensis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008s). *Pipistrellus flavescens*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008t). *Pipistrellus helios*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008u). *Pipistrellus musciculus*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008v). *Pipistrellus permixtus*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008w). *Pipistrellus rendalli*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008x). *Rhinolophus adami*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008y). *Rhinolophus alcyone*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008z). *Rhinolophus capensis*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008aa). *Rhinolophus darlingi*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008ab). *Rhinolophus deckenii*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008ac). *Rhinolophus eloquens*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008ad). *Rhinolophus hillorum*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008ae). *Rhinolophus maendeleo*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill and P. J. Taylor (2008af). *Scotoecus hirundo*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor, S. Aulagnier, Z. Nagy and A. Karatas (2008ag). *Rhinolophus blasii*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and J. Fahr (2008ah). *Eptesicus floweri*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and J. Fahr (2008ai). *Mimetillus moloneyi*. In IUCN 2009 : *IUCN Red List of Threatened Species*. Version 2009.2. <www.iucnredlist.org>.

Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and M. Griffin (2008aj). *Miniopterus natalensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and M. Griffin (2008ak). *Rhinolophus denti*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and M. Griffin (2008al). *Rhinolophus fumigatus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and A. Monadjem (2008am). *Pipistrellus rusticus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and A. Monadjem (2008an). *Rhinolophus landeri*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor and A. Monadjem (2008ao). *Rhinolophus simulator*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.), F. P. D. Cotterill, P. J. Taylor, A. Monadjem and M. Griffin (2008ap). *Pipistrellus anchietae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. S. and F. W. Cotterill (2004a). *Eptesicus hottentotus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. and F. W. Cotterill (2004b). *Neoromicia zuluensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S. and F. W. Cotterill (2004c). *Scotoecus albigula*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004a). *Kerivoula lanosa*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004b). *Myotis morrisi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004c). *Laephotis angolensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004d). *Myotis welwitschii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004e). *Glauconycteris alboguttata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004f). *Glauconycteris beatrix*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004g). *Glauconycteris argentata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004h). *Kerivoula argentata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004i). *Hypsugo musciculus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004j). *Glauconycteris variegata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004k). *Glauconycteris poensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004l). *Glauconycteris kenyacola*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004m). *Glauconycteris gleni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004n). *Glauconycteris egeria*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004o). *Miniopterus minor*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004p). *Rhinolophus deckenii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004q). *Scotoecus hindei*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004r). *Rhinolophus maendeleo*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004s). *Rhinolophus hillorum*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004t). *Neoromicia capensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004u). *Rhinolophus elequens*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004v). *Rhinolophus darlingi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004w). *Rhinolophus capensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004x). *Rhinolophus blasii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004y). *Rhinolophus alcyone*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004z). *Neoromicia helios*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004aa). *Neoromicia flavescens*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004ab). *Rhinolophus adami*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Jacobs, D. S., F. W. Cotterill and P. Taylor (2004ac). *Pipistrellus permixtus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004ad). *Neoromicia rendalli*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill and P. Taylor (2004ae). *Pipistrellus aero*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and S. Aulagnier (2004af). *Rhinolophus hipposideros*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. (S.), F. W. Cotterill, P. Taylor, S. Aulagnier, J. Juste, F. Spitzenberger and A. M. Hutson (2008aq). *Rhinolophus hipposideros*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. (S.), F. W. Cotterill, P. Taylor, S. Aulagnier and J. Palmeirim (2008a). *Pipistrellus rueppellii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jacobs, D. S., F. W. Cotterill, P. Taylor and J. Fahr (2004ag). *Pipistrellus rueppelli*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and J. Fahr (2004ah). *Mimetillus moloneyi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and J. Fahr (2004at). *Eptesicus floweri*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and M. Griffin (2004ai). *Miniopterus natalensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and M. Griffin (2004aj). *Rhinolophus fumigatus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and M. Griffin (2004ak). *Rhinolophus denti*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and A. Monadjem (2004al). *Rhinolophus simulator*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and A. Monadjem (2004am). *Nycticeinops schlieffeni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and A. Monadjem (2004an). *Rhinolophus clivosus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and A. Monadjem (2004ao). *Pipistrellus rusticus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor and A. Monadjem (2004ap). *Rhinolophus landeri*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. S., F. W. Cotterill, P. Taylor, A. Monadjem and M. Griffin (2004aq). *Hypsugo anchietae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Jacobs, D. (S.), M. Cunnama and B. Siemers (2013b). Can an evolutionary trade-off between bite force and detection range explain anomalously high frequency echolocation calls? 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 75 - 76. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Jacobs, D. S., G. N. Eick, E. J. Richardson and P. J. Taylor (2004ar). Genetic similarity amongst phenotypically diverse little free-tailed bats, *Chaerephon pumilus*. *Acta Chiropterologica*, **6 (2):** 13 - 21.
Jacobs, D. S., G.(N.) Eick, M. C. Schoeman and C.(A.) Mattee (2004as). Sympatric speciation in the insectivorous bat *Scotophilus dinganii*. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 11.
Jacobs, D. S., G. N. Eick, M. C. Schoeman and C. A. Matthee (2006). Cryptic species in an insectivorous bat, *Scotophilus dinganii*. *Journal of Mammalogy*, **87 (1):** 161 - 170. doi: 10.1644/04-MAMM-A-132R2.1.
Jacobs, D. S. and M. B. Fenton (2001). The status of *Sauromys petrophilus* and *Chaerephon pumilus* (Chiroptera: Molossidae) in the Western Cape Province of South Africa. *African Zoology*, **36 (2):** 129 - 136.
Jacobs, D. S. and M. B. Fenton (2002). *Mormopterus petrophilus*. *Mammalian Species*, **703:** 1 - 3, 3 figs.
Jacobs, D. S., E. J. Kelly, M. Mason and S. Stoffberg (2007b). Thermoregulation in two free-ranging subtropical insectivorous bat species: *Scotophilus* species (Vespertilionidae). *Canadian journal of zoology*, **85 (8):** 883 - 890. doi: 10.1139/Z07-067.
Jacobs, D. (S.), K. (L.) MacEwan, L. Cohen, A. Monadjem, L. (R.) Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016e). *A conservation assessment of Sauromys petrophilus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Jacobs, D. (S.), K. (L.) MacEwan, L. Cohen, A. Monadjem, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016f). *A conservation assessment of Cistugo seabrae.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Jacobs, D. S., G. L. Mutumi, T. Maluleke and P. W. Webala (2016g). *Convergence as an evolutionary trade-off in the evolution of acoustic signals: echolocation in horseshoe bats as a case study.* In Pontarotti, P. : *Evolutionary Biology* Springer International Publishing Switzerland: 89 - 103. doi: 10.1007/978-3-319-41324-2_6.
Jacobs, D. S., J. M. Ratcliffe and J. H. Fullard (2008ar). Beware of bats, beware of birds: The auditory responses of eared moths to bat and bird predation. *Behavioral Ecology*, **19 (6):** 1333 - 1342. doi: 10.1093/beheco/arn071.
Jacobs, D. (S.), (M.) C. Schoeman, L. Cohen, K. (L.) MacEwan, A. Monadjem, L. R. Richards, T. Sethusa and P. J. Taylor (2016h). *A conservation assessment of Rhinolophus swinnyi.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Jacobs, D. (S.), P. J. Taylor, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and A. Monadjem (2016i). *A conservation assessment of Rhinolophus damarensis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South

African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Jacobs, D. (S.), P. J. Taylor, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and A. Monadjem (2016j). *A conservation assessment of Rhinolophus darlingi.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Jacobs, D. (S.), P. J. Taylor, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and A. Monadjem (2016k). *A conservation assessment of Rhinolophus fumigatus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Jacobs, D. (S.), P. J. Taylor, L. R. Richards, L. Cohen, K. (L.) MacEwan, (M.) C. Schoeman, T. Sethusa and A. Monadjem (2016l). *A conservation assessment of Rhinolophus simulator.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Jacobsen, N. H. G. and E. Du Plessis (1976). Observation of the ecology and biology of the Cape Fruit Bat *Rousettus aegyptiacus leachi* in the eastern Transvaal. *South African Journal of Sciences*, **72:** 270 - 273.

Jacobsen, N. H. G., P. C. Viljoen and W. Ferguson (1986). Radio tracking of problem Fruit bats (*Rousettus aegyptiacus*) in the Transvaal with notes on flight and emergetics. *Zeitschrift für Säugetierkunde*, **51:** 205 - 208. [Abstract]

Jacquet, S., J.-B. Pons, A. De Bernardo, B. Ngoubangoye, F.-L. Cosset, C. Régis, L. Etienne and D. Pontier (2019). Evolution of Hepatitis B virus receptor NTCP reveals differential pathogenicities and species specificities of Hepadnaviruses in Primates, Rodents, and Bats. *Journal of Virology*, **93 (5):** e01738-18. doi: 10.1128/JVI.01738-18.

Jadin, J. B., P. H. Vercammen-Grandjean and A. Fain (1955). *Trombicula nycteris* n.sp. Un Trombiculidae (Acarina) parasite de chiroptères. *Revue de zoologie et de botanique africaines*, **52 (3 - 4):** 249 - 251. [Abstract]

Jaeger, E. C. (1972). *A source-book of biological names and terms. Third Edition. Fifth Printing.* Charles C. Thomas Publisher - Springfield, Illinois. 323 pp.

Jahelková, H. and P. Vašícková (2010). Social calls and behaviour of *Rousettus aegyptiacus*: First results. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 182 - 183.

Jahelková, H. and P. Vašicková (2011). Coupling behaviour in *Rousettus aegyptiacus*. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 31 - 32. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.

Jahelková, H., P. Vašícková, K. Boháckova and I. Horácek (2013). Patterns of social behaviour of *Rousettus aegyptiacus* in a captive breeding colony. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 76. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

James, D. K. (1986). Notes on bats (Mammalia: Microchiroptera) found in the Taung District, Bophuthatswana, South Africa. *Bulletin Zoologisch Museum, Universiteit Amsterdam*, **10 (26):** 217 - 220.

Jameson, H. L. (1909). LIII. On a collection of mammals from South Africa. *Annals and Magazine of Natural History*, **ser. 8, 4 (23):** 455 - 474.

Jan, C., D. A. Dawson, J. D. Altringham, T. Burke and R. K. Butlin (2012). Development of conserved microsatellite markers of high cross-species utility in bat species (Vespertilionidae, Chiroptera, Mammalia). *Molecular Ecology Resources*, **12 (3):** 532 - 548. doi: 10.1111/j.1755-0998.2012.03114.x.

Jánoska, M., M. Vidovszky, V. Molnár, M. Liptovszky, B. Harrach and M. Benkö (2011). Novel adenoviruses and herpesviruses detected in bats. *The Veterinary Journal*, **189 (1):** 118 - 121. doi: 10.1016/j.tvjl.2010.06.020.

Jansen van Vuren, P., M. Allam, M. R. Wiley, A. Ismail, N. Storm, M. Birkhead, W. Markotter, G. Palacios and J. T. Paweska (2018). A novel adenovirus isolated from the Egyptian fruit bat in South Africa is closely related to recent isolates from China. *Scientific Reports*, **8:** 9584. doi: 10.1038/s41598-018-27836-w.

Jansen van Vuren, P., M. R. Wiley, G. Palacios, N. Storm, W. Markotter, M. Birkhead, A. Kemp and J. T. Paweska (2017). Isolation of a novel orthobunyavirus from bat flies (*Eucampsipoda africana*). *Journal of general virology*, **98 (5):** 935 - 945. doi: 10.1099/jgv.0.000753.

Jansen van Vuren, P., M. (R.) Wiley, G. Palacios, N. Storm, S. McCulloch, W. Markotter, M. Birkhead, A. Kemp and J. T. Paweska (2016). Isolation of a Novel Fusogenic Orthoreovirus from *Eucampsipoda africana* Bat Flies in South Africa. *Viruses*, **8 (3):** 65. doi: 10.3390/v8030065.

Javrujan, E. G. (1989). On some bat species from northern Africa (Algeria). Abstract. In Hanák, V., I. Horácek and J. Gaisler : *European Bat Research 1987.* Charles University Press - Praha: 450 - 451. [Abstract]

Jeffrey, S. M. (1975). Notes on mammals from the high forest of Western Ghana (excluding Insectivora). *Bulletin de l'Institut fondamental d'Afrique noire: sciences naturelles*, **37 (A) (4):** 950 - 973. [Abstract]

Jeffreys, M. D. W. (1944). African Pterodactyls. *Journal of the Royal African Society*, **43 (171):** 72 - 74.

Jeitteles, L. H. (1862). Prodomus vertebratorum Hungariae Superioris. (Beiträge zur näheren Kenntniss der Wirbelthiere Ungarn's.). *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, **12:** 245 - 314.

Jenkins, P. D. and M. D. Carleton (2005). Charles Immanuel Forsyth Major's expedition to Madagascar, 1894 to 1896: Beginnings of modern systematic study of the island's mammalian fauna. *Journal of natural history*, **39 (20):** 1779 - 1818. doi: 10.1080/00222930400023719.

Jenkins, R. (K. B.) (2007). Bat Conservation Madagascar. Final Report. Madagasikara Voakajy, Antananarivo: 36 pp. URL: http://www.conservationleadershipprogramme.org/project/bat-conservation-madagascar/.

Jenkins, R. K. B., D. Andriafidison, H. J. Razafimanahaka, A. Rabearivelo, N. Razafindrakoto, Z. Ratsimandresy, R. H. Andrianandrasana, E. Razafimahatratra and P. A. Racey (2007a). Not rare, but threatened: the endemic Madagascar flying fox *Pteropus rufus* in a fragmented landscape. *Oryx*, **41 (2):** 263 - 271. doi: 10.1017/S0030605307001883.

Jenkins, R. K. B., A. Keane, A. R. Rakotoarivelo, V. Rakotomboavonjy, F. H. Randrianandrianina, H. J. Razafimanahaka, S. R. Ralaiarimalala and J. P. G. Jones (2011). Analysis of patterns of bushmeat consumption reveals extensive exploitation of protected species in eastern Madagascar. *PLoS ONE*, **6 (12) e27570:** 1 - 12. doi: 10.1371/journal.pone.0027570.

Jenkins, R. K. B., A. F. Kofoky, J. M. Russ, D. Andriafidison, B. M. Siemers, F. Randrianadrianina, T. Mbohoahy, V. N. Rahaingondrahety and P. A. Racey (2007b). *Ecology and conservation of bats in the southern Anosy Region.* In Ganzhorn, J. U., S. M. Goodman and M. Vincelette : *Biodiversity, ecology and conservation of the littoral ecosystem in*

southeastern Madagascar, Tolagnaro (Fort Dauphin). SI/MAB Series 11. Smithsonian Institution, Washington, D.C.: 209 - 222. URL: http://www.riotintomadagascar.com/pdf/biodiversityBook/Madagascar_4.7.pdf.
Jenkins, R. K. B. and P. A. Racey (2008). Bats as bushmeat in Madagascar. *Madagascar Conservation & Development*, **3 (1):** 22 - 30.
Jenkins, R. K. B., P. A. Racey, J. Ranivo, F. Ratimomanarivo, S. Mickleburgh, A. M. Hutson, W. Bergmans, F. P. D. Cotterill and J. Fahr (2008a). *Tadarida midas*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., A. R. Rakotoaivelo, F. H. Ratrimomanarivo and S. G. Cardiff (2008b). *Scotophilus marovaza*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., A. R. Rakotoaivelo, F. H. Ratrimomanarivo and S. G. Cardiff (2008c). *Scotophilus tandrefana*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B. and A. R. Rakotoarivelo (2008a). *Miniopterus majori*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B. and A. R. Rakotoarivelo (2008b). *Miniopterus petersoni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., A. R. Rakotoarivelo, F. H. Ratrimomanarivo and S. G. Cardiff (2008d). *Emballonura atrata*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., A. R. Rakotoarivelo, F. H. Ratrimomanarivo and S. G. Cardiff (2008e). *Emballonura tiavato*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., A. R. Rakotoarivelo, F. H. Ratrimomanarivo and S. G. Cardiff (2008f). *Miniopterus sororculus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., A. R. Rakotoarivelo, F. H. Ratrimomanarivo and S. G. Cardiff (2008h). *Myzopoda aurita*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., A. R. Rakotoarivelo, F. H. Ratrimomanarivo and S. G Cardiff (2008I). *Myzopoda schliemanni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R.K.B., A.R. Rakotoarivelo, F.H. Ratrimomanarivo and S.G. Cardiff (2008j). *Pipistrellus raceyi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jenkins, R. K. B., V. Tatayah and P. A. Racey (2008k). *Pteropus niger*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Jentink, F. A. (1879a). XXXII. On a new bat, *Taphozous Dobsoni* from Madagascar. *Notes Leyden Museum*, **1 (1):** 121 - 124.
Jentink, F. A. (1879b). XXXIII. On a new bat, *Nyctinomus bemmeleni*, from Liberia. *Notes Leyden Museum*, **1 (1):** 125 - 127.
Jentink, F. A. (1881). Description of a new African bat, *Leiponyx büttikoferi*. *Notes Leyden Museum*, **3 (15):** 59 - 62. [Abstract]
Jentink, F. A. (1885). VII. On some rare and interesting mammals. *Notes Leyden Museum*, **7 (1):** 33 - 38.
Jentink, F. A. (1887a). XIV. On mammals from Mossamedes. *Notes Leyden Museum*, **9 (2):** 171 - 180.
Jentink, F. A. (1887b). IX. Catalogue ostéologique des mammifères. *Musée d'Histoire Naturelle des Pays-Bas, Leyden*, **1:** 1 - 360.
Jentink, F. A. (1888a). Zoological researches in Liberia. A list of mammals, collected by J. Büttikofer, C.F. Sala and F.X. Stampfli, with biological observations. *Notes Leyden Museum*, **10 (1 - 2):** 1 - 58. [Abstract]
Jentink, F. A. (1888b). XII. Catalogue systématique de mammifères (Rongeurs, Insectivores, Cheiroptères, Edentés et Marsupiaux). *Musée d'Histoire Naturelle des Pays-Bas, Leyden*, **1:** 1 - 280.
Jentink, F. A. (1890). On a collection of mammals from Billiton. *Notes Leyden Museum*, **12 (1 - 2):** 149 - 154. [Abstract]
Jentink, F. A. (1904). IV. On *Kerivoula picta* (Pallas) and description of a new bat from Paramaribo. *Notes Leyden Museum*, **24 (4):** 174 - 176 (for 1902).
Jentink, F. A. (1910). Note VII. *Chrysopteron bartelsii*, novum genus et nova species, from Java. *Notes Leyden Museum*, **32:** 73 - 77.
Jerdon, T. C. (1867). *Mammals of India. A natural history of all the animals known to inhabit continental India.* Rookee - Printed for the author by the Thomason college press: 1 - 319; 1 - xii. URL: https://babel.hathitrust.org/cgi/pt?id=hvd.32044107329211;view=1up;seq=5.
Jerdon, T. C. (1874). *The mammals of India. A natural history of all the animals known to inhabit continental India. (Reprint).* John Wheldon, London: i - xxxii; 1 - 335.
Jerdon, T. C. (1877). *Mammals of India.* .
Jesus, J., S. Teixeira, T. Freitas, D. Teixeira and A. Brehm (2013). Genetic identity of *Pipistrellus maderensis* from the Madeira archipelago: a first assessment, and implications for conservation. *Hystrix, Italian Journal of Mammalogy*, **24 (2):** 177 - 180. doi: 10.4404/hystrix-24.2-8736.
Jiao, H., Y. Wang, L. Zhang, P. Jiang and H. Zhao (2018). Lineage-specific duplication and adaptive evolution of bitter taste receptor genes in bats. *Molecular Ecology*, **27 (22):** 4475 - 4488. doi: 10.1111/mec.14873.
Jiménez, S. and C. J. Hazevoet (2010). First record of Straw-coloured fruit bat *Eidolon helvum* (Kerr, 1792) for the Cape Verde Islands. *Zoologia Caboverdiana*, **1 (2):** 116 - 118.
Jobling, B. (1939). On the African Streblidae (Diptera, Acalypterae) including the morphology of the genus *Ascodipteron* Adens and a description of a new species. *Parasitology*, **31 (2):** 147 - 165. [Abstract]
Jobling, B. (1952). Description of two new species of *Ascodipteron* from Africa and one species of *Nycteribosca* from Madagascar (Diptera, Streblidae). *Parasitology*, **42:** 126 - 135. [Abstract]
Jobling, B. (1954). Streblidae from the Belgian Congo, with a description of a new genus and three new species (Diptera). *Revue de zoologie et de botanique africaines*, **50 (1-2):** 89 - 115. [Abstract]
Jobling, B. (1956). Streblidae from the French Ivory Coast, with a description of new species (Diptera). *Revue suisse de zoologie*, **63 (24):** 377 - 384. [Abstract]
Joffrin, L., M. Dietrich, P. Mavingui and C. Lebarbenchon (2018). Bat pathogens hit the road: But which one? *PloS Pathogens*, **14 (8):** e1007134. doi: 10.1371/journal.ppat.1007134.
Johansson, S. G., P. Cunneyworth, N. Doggart and R. Botterweg (1998). Biodiversity surveys in the East Usambara Mountains: Preliminary findings and management implications. *Journal of East African Natural History*, **87 (1):** 139 - 157. doi: 10.2982/0012-8317(1998)87[139:BSITEU]2.0.CO;2. [Abstract]
Johne, R., P. Dremsek, J. Reetz, G. Heckel, M. Hess and R. G. Ulrich (2014). Hepeviridae: An expanding family of vertebrate viruses. *Infection, Genetics and Evolution*, **27:** 212 - 229. doi: 10.1016/j.meegid.2014.06.024.
Johnson, S. A., R. J. Y. Perryman, M. D. Steer and E. M. S. Belle (2010). Observations of a *Pteropus rufus* colony in a dry deciduous forest fragment of northern Madagascar. *African Bat Conservation News*, **23:** 3 - 6.
Johnston, D. S. (2006). *Nycticeinops schlieffeni*. *Mammalian Species*, **798:** 1 - 4, 3 figs.

Johnston, H. H. (1884). *The River Congo from its Mouth to Bolobo: with a general description of the natural history and anthropology of its western basin.* London, i - xvii, 1 - 470, 11 pls.
Johnston, H. H. (1905). 2. Notes on the Mammals and Birds of Liberia. *Proceedings of the Zoological Society of London*, **1905, I (2):** 197 - 210.
Johnston, H. (H.) (1906). *Liberia. Volume II.* Hutchinson & Co., London: i - xvi; 521 - 1183.
Jolicoeur, P., P. Pirlot, G. Baron and H. Stephan (1984). Brain structure and correlation patterns in Insectivora, Chiroptera, and Primates. *Systematic zoology*, **33 (1):** 14 - 29.
Jones, C. (1971). The bats of Rio Muni, West Africa. *Journal of Mammalogy*, **52 (1):** 121 - 140. [Abstract]
Jones, C. (1972). Comparative ecology of three pteropid bats in Rio Muni, West Africa. *Journal of Zoology*, **167:** 353 - 370. [Abstract]
Jones, C. (1977a). *Plecotus rafinesquii*. *Mammalian Species*, **69:** 1 - 4, 2 figs.
Jones, C. and R. W. Manning (1989). *Myotis austroriparius*. *Mammalian Species*, **332:** 1 - 3, 3 figs.
Jones, C. A. and C. Jones (2016). Obituary: Clyde Jones (1935 - 2015). *Journal of Mammalogy*, **97 (6):** 1774 - 1782. doi: 10.1093/jmammal/gyw161.
Jones, D. P. and T. H. Kunz (2000). *Pteropus hypomelanus*. *Mammalian Species*, **639:** 1 - 6, 3 figs.
Jones, G. (1992). Bats vs Moths: studies on the diets of rhinolophid and hipposiderd bats support the allotonic frequency hypothesis. *Prague Studies in Mammalogy*87 - 92.
Jones, G. and E. M. Barratt (1999). Case 3073. *Vespertilio pipistrellus* Schreber, 1774 and *V. pygmaeus* Leach, 1825 (currently *Pipistrellus pipistrellus* and *P. pygmaeus*; Mammalia, Chiroptera): proposed designation of neotypes. *Bulletin of Zoological Nomenclature*, **56 (3):** 182 - 186.
Jones, G., T. Gordon and J. Nightingale (1992). Sex and age differences in the echolocation calls of the lesser horseshoe bat, *Rhinolophus hipposideros*. *Mammalia*, **56 (2):** 189 - 193. [Abstract]
Jones, G., D. S. Jacobs, T. H. Kunz, M. Willig and P. A. Racey (2009a). Carpe noctem: the importance of bats as bioindicators. *Endangered Species Research*, **:** 1 - 23. doi: 10.3354/esr00182.
Jones, G. and T. Kokurewicz (1994). Sex and age variation in echolocation calls and flight morphology of Daubenton's Bats *Myotis daubentonii*. *Mammalia*, **58 (1):** 41 - 50. doi: 10.1515/mamm.1994.58.1.41. [Abstract]
Jones, G., M. Morton, P. M. Hughes and R. M. Budden (1993). Echolocation, flight morphology and foraging strategies of some West African hipposiderid bats. *Journal of Zoology*, **230:** 385 - 400. [Abstract]
Jones, G. and R. D. Ransome (1993). Echolocation calls of bats are influenced by maternal effects and change over a lifetime. *Proceedings of the Royal Society of London*, **B 252 (1334):** 125 - 128. doi: 10.1 098/rspb.1993.0055. [Abstract]
Jones, G. and J. M. V. Rayner (1989). Foraging behavior and echolocation of wild horseshoe bats *Rhinolophus ferrumequinum* and *R. hipposideros* (Chiroptera Rhinolophidae). *Behavioral ecology and sociobiology*, **25 (3):** 183 - 191. doi: 10.1007/BF00302917. [Abstract]
Jones, G. and J. Rydell (1994). Foraging strategy and predation risk as factors influencing emergence time in echolocating bats. *Philosophical transactions of the Royal Society of London*, **346:** 445 - 455.
Jones, G. and B. M. Siemers (2010). The communicative potential of bat echolocation pulses. *Journal of Comparative Physiology*, **A 197 (5):** 447 - 457. doi: 10.1007/s00359-010-0565-x.
Jones, G. and S. M. van Parijs (1993). Bimodal echolocation in pipistrelle bats: are cryptic species present?. *Proceedings of the Royal Society of London*, **B 251:** 119 - 125. [Abstract]
Jones, J. K. Jr. (1977b). *Rhogeessa gracilis*. *Mammalian Species*, **76:** 1 - 2, 3 figs.
Jones, J. K. Jr. and H. H. Genoways (1969). Holotypes of recent mammals in the Museum of Natural History, the University of Kansas. In Jones, J.K. Jr. : *A volume honoring Professor E. Raymond Hall. Miscellaneous Publication, University of Kansas, Museum of Natural History*, **51:** 129 - 146.
Jones, J. K. Jr. and H. H. Genoways (1973). *Ardops nichollsi*. *Mammalian Species*, **24:** 1 - 2, 2 figs.
Jones, J. K. Jr. and H. H. Genoways (1975). *Sturnira thomasi*. *Mammalian Species*, **68:** 1 - 2, 1 fig.
Jones, J. K. Jr. and J. A. Homan (1974). *Hylonycteris underwoodi*. *Mammalian Species*, **32:** 1 - 2, 2 figs.
Jones, K. E., S. P. Mickleburgh, W. Sechrest and A. L. Walsh (2009b). *Global overview of the conservation of island bats: importance, challenges, and opportunities.* In Fleming, T. H. and P. A. Racey [Eds]: *Island Bats - Evolution, Ecology, and Conservation.* The University of Chicago Press - Chicago and London: 496 - 530.
Jones, K. E., A. Purvis, A. MacLarnon, O. R. P. Bininda-Emonds and N. B. Simmons (2002). A phylogenetic supertree of the bats (Mammalia: Chiroptera). *Biological Reviews*, **77:** 223 - 259. doi: 10.1017/S1464793101005899.
Jones, M. E. B. , Schuh, A. J. , Amman, B. R. , Sealy, T. K. , Zaki, S. R. , Nichol, S. T. , Towner, J. S. (2015). Experimental inoculation of Egyptian rousette bats (*Rousettus aegyptiacus*) with viruses of the Ebolavirus and Marburgvirus genera. *Viruses*, **7:** 3420 - 3442.
Jones, M. (E. B.), B. (R.) Amman, C. Paddock, S. Zaki and J. Towner (2013). Pathology of Marburg virus infection in a natural reservoir host, *Rousettus aegyptiacus*. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 77 - 78. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Jones, M. E. B., B. R. Amman, T. K. Sealy, L. S. Uebelhoer, A. J. Schuh, T. Flietstra, B. H. Bird, J. D. Coleman-McCray, S. R. Zaki, S. T. Nichol and J. S. Towner (2019). Clinical, histopathologic, and immunohistochemical characterization of experimental Marburg virus infection in a natural reservoir host, the Egyptian Rousette Bat (*Rousettus aegyptiacus*). *Viruses*, **11 (3):** 214. doi: 10.3390/v11030214.
Jones, T. (2008). Bats in the post. *The Australasian Bat Society Newsletter*, **31:** 13 - 15.
Jones, T. S. (1962). Twins in an African bat (*Scotophilus nigrita*). *Mammalia*, **26 (1):** 136.
Jordaan, L. A., S. D. Johnson and C. T. Downs (2011). Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*) as a potential dispersal agent for fleshy-fruited invasive alien plants: effects of handling behaviour on seed germination. *Biological Invasions*, **14 (5):** 959 - 968 (for 2012). doi: 10.1007/s10530-011-0131-7.
Jordaan, S. (L.) (2011). Factors affecting the activity patterns of *Myotis tricolor* (Chiroptera: Vespertilionidae). M.S. dissertation - University of Cape Town: i - v; 1 - 73.
Jordaan, S. L. and D. S. Jacobs (2009). Foraging behaviour of *Myotis tricolor* (Chiroptera: Vespertilionidae) in relation to reproductive state. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 35. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.
Jordan, I., V. J. Munster and V. Sandig (2012). Authentication of the R06E fruit bat cell line. *Viruses*, **4 (5):** 889 - 900. doi: 10.3390/v4050889.

Jordan, K. (1936). Dr. Karl Jordan's expedition to South-West Africa and Angola: Siphonaptera. *Novitates Zoologicae*, **40:** 82 - 94. [Abstract]

Joubert, F. (2004). A preliminary investigation into the general ecology, status and habitat of the Seychelles sheath-tailed bat *Coleura seychellensis* (Emballonuridae). *Phelsuma*, **12:** 54 - 68. URL: http://islandbiodiversity.com/Phelsuma%2012-2.pdf.

Joubert, L. (2011). Biodiversity value of grassland ecological networks in afforested areas, KwaZulu-Natal, South Africa. Masters Thesis - Faculty of AgriSciences (Department Conservation Ecology and Entomology) at University of Stellenbosch: i - xviii; 1 - 142. URL: http://scholar.sun.ac.za/bitstream/handle/10019.1/6465/joubert_biodiversity_2011.pdf?sequence=2.

Jüdes, U. (1994). Methods for monitoring of bats using ultrasonic detectors. Abstract. Symposium on Current problems of bat protection in Central and Eastern Europe - Bonn. [Abstract]

Juma, J. (2007). CEPF Project: Conservation of Indigenous Forest and Endemic Species on Pemba Island. Unpublished report by Flora and Fauna International, Nairobi, Kenya.

Junker, K., O. Bain and J. Boomker (2008a). Helminth parasites of Natal long-fingered bats, *Miniopterus natalensis* (Chiroptera: Miniopteridae), in South Africa. *Onderstepoort Journal of Veterinary Research*, **75:** 261 - 265.

Junker, K., M. Barbuto, M. Casiraghi, C. Martin, S. Uni, J. Boomker and O. Bain (2008b). *Litomosa chiropterorum* Ortlepp, 1932 (Nematoda: Filarioidea) from a South African Miniopterid: redescription, *Wolbachia* screening and phylogenetic relationships with *Litomosoides*. *Parasite*, **16 (1):** 43 - 50 (for 2009).

Juste, J. (2008a). *Miniopterus griveaudi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Juste, J. (2008b). *Miniopterus newtoni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Juste, J., S. Aulagnier and P. Benda (2004a). *Plecotus teneriffae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Juste, J., P. Benda, J. L. Garcia-Mudarra and C. Ibáñez (2013). Phylogeny and systematics of Old World serotine bats (genus *Eptesicus*, Vespertilionidae, Chiroptera): an integrative approach. *Zoologica Scripta: an international journal of evolutionary zoology*, **42 (5):** 441 - 457. doi: 10.1111/zsc.12020.

Juste, J., R. Bilgin, J. Muñoz and C. Ibáñez (2009). Mitochondrial DNA signatures at different spatial scales: from the effects of the Straits of Gibraltar to population structure in the meridonal serotine bat (*Eptesicus isabellinus*). *Heredity*, **:** 1 - 10. doi: 10.1038/hdy.2009.47.

Juste, J., A. Hutson and W. Bergmans (2004b). *Myonycteris brachycephala*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Juste, J., A. M. Hutson and W. Bergmans (2008a). *Myonycteris brachycephala*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Juste, J. and C. Ibáñez (1992). Taxonomic review of *Miniopterus minor* Peters, 1867 (Mammalia: Chiroptera) from western central Africa. *Bonner zoologische Beitrage*, **43 (3):** 355 - 365. URL: http://zfmk.de/BZB/1992/1992%20Juste%20J.%20u.%20Ibanez%20C.%20p355.pdf. [Abstract]

Juste, J. and C. Ibáñez (1993a). An asymmetric dental formula in a mammal, the São Tomé Island fruit bat *Myonycteris brachycephala* (Mammalia: Megachiroptera). *Canadian journal of zoology*, **71 (1):** 221 - 224. [Abstract]

Juste, J. and C. Ibáñez (1993b). A new *Tadarida* of the subgenus *Chaerephon* (Chiroptera: Molossidae) from Sao Tomé Island, Gulf of Guinea (West Africa). *Journal of Mammalogy*, **74 (4):** 901 - 907. [Abstract]

Juste, J. and C. Ibáñez (1993c). Geographic variation and taxonomy of *Rousettus aegyptiacus* (Mammalia: Megachiroptera) in the islands of the Gulf of Guinea. *Zoological Journal of the Linnean Society*, **107:** 117 - 129.

Juste, J., C. Ibáñez and A. Machordom (2000). Morphological and allozyme variation of *Eidolon helvum* (Mammalia: Megachiroptera) in the islands of the Gulf of Guinea. *Biological Journal of the Linnean Society*, **71 (2):** 359 - 378. doi: 10.1006/bijl.2000.0449.

Juste, J., C. Ibañez, J. Muñoz, D. Trujillo, P. Benda, A. Karatas and M. Ruedi (2004c). Mitochondrial phylogeography of the long-eared bats (*Plecotus*) in the Mediterranean Palaearctic and Atlantic Islands. *Molecular phylogenetics and evolution*, **31 (3):** 1114 - 1126. doi: 10.1016/j.ympev.2003.10.005.

Juste, J., C. Ibánez, D. Trujillo, J. Muñoz and M. Ruedi (2003). Phylogeography of Barbastelle bats (*Barbastella barbastellus*) in the western Mediterranean and the Canary Islands. *Acta Chiropterologica*, **5 (2):** 165 - 175.

Juste, J., A. Karatas, J. Palmeirim, M. Paunovic, F. Spitzenberger and A. M. Hutson (2008b). *Plecotus austriacus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Juste, J., C. López-González and R. E. Strauss (2001a). Analysis of asymmetries in the African fruit bats *Eidolon helvum* and *Rousettus egyptiacus* (Mammalia: Megachiroptera) from the islands of the Gulf of Guinea. I. Variance and size components of bilateral variation. *Journal of Evolutionary Biology*, **14 (4):** 663 - 671.

Juste, J., C. López-González and R. E. Strauss (2001b). Analysis of asymmetries in the African fruit bats *Eidolon helvum* and *Rousettus egyptiacus* (Mammalia: Megachiroptera) from the islands of the Gulf of Guinea. II. Integration and levels of multivariate fluctuating asymmetry across a geographical range. *Journal of Evolutionary Biology*, **14 (4):** 672 - 680.

Juste, J., M. Ruedi, S. J. Puechmaille, I. Salicini and C. Ibáñez (2019). Two new cryptic bat species within the *Myotis nattereri* species complex (Vespertilionidae, Chiroptera) from the Western Palaearctic. *Acta Chiropterologica*, **20 (2):** 285 - 300 (for 2018). doi: 10.3161/15081109ACC2018.20.2.001.

Juste, J., D. Trujillo and C. Ibáñez (2010). The pipistrelle bats of Macaronesia: A phylogeographic approach. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 190.

Juste B. , J., Y. Álvarez, E. Tabarés, A. Garrido-Pertierra, C. Ibáñez and J. M. Bautista (1999). Phylogeography of African Fruitbats (Megachiroptera). *Molecular phylogenetics and evolution*, **13 (3):** 596 - 604. doi: 10.1006/mpev.1999.0669.

Juste [B.], J., A. Ferrández, J. E. Fa, W. Masefield and C. Ibañez (2007). Taxonomy of little bent-winged bats (*Miniopterus*, Miniopteridae) from the African islands of São Tomé, Grand Comoro and Madagascar, based on mtDNA. *Acta Chiropterologica*, **9 (1):** 27 - 37. doi: 10.3161/1733-5329(2007)9[27:TOLBBM]2.0.CO;2.

Juste B. , J. and C. Ibáñez (1994a). Contribution to the knowledge of the bat fauna of Bioko island, Equatorial Guinea (Central Africa). *Zeitschrift für Säugetierkunde*, **59 (5):** 274 - 281. [Abstract]

Juste B. , J. and C. Ibáñez (1994b). Bats of the Gulf of Guinea islands: faunal composition and origins. *Biodiversity and conservation*, **3:** 837 - 850. [Abstract]

Juste B. , J., C. Ibáñez and A. Machordom (1997). Evolutionary relationships among the African Fruit Bats: *Rousettus egyptiacus*, *R. angolensis*, and *Myonycteris*. *Journal of Mammalogy*, **78 (3):** 766 - 774. [Abstract]

Juste B. , J., A. Machordom and C. Ibáñez (1996). Allozyme variation of the Egyptian Rousette (*Rousettus egyptiacus*; Chiroptera, Pteropodidae) in the Gulf of Guinea (West-Central Africa). *Biochemical Systematics and Ecology*, **24 (6):** 499 - 508. [Abstract]

Juste B. , J. and J. Perez del Val (1995). Altitudinal variation in the sub canopy fruit bat guild in Bioko Island, Equatorial Guinea, Central Africa. *Journal of Tropical Ecology*, **11:** 141 - 146.

Justine, J.-L. (1989a). Une nouvelle espèce de *Capillaria* (Nematoda, Capillariinae) parasite de chauve-souris (Mammalia, Chiroptera) du Gabon. *Bulletin du Muséum national d'histoire naturelle de Paris*, **sér. 4, 11 (A) 2:** 333 - 347. [Abstract]

Justine, J.-L. (1989b). Quatre nouvelles espèces de *Capillaria* (Nematoda, Capillariinae) parasites de Chiroptères du Gabon. *Bulletin du Muséum national d'histoire naturelle de Paris*, **sér. 4, 11 (A) 3:** 535 - 561. [Abstract]

Kading, R. C., A. T. Gilbert, E. C. Mossel, M. B. Crabtree, I. V. Kuzmin, M. Niezgoda, B. Agwanda, W. Markotter, M. R. Weil, J. Montgomery, C. E. Rupprecht and B. R. Miller (2013). Isolation and molecular characterization of Fikirini rhabdovirus, a novel virus from a Kenya bat. *Journal of general virology*, **94 (11):** 2393 - 2398. doi: 10.1099/vir.0.053983-0.

Kading, R. C., R. M. Kityo, E. C. Mossel, E. M. Borland, T. Nakayiki, B. Nalikka, L. Nyakarahuka, J. P. Ledermann, N. A. Panella, A. T. Gilbert, M. B. Crabtree, J. Kerbis Peterhans, J. S. Towner, B. R. Amman, T. K. Sealy, S. T. Nichol, A. M. Powers, J. J. Lutwama and B. R. Miller (2018). Neutralizing antibodies against flaviviruses, Babanki virus, and Rift Valley fever virus in Ugandan bats. *Infection Ecology & Epidemiology*, **8 (1):** 1439215. doi: 10.1080/20008686.2018.1439215.

Kahmann, H. and P. Goerner (1956). Les chiroptères de Corse. *Mammalia*, **20 (4):** 333 - 389. doi: 10.1515/mamm.1956.20.4.333.

Kaipf, I., H. Rudolphi and H. Meinig (2015). *Assessment of fruit-bats and bats in the Kafa Biosphere Reserve.* 22 p. URL: https://www.google.be/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjWkYu9g4rPAhXqLsAKHYqbCoAQFggeMAA&url=http%3A%2F%2Fimperia.verbandsnetz.nabu.de%2Fimperia%2Fmd%2Fcontent%2Fnabude%2Finternational%2F2_nabu_kafa_ba_bats_final_draft.pdf&usg=AFQjCNFl83tOxo-8ILe148cMEooVyfKVxg.

Kalemba, L. N., M. Niezgoda, A. T. Gilbert, J. B. Doty, R. M. Wallace, J. M. Malekani and D. S. Carroll (2017). Exposure to Lyssaviruses in Bats of the Democratic Republic of the Congo. *Journal of wildlife diseases*, **53 (2):** 408 - 410. doi: 10.7589/2016-06-122.

Kaleme, P. K., J. Bates, J. Kerbis Peterans, M. M. Jacques and B. R. Ndara (2007). Small mammal diversity and habitat requirements in the Kahuzi-Biega National Park and surrounding areas, eastern Democratic Republic of Congo. *Integrative Zoology*, **2 (4):** 239 - 246. doi: 10.1111/j.1749-4877.2007.00066.x.

Kalko, E. K. V. and J. Fahr (2011). *10.5. Échantillonnage de chauvesouris / Sampling bats.* In Sinsin, B., A. Thiombiano, S. Konaté and D. Kampmann : *Biodiversity Atlas of West Africa, Volumes I-III: Benin, Burkina Faso & Côte d'Ivoire.* Cotonou, Ouagadougou, Abidjan & Frankfurt/Main: 540 - 545.

Kalko, E. K. V. and H.-U. Schnitzler (1993). Plasticity in echolocation signals of European pipistrelle bats in search flight: implications for habitat use and prey detection. *Behavioral ecology and sociobiology*, **33 (6):** 415 - 428. [Abstract]

Kalko, E. K. V. and H.(-U.) Schnitzler (1998). *How echolocating bats approach and acquire food.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 197 - 204.

Kalúz, S. and M. Ševcík (2014). A new species of the genus *Grandjeana* (Koçak & Kemal, 2009) (Acari: Trombiculidae) from Mauritanian bat with a key to species of the genus. *International Journal of Acarology*, **40 (1):** 31 - 36. doi: 10.1080/01647954.2013.875063.

Kalúz, S. and M. Ševcík (2015). A new species of *Grandjeana* (Acari: Trombiculidae) from heart-nosed bat (Chiroptera: Megadermatidae) in Ethiopia (Africa) with notes to biogeography of this genus. *Biologia*, **70 (3):** 380 - 385. doi: 10.1515/biolog-2015-0043.

Kamalakannan, M. and P. O. Nameer (2019). A checklist of mammals of Tamil Nadu, India. *Journal of Threatened Taxa*, **11 (8):** 13992 - 14009. doi: 10.11609/jott.4705.11.8.13992-14009.

Kamani, J., G. Baneth, M. Mitchell, K. Y. Mumcuoglu, R. Gutiérrez and S. Harrus (2014). *Bartonella* species in bats (Chiroptera) and bat flies (Nycteribiidae) from Nigeria, West Africa. *Vector-Borne and Zoonotic Diseases*, **14 (9):** 625 - 632. doi: 10.1089/vbz.2013.1541.

Kameneva, S. P. (1976). *On the behavior of Mehely's Horseshoe Bat, Rhinolophus mehelyi, in an aviary (In Russian).* Doklady II Vsesoyuz. konf. po povedeniyu zhivotnykh (Group Behavior in Animals: Proc. II All-Union Conf. on Animal Behavior), Moscow, 1976, pp. 154 - 156.

Kamins, A., O. Restif, M. Rowcliffe, A. Cunningham and J. Wood (2011b). Use of bats as bushmeat: implications for human health in Ghana, West Africa. In Anonymus : *1st International One Health Congress. EcoHealth*, **7 (Suppl. 1):** S102. doi: 10.1007/s10393-010-0376-0. URL: http://www.springerlink.com/content/fk7568613802u117/fulltext.pdf.

Kamins, A., O. Restif, M. Rowcliffe, A. A. Cunningham, Y. Ntiamoa-Baidu and J. L. N. Wood (2010). Waiter, there's a bat in my soup! Implications of fruit bast as bushmeat in Ghana, West Africa. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 190 - 191.

Kamins, A. O., O. Restif, Y. Ntiamoa-Baidu, R. Suu-Ire, D. T. S. Hayman, A. A. Cunningham, J. L. N. Wood and J. M. Rowcliffe (2011a). Uncovering the fruit bat bushmeat commodity chain and the true extent of fruit bat hunting in Ghana, West Africa. *Biological Conservation*, **144 (12):** 3000 - 3008. doi: 10.1016/j.biocon.2011.09.003.

Kamins, A. O., J. M. Rowcliffe, Y. Ntiamoa-Baidu, A. A. Cunningham, J. L. N. Wood and O. Restif (2014). Characteristics and risk perceptions of Ghanaians potentially exposed to bat-borne zoonoses through bushmeat. *EcoHealth*, **12 (1):** 104 - 120 (for 2015). doi: 10.1007/s10393-014-0977-0.

Kandeil, A., M. R. Gomaa, M. M. Shehata, A. N. El Taweel, S. H. Mahmoud, O. Bagato, Y. Moatasim, O. Kutkat, A. S. Kayed, P. Dawson, X. Qiu, J. Bahl, R. J. Webby, W. B. Karesh, G. Kayali and M. A. Ali (2019). Isolation and characterization of a distinct influenza A virus from Egyptian bats. *Journal of Virology*, **93 (2):** e01059-18. doi: 10.1128/JVI.01059-18.

Kang, H. J., W. T. Stanley, J. A. Esselstyn, S. H. Gu and R. Yanagihara (2014). Expanded host diversity and geographic distribution of hantaviruses in Sub-Saharan Africa. *Journal of Virology*, **88 (13):** 7663 - 7667. doi: 10.1128/JVI.00285-14.

Kangoyé, M. N., W. Guenda, A. Thiombiano, E. K. V. Kalko and J. Fahr (2010). *6.17. Les petits mammifères: Chauves-souris / Small mammals: Bats.* In Thiombiano, A. and D. Kampmann : *Biodiversity Atlas of West Africa, Volume II: Burkina Faso.* Ouagadougou & Frankfurt/Main: 288 - 291.

Kangoyé, N. M., A. Ouéda, L. Granjon, A. Thiombiano, W. Guenda and J. Fahr (2015a). Diversity and distribution of bats (Mammalia Chiroptera) in Burkina Faso. *Biodiversity Journal*, **6 (2):** 597 - 632.

Kangoyé, N. M., A. Ouéda, A. Thiombiano and W. Guenda (2012). Bats (Chiroptera) of Burkina Faso: preliminary list with fifteen first record species. *International Journal of Biological and Chemical Sciences*, **6 (6):** 6017 - 6030. doi: 10.4314/ijbcs.v6i6.29.

Kangoyé, N. M., A. Ouéda, A. Thiombiano and W. Guenda (2015b). Diversité et structure du peuplement des chauves-souris au Burkina Faso. *Le Vespère*, **5:** 357 - 369.
Kankam, B. O. and W. Oduro (2009). Frugivores and fruit removal of Antiaris toxicaria (Moraceae) at Bia Bioshere Reserve, Ghana. *Journal of Tropical Ecology*, **25 (2):** 201 - 204.
Kankam, B. O. and W. Oduro (2011). The effect of frugivory on postdispersal seed removal and germination in the pantropical forest tree *Antiaris toxicaria* Leschenault. *African Journal of Ecology*, **50 (1):** 21 - 28 (for 2012). doi: 10.1111/j.1365-2028.2011.01288.x.
Kanuch, P., T. Aghová, Y. Meheretu, R. Šumbera and J. Bryja (2015). New discoveries on the ecology and echolocation of the heart-nosed bat *Cardioderma cor* with a contribution to the phylogeny of Megadermatidae. *African Zoology*, **50 (1):** 53 - 57. doi: 10.1080/15627020.2015.1021711.
Kanuch, P., A. Krištín and J. Krištofík (2005). Phenology, diet, and ectoparasites of Leisler's bat (*Nyctalus leisleri*) in the Western Carpathians (Slovakia). *Acta Chiropterologica*, **7 (2):** 249 - 257. doi: 10.3161/1733-5329(2005)7[249:PDAEOL]2.0.CO;2.
Kapteyn, K. (1995). *Vleermuizen in het landschap. Over hun ecologie, gedrag en verspreiding.* Schuyt & Co. - Haarlem: 224 pp.
Karadjian, G., A. Hassanin, B. Saintpierre, G.-C. Gembu Tungaluna, F. Ariey, F. J. Ayala, I. Landau and L. Duval (2016). Highly rearranged mitochondrial genome in *Nycteria* parasites (Haemosporidia) from bats. *Proceedings of the National Academy of Sciences, U.S.A.*, **113 (35):** 9834 - 9839. doi: 10.1073/pnas.1610643113.
Karaman, K., A. Salcioglu, K. Gürün, E. Çoraman, A. Furman, A. Karatas and R. Bilgin (2017). Sanger and next-generation sequencing based nuclear genetic analyses of the long-fingered bat, *Myotis capaccinii* around the Mediterranean basin. In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 119. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.
Karami, M., R. Huterer, P. Benda, R. Siahsarvie and B. Kryštufek (2009). Annotated check-list of the mammals of Iran. *Lynx (Praha)*, **n.s. 39 (1):** 63 - 102 (for 2008).
Karatas, A., S Özkurt and D. Kock (2007). The recovery of *Nyctalus lasiopterus* (Schreber, 1780) (Chiroptera: Vespertilionidae) in Turkey. *Acta Zoologica cracoviense*, **50A (1 - 2):** 53 - 56.
Karatas, A. and M. Sözen (2003). Karyotype of *Taphozous nudiventris* Cretzschmar, 1830 (Mammalia: Chiroptera) from Turkey. *Israel journal of zoology*, **48 (3):** 359 - 360 (for 2002).
Karatas, A. and M. Sözen (2004). Contribution to karyology, distribution and taxonomic status of the Long-winged Bat, *Miniopterus schreibersii* (Chiroptera: Vespertilionidae), in Turkey. *Zoology in the Middle East*, **33:** 51 - 64.
Karatas, A., M. Sözen and F. Matur (2006). Karyology of some bat species (Chiroptera: Rhinolophidae, Molossidae) from Turkey. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **71 (3):** 159 - 163. doi: 10.1016/j.mambio.2005.11.008.
Karelin, G. S. (1875). Analysis of A.Ryabinin's article "Natural products from the lands of the Urals Cossack District" [in Russian]. *Transactions of the St. Petersburg Nature Society*, **6:** 1 - 113.
Kassahun, A., J. Sadlova, P. Benda, T. Kostalova, A. Warburg, A. Hailu, G. Baneth, P. Volf and J. Votypka (2015). Natural infection of bats with *Leishmania* in Ethiopia. *Acta Tropica*, **150:** 166 - 170. doi: 10.1016/j.actatropica.2015.07.024.
Kaswera Kyamakya, C., C. Nebesse Mololo and S. Gambalemoke Mbalitini (2019). Bushmeattrade in Kisangani (DRC), constancy and abundance of mammalian species on the market from 1976 to 2016. *International Journal of Environment, Agriculture and Biotechnology*, **4 (2):** 323 - 333. doi: 10.22161/ijeab/4.2.10.
Katoh, H., T. Kubota, T. Ihara, K. Maeda, M. Takeda and M. Kidokoro (2016). Cross-neutralization between human and African bat mumps viruses. *Emerging Infectious Diseases*, **22 (4):** 703 - 706. doi: 10.3201/eid2204.151116.
Kaudern, W. (1914). Einige Beobachtungen über die Zeit der Fortpflanzung der madagassischen Säugetiere. *Arkiv för zoologi, Stockholm*, **9 (1) 1:** 1 - 22.
Kaudern, W. (1915). Säugetiere aus Madagaskar. *Arkiv för zoologi, Stockholm*, **9 (3 - 4):** 1 - 101.
Kaup, J. (1829). kizzirte Entwickelungs-Geschichte und natürliches System der europäischen Thierwelt: Erster Theil, welcher die Vogelsäugethiere und Vögel, nebst Andeutung der Entstehung der letzteren aus Amphibien enthält. Darmstadt & Leipzig: i - xii; 1 - 203.
Kawashima, T., R. W. Jr. Thorington, P. W. Bohaska and F. Sato (2017). Variability and constraint of vertebral formulae and proportions in colugos, tree shrews, and rodents, with special reference to vertebral modification by aerodynamic adaptation. *Folia Morphologica*, **77 (1):** 44 - 56 (for 2018). doi: 10.5603/FM.a2017.0064.
Kearney, T. C. (2005). Systematic revision of Southern African species in the genera *Eptesicus*, *Neoromicia*, *Hypsugo* and *Pipistrellus* (Chiroptera: Vespertilionidae). PhD thesis, University of KwaZulu-Natal - Durban: i - xxvii; 1 - 580.
Kearney, T. C. (2008). My midday encounter with a *Myotis welwitchii*: editorial response. *African Bat Conservation News*, **17:** 3.
Kearney, T. (C.) (2013a). *Genus Laephotis African Long-eared Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 578 - 579.
Kearney, T. (C.) (2013b). *Laephotis angolensis Angolan Long-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 580 - 581.
Kearney, T. (C.) (2013c). *Laephotis botswanae Botswanan Long-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 581 - 582.
Kearney, T. (C.) (2013d). *Laephotis namibensis Namibian Long-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 583 - 584.
Kearney, T. (C.) (2013e). *Laephotis wintoni de Winton's Longe-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 584 - 585.
Kearney, T. (C.) (2013f). *Pipistrellus anchietae Anchieta's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 610 - 611.
Kearney, T. (C.) (2013g). *Pipistrellus capensis Cape Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 614 - 617.
Kearney, T. (C.) (2013h). *Pipistrellus hesperidus Dusk Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 629 - 631.
Kearney, T. (C.) (2013i). *Pipistrellus cf. melckorum Melck's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 635 - 637.
Kearney, T. (C.) (2013j). *Pipistrellus rusticus Rustic Pipistrelle (Rusty Pipistrelle).* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 649 - 651.
Kearney, T. (C.) (2013k). *Genus Cistugo Wing-gland Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 685.

Kearney, T. (C.) (2013l). *Cistugo lesueuri Lesueur's Wing-gland Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 685 - 687.
Kearney, T. (C.) (2013m). *Cistugo seabrae Angolan Wing-gland Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 687 - 688.
Kearney, T. C. (2014). Erratum for KEARNEY *et al.* (2010) - Chiroptera of Lufupa Camp, Kafue National Park, Zambia; with taxonomic notes on *Epomophorus, Nycticeinops, Scotophilus* and *Scotoecus*. *African Bat Conservation News*, **34:** 3.
Kearney, T. C. and W. Bogdanowicz (2007). Resolving relationships between species of Long-eared bats from the genus *Laephotis* using DNA sequence data and 3D geometric morphometrics. *African Bat Conservation News*, **11:** 2.
Kearney, T. C., M. Keith, W. Markotter, M. Pretorius and E. C. J. Seamark (2019). Bat species (Mammalia: Chiroptera) occurring at Telperion Nature Reserve. *Annals of the Ditsong National Museum of Natural History*, **8:** 30 - 42.
Kearney, T. C., M. Keith and E. C. J. Seamark (2016). New records of bat species using Gatkop Cave in the maternal season. *Mammalia*, **81 (1):** 41 - 48. doi: 10.1515/mammalia-2015-0043.
Kearney, T. C. and E. C. J. Seamark (2004). Correction of a montane (Drakensberg) record of lesser yellow house bat *Scotophilus viridis* (Chiroptera: Vespertilionidae). *Durban Museum Novitates*, **29:** 123 - 125.
Kearney, T. C. and E. C. J. Seamark (2005). Morphometric analysis of cranial and external characters of *Laephotis* Thomas, 1901 (Mammalia: Chiroptera: Vespertilionidae) from southern Africa. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **42:** 71 - 87.
Kearney, T. C. and E. C. J. Seamark (2011). Report for the Botswana Ministry of Environment, Wildlife and Tourism. Bat fieldwork at three different areas in the Okavango Delta in 2009. Africanbats.org Technical Report 1/2011: i-iv+1-66pp.
Kearney, T. C. and E. C. J. Seamark (2012). Report for Shangoni Management Services Pty Ltd. Assessment of the bats at Gatkop Cave, and possible mitigation measures. Africanbats.org Technical Report Nr. 01/2012: i - v; 1 - 47. URL: http://www.shangoni.co.za/Cms_Data/Contents/shangoniDB/Media/documents/addendum/Addendum%202A-%20Assessment%20of%20the%20bats%20at%20Gatkop%20Cave.pdf.
Kearney, T. C. and E. C. J. Seamark (2014). Museum accession numbers for voucher specimens from Namibia referred to by field number in MONADJEM *et al.* (2013) - A cryptic new species of *Miniopterus* from south-eastern Africa based on molecular and morphological characters. *African Bat Conservation News*, **34:** 3 - 4.
Kearney, T. C., E. C. J. Seamark, W. Bogdanowicz, E. Roberts and A. Roberts (2008a). Chiroptera of Lapalala Wilderness Area, South Africa. *African Bat Conservation News*, **18:** 8 - 12.
Kearney, T. (C.), E. C. J. Seamark, C. Mateke and D. Hood (2010). Chiroptera of Lufupa Camp, Kafue National Park, Zambia; with taxonomic notes on *Epomophorus, Nycticeinops, Scotophilus* and *Scotoecus*. *African Bat Conservation News*, **23:** 7 - 31.
Kearney, T. C. and P. J. Taylor (1997). New distribution records of bats in KwaZulu-Natal. *Durban Museum Novitates*, **22:** 53 - 56. [Abstract]
Kearney, T. C. and P. J. Taylor (2006). Variation in cranial morphology of species of vesper bats in the genera *Eptesicus*, *Neoromicia*, *Hypsugo* and *Pipistrellus* (Microchiroptera; Vespertilionidae) occurring in southern Africa. Abstract. South African Society for Systematic Biology Meeting, Kruger National Park - 14 - 17 July 2006: 28.
Kearney, T. C. and P. J. Taylor (2011). Selection of cranial and mandible measurements for traditional morphometric analyses of southern African vesper bats of the genera *Eptesicus, Hypsugo, Neoromicia*, and *Pipistrellus* (Mammalia: Chiroptera: Vespertilionidae). *Annals of the Ditsong National Museum of Natural History*, **1:** 53 - 61.
Kearney, T. C., V. Van Cakenberghe, E. C. J. Seamark, C. Ndhlovu and L. Cohen (2008b). Notes on the taxonomy and distribution of *Eptesicus hottentotus* (Chiroptera: Vespertilionidae) and reidentification of some museum voucher specimens. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **45:** 127 - 134.
Kearney, T. C. and E. Van Schalkwyk (2009). Variation in the position within the tooth row of the minute premolars of *Citugo lesueuri* and *C. seabrae* (Chiroptera: Vespertilionidae), and re-identification of some museum voucher specimens. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **46:** 117 - 120.
Kearney, T. C., M. Volleth, G. Contrafatto and P. J. Taylor (2002). Systematic implications of chromosome GTG-band and bacula morphology for Southern African *Eptesicus* and *Pipistrellus* and several other species of Vespertilioninae (Chiroptera: Vespertilionidae). *Acta Chiropterologica*, **4 (1):** 55 - 76. doi: 10.3161/001.004.0107.
Keegan, D. J. (1977). Aspects of the assimilation of sugars by *Rousettus aegyptiacus*. *Comparative Biochemistry and Physiology*, **58A:** 349-352.
Keeley, A. T. H. and B. W. Keeley (2004). The mating system of *Tadarida brasiliensis* (Chiroptera: Molossidae) in a large highway bridge colony. *Journal of Mammalogy*, **85 (1):** 113 - 119. doi: 10.1644/BME-004.
Keeley, B. W., A. T. H. Keeley and P. Houlahan (2018). Ridge number in bat ears is related to both guild membership and ear length. *PLoS ONE*, **13 (7):** e0200255. doi: 10.1371/journal.pone.0200255.
Keith, M. (2005). Conservation assessment of South African mammals. PhD thesis, University of Pretoria - Pretoria.
Keith, M., C. T. Chimimba, B. Reyers and A. S. van Jaarsveld (2005). Taxonomic and phylogenetic distinctiveness in regional conservation assessmsnts: A case study based on extant South African Chiroptera and Carnivora. *Animal conservation*, **8 (3):** 279 - 288. doi: 10.1017/S1367943005002192.
Keith, M., C. T. Chimimba, B. Reyers and A. S. van Jaarsveld (2007). A comparative analysis of components incorporated in conservation priority assessments; a case study based on South African species of terrestrial mammals. *African Zoology*, **42 (1):** 97 - 111.
Keller, A. (1986). Etude comparative de la structure fine des poils des Pipistrelles d'Europe (Mammalia: Chiroptera). *Revue suisse de zoologie*, **93 (2):** 409 - 415. [Abstract]
Kelly, E. (2008). In memory of Lloyd R. Wingate (1947-2007). *African Bat Conservation News*, **17:** 2.
Kelm, D. H., A. G. Popa-Lisseanu, M. Dehnhard and C. Ibáñez (2015). Non-invasive monitoring of stress hormones in the bat *Eptesicus isabellinus* - Do fecal glucocorticoid metabolite concentrations correlate with survival? *General & Comparative Endocrinology*, **226:** 27 - 35 (for 2016). doi: 10.1016/j.ygcen.2015.12.003.
Kemp, A. C. and I. L. Rautenbach (1987). Bat hawks or bat-eating hawks? *Gabar*, **2 (2):** 4 - 6.
Kemp, G. E. (1975). Viruses other than arenaviruses from West African wild mammals. Factors affecting transmission to man and domestic animals. *Bulletin of the World Health Organization*, **52 (4 - 6):** 615 - 620. [Abstract]
Kemp, G. E., O. R. Causey, H. W. Setzer and D. L. Moore (1974). Isolation of viruses from wild mammals in West Africa, 1966-1970. *Journal of wildlife diseases*, **10:** 279 - 293. [Abstract]
Kemp, G. E., G. Le Gonidec, N. Karabatsos, A. Rickenbach and C. B. Cropp (1988). IFE: a new African orbivirus isolated from *Eidolon helvum* bats captured in Nigeria, Cameroon and the Central African Republic. *Bulletin de la Société de Pathologie exotique et ses filiales*, **81:** 40 – 48.

Kemp, J., A. López-Baucells, R. Rocha, O. S. Wangensteen, Z. Andriatafika, A. Nair and M. Cabeza (2018). Bats as potential suppressors of multiple agricultural pests: A case study from Madagascar. *Agriculture, Ecosystems and Environment*, **269:** 88 - 96 (for 2019). doi: 10.1016/j.agee.2018.09.027.
Kenyon, P. A. (2015). Botswana Gwihaba Hills project. *South African Spelaeological Association Bulletin*, **41:** 48 - 53.
Kepka, O. (1960). Die Ergenbisse der Fledermausberingung in der Steinmark vom Jahr 1949-1960. *Bonner zoologische Beitrage*, **11:** 54- 76.
Kerbis Peterhans, J. C., J. Fahr, M. H. Huhndorf, P. Kaleme, A. J. Plumptre, B. D. Marks and R. Kizungu (2013). Bats (Chiroptera) from the Albertine Rift, eastern Democratic Republic of Congo, with the description of two new species of the *Rhinolophus maclaudi* group. *Bonner Zoological Bulletin*, **62 (2):** 186 - 202.
Kerr (1792). Animal Kingdom. 1 (1).
Kershaw, P. S. (1921). IV. - On the collection of South African mammals in the Durban Museum. *Durban Museum Novitates*, **3 (1):** 27 - 37. [Abstract]
Kershaw, P. S. (1922a). On a collection of mammals obtained by Capt. G.C. Shortridge in Northern Rhodesia, with field-notes by the collector. *Annals and Magazine of Natural History*ser. 9, 10 (55).
Kershaw, P. S. (1922b). On a collection of mammals from Chiromo and Cholo, Ruo, Nyasaland, made by Mr. Rodney C. Wood, with field-notes by the collector. *Annals and Magazine of Natural History*, **ser. 9, 10 (56):** 177 - 192. doi: 10.1080/00222932308632761.
Kershaw, P. S. (1923a). Notes on mammals collected by Dr. H. Schouteden in the Belgian Congo. *Revue de zoologie africaine*, **11 (4):** 355 - 368. [Abstract]
Kershaw, P. S. (1923b). LIII. On some small mammals from Tanganijika Territory. *Annals and Magazine of Natural History*, **ser. 9, 12 (70):** 534 - 536.
Kessel, Q. C. (1925). A synopsis of the Streblidae of the world. *Journal of the New York Entomological Society*, **33:** 11 - 33.
Kessler, M. K., D. J. Becker, A. J. Peel, N. V. Justice, T. Lunn, D. E. Crowley, D. N. Jones, P. Eby, C. A. Sánchez and R. K. Plowright (2018). Changing resource landscapes and spillover of henipaviruses. *Annals of the New York Acadamy of Science*, **1429:** 78 - 99. doi: 10.1111/nyas.13910.
Keymer, I. F. (1971). Blood protozoa of insectivores, bats and primates in Central Africa. *Journal of Zoology*, **163:** 421 - 441. [Abstract]
Keyserling, A. and J. H. Blasius (1839). Uebersicht der Gattungs- und Artcharaktere der europäische Fledermäuse. *Wiegmans Archiv für Naturgeschichte München*, **5 (1):** 293 - 331.
Kgaladi, J., L. H. Nel and W. Markotter (2013). Comparison of pathogenic domains of rabies and African rabies-related lyssaviruses and pathogenicity observed in mice. *Onderstepoort Journal of Veterinary Research*, **80 (1):** #511. doi: 10.4102/ojvr.v80i1.511.
Khajuria, H. (1972). Courtship and mating in *Rhinopoma h. hardwickei* Gray (Chiroptera : Rhinopomatidae). *Mammalia*, **36 (2):** 307 - 307. doi: 10.1515/mamm.1972.36.2.305.
Khajuria, H. (1988). A new species of rat-tailed bats (Chiroptera: Rhinopomatidae) from Iraq. *Records of the zoological Survey of India*, **85 (3):** 391 - 402. [Abstract]
Khalil, L. F. (1975). Two new species of the nematode genus *Spirura* Blanchard, 1849, from bats in Tanzania. *Journal of helminthology*, **49:** 93 - 99. [Abstract]
Khan, M. A. R. (2001). Status and dsitribution of bats in Bangladesh with notes on their ecology. *Zoos'Print Journal*, **16 (5):** 479 - 483. URL: http://www.zoosprint.org/ZooPrintJournal/2001/May/479-483.pdf.
Khwanmunee, J., L. Leelawatwattana and P. Prapunpoj (2015). Gene structure and evolution of transthyretin in the order Chiroptera. *Genetica*, **144:** 71 - 83 (for 2016). doi: 10.1007/s10709-015-9879-5.
Kia, G. S., I. I. Kuzmin, J. U. Umoh, J. K. Kwaga, H. M. Kazeem, M. O. Osinubi and C. E. Rupprecht (2014). Detection of some Lyssaviruses from fruigivorous and insectivorous bats in Nigeria. *Online Journal of Public Health Informatics*, **6 (1):** e31. doi: 10.5210/ojphi.v6i1.5071.
Kiefer, A. and M. Veith (2001). A new species of long-eared bat from Europe. *Myotis*, **39:** 5 - 16.
Killick, R., A. R. Barbon, M. Barrows, A. Routh, R. Saunders, C. Day, A. Naylor, N. Hayward, D. Sewell, K. Borgeat, A. L. Drane and L. Wilkie (2017). Medical management of dilated cardiomyopathy in Livingstone fruit bats (*Pteropus livingstonii*). *Journal of Zoo and Wildlife Medicine*, **48 (4):** 1077 - 1080. doi: 10.1638/2016-0211.1.
Killick-Kendrick, R. (1973). Parasitic protozoa of the blood of rodents. III. Two new malaria parasites of Anomalurine flying squirrels of the Ivory Coast. *Annales de Parasitologie humaine et comparée*, **48 (5):** 639 - 651. [Abstract]
Kindon, J. (1981). Where have the colonists come from? A zoogeographical examination of some mammalian isolates in Eastern Africa. *African Journal of Ecology*, **19:** 115 - 124.
King, A., P. Davies, Lawrie and A. (1990). The rabies viruses of bats. *Veterinary Microbiology*, **23 (1-4):** 165 - 174. [Abstract]
King, T. and M. Dallimer (2010). The fruit bats (Chiroptera: Pteropodidae) of the Lesio-Louna Reserve, Bateke Plateau, Republic of Congo. *Mammalia*, **74 (1):** 63 - 69. doi: 10.1515/MAMM.2009.073.
Kingdon, J. (1974). *East African Mammals. An atlas of evolution in Africa. Volume 2. Part A. (Insectivores and Bats).* Academic Press - New York & London: i - xi; 1 - 340.
Kingdon, J. (1989). *Island Africa.* Princeton University Press, Princeton, New Jersey: 287 pp.
Kinkelin, F. (1875). Report on the meeting of "Samstag den 13. März 1875". *Bericht über die Senckenbergische naturforschenden Gesellschaft in Frankfurt am Main*, **1875:** 364 - 365.
Kinman, K. E. (1994). *The Kinman System: toward a stable cladisto-eclectic classification of organisms (living and extinct: 48 phyla, 269 classes, 1,719 orders.* K. Kinman, Hays, Kansas (P.O. Box 1377, Hays 67601): 88 pp.
Kinnear, N. B. (1916). Notes on the animals (mammals, birds and reptiles) of Mesopotamia. *Bombay Natural History Society Special Publication*1 - 32.
Kioko, J., C. Kiffner, N. Jenkins and W. J. Collinson (2015). Wildlife roadkill patterns on a major highway in northern Tanzania. *African Zoology*, **50 (1):** 17 - 22. doi: 10.1080/15627020.2015.1021161.
Kipalu, P. (2009). Ecology, distribution, status and protection of three Congolese fruit bats, DRC (2005). Final Report. BP Conservation Programme (CLP) 2005. Project No. 101405: 21 pp. URL: http://www.conservationleadershipprogramme.org/UserDataWEB/ProjectData/000605/101405_DRC_Fruit%20Bats_Final%20Report.pdf.
Kirby, P. R. (1942). 1. Andrew Smith, M.D., Founder of the first South African Museum. *Annals of the South African Museum / Annale van die suid-afrikaanse museum*, **36 (1):** 1 - 26.
Kirk, J. (1865). List of mammalia met with in Zambesia, east tropical Africa. *Proceedings of the Zoological Society of London*, **1864, III:** 649 - 660.

Kirsch, J. A. W., T. F. Flannery, M. S. Springer and F. J. Lapointe (1995). Phylogeny of the Pteropodidae (Mammalia: Chiroptera) based on DNA hybridisation, with evidence for bat monophyly. *Australian Journal of Zoology*, **43 (4):** 395 - 428. doi: 10.1071/ZO9950395. [Abstract]
Kishida, K. (1924). On the additional species of Chiroptera in Taiwan. *Zoological Magazine; Tokyo*, **36:** 127 - 138.
Kishida, K. and T. Mori (1931). On distribution of the Korean land mammals [In Japanese]. *Zoological Magazine; Tokyo*, **43:** 372 - 391.
Kitchener, D. J. and N. Caputi (1985). Systematic revision of Australian *Scoteanax* and *Scotorepens* (Chiroptera: Vespertilionidae), with remarks on relationships to other Nycticeiini. *Records of the Western Australian Museum, Perth*, **12 (1):** 85 - 146. [Abstract]
Kitchener, D. J., N. Caputi and B. Jones (1986). Revision of Australo-Papuan *Pipistrellus* and *Falsistrellus* (Microchiroptera: Vespertilionidae). *Records of the Western Australian Museum, Perth*, **12 (4):** 435 - 495. [Abstract]
Kitchener, D. J., R. A. How and I. Maryanto (1992). A new species of *Otomops* (Chiroptera; Molossidae) from Alor I., Nusa Tenggara, Indonesia. *Records of the Western Australian Museum, Perth*, **15 (4):** 729 - 738.
Kityo, R. M., J. C. Kerbis Peterhans, M. H. Huhndorf and R. Hutterer (2009). *9. Appendix 3. New additions and noteworthy records of the bat (Mammalia: Chiroptera) fauna of Uganda, Rwanda, and the Democratic Republic of Congo.* In Thorn, E. and J. Kerbis Peterhans [Eds]: *Small mammals of Uganda: Bats, shrews, hedgehog, golden-moles, otter-tenrec, elephant-shrews, and hares* Zoologisches Forschungsmuseum Alexander Koenig, Bonn. Vol. 55: 127 - 140.
Kityo, R. M. and J. C. Kerbis (1996). Observations on the distribution and ecology of bats in Uganda. *Journal of East African Natural History*, **85:** 49 - 63. [Abstract]
Klimpel, S. and H. Mehlhorn [Eds] (2014). *Bats (Chiroptera) as vectors of diseases and parasites. Facts and myths.* Parasitology Research Monographs, 5 - Springer Verlag - Berlin Heidelberg: i - xii; 1 - 187. doi: 10.1007/978-3-642-39333-4.
Kling, J. (2018). Phased arrays & the Egyptian fruit bat. *Lab Animal*, **47 (3):** 61. doi: 10.1038/s41684-018-0010-2.
Klingerer, D. and T. A. Griffiths (1991). Karl F. Koopman: A biography and bibliography. In Griffiths, T.A. and D. Klingerer : *Contributions to Mammalogy in honor of Karl F. Koopman. Bulletin of the American Museum of Natural History*, **206:** 5 - 11.
Klop, E., J. Lindsell and A. Siaka (2008). Biodiversity of Gola Forest, Sierra Leone. A survey of Gola's mammals, birds, butterflies, dragonflies and damselflies, trees and non-woody plants, forest structure. Royal Society for the Protection of Birds - Conservation Society of Sierra Leone - Government of Sierra Leone: 1 - 195. URL: http://www.golarainforest.org/downloads/downloads_list.php.
Kobayashi, M. (2018). Anatomical attributes of the musculus quadriceps femoris responsible for poor crawling ability in the greater horseshoe bat (*Rhinolophus ferrumequinum*). *International Journal of Morphology*, **36 (1):** 69 - 73.
Kobayasi, K. I., S. Hiryu, R. Shimozawa and H. Riquimaroux (2012). Vocalization of echolocation-like pulses for interindividual interaction in horseshoe bats (*Rhinolophus ferrumequinum*). *Journal of the Acoustical Society of America*, **132 (5):** EL417 - EL422. doi: 10.1121/1.4757695.
Koch, C. (1860). ?? Title still needs to be checked. ?? .
Koch, C. (1862). Das Wesentliche der Chiropteren mit besonderer Beschreibung der in dem Herzogthum Nassau und den angränzenden Landestheilen vorkommenden Fledermäuse. *Jahresbücher des Vereins für Naturkunde im Herzogthum Nassau*, **18:** 261 - 579.
Koch, C. (1863). ?? Title still needs to be checked. ?? *Jahresbücher des Vereins für Naturkunde im Herzogthum Nassau*.
Koch-Weser, S. (1984). Fledermäuse aus Obervolta, W-Afrika (Mammalia: Chiroptera). *Senckenbergiana biologica*, **64 (4/6):** 255 - 311. [Abstract]
Kock, D. (1967). Ein Neunachweis von *Myotis welwitschi* und der Status von *Myotis venustus* (Mammalia, Chiroptera). *Senckenbergiana biologica*, **48 (5/6):** 319 - 325. [Abstract]
Kock, D. (1969a). Die Fledermaus-Fauna des Sudan (Mammalia, Chiroptera). *Abhandlungen der Senckenbergischen naturforschenden Gesellschaft*, **521:** 1 - 238. [Abstract]
Kock, D. (1969b). Ueber ein weibliches Exemplar des afrikanischen Bulldogg-Fledermaus, *Xiphonycteris spurelli* von Fernando Poo. *Senckenbergiana biologica*, **50 (1/2):** 9 - 13. [Abstract]
Kock, D. (1974a). Hildegarde's Tomb bat *Taphozous hildegardeae* Thomas, 1909, first record from Tanzania. *East African natural History Society Bulletin*, **xx (5):** 70 - 71.
Kock, D. (1974b). Egyptian Tomb bat *Taphozous perforatus* E. Geoffroy, 1818, first record from Uganda. *East African natural History Society Bulletin*130.
Kock, D. (1974c). Accidental death of a greater long-fingered bat, *Miniopterus inflatus* Thomas, 1901. *East African natural History Society Bulletin*162.
Kock, D. (1974d). Pupipare Dipteren von Säugetieren des nordöstlichen Mittelmeerraumens (Ins.: Diptera). *Senckenbergiana biologica*, **17:** 87–104.
Kock, D. (1975). Ein Originalexemplar von *Nyctinomus ventralis* Heuglin 1861 (Mammalia: Chiroptera: Molossidae). *Stuttgarter Beiträge zur Naturkunde*, **(A) 272:** 1 - 9. [Abstract]
Kock, D. (1977). Körper-Vibrissen bei Bulldogg-Fledermäusen - eine Anpassung an das Tagesquartier. *Natur und Museum - Bericht der Senckenbergische naturforschenden Gesellschaft*, **107 (9):** 274 - 277.
Kock, D. (1978a). Vergleichende Untersuchung einiger Säugetiere im südlichen Niger (Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia). *Senckenbergiana biologica*, **58 (for 1977) (3/4):** 113 - 136. [Abstract]
Kock, D. (1978b). *?? Title still needs to be checked. ??* Proceedings of the Fourth International Bat Research Conference - Nairobi.
Kock, D. (1981a). Zwei Fledermäuse neu für Kenya (Mammalia: Chiroptera). *Senckenbergiana biologica*, **61 (for 1980) (5/6):** 321 - 327. [Abstract]
Kock, D. (1981b). Zur Chiropteren-Fauna von Burundi (Mammalia). *Senckenbergiana biologica*, **61 (for 1980) (5/6):** 329 - 336. [Abstract]
Kock, D. (1983). Fledermaus-Fliegen in Iran (Insecta: Diptera: Streblidae, Nycteribiidae). *Senckenbergiana biologica*, **63:** 167 - 180. [Abstract]
Kock, D. (1987a). *Tadarida tenoitis* (Rafinesque, 1814): Zweiter Nachweis für Marokko, w-paläarktische Arealgrenzen und taxonomische Anmerkung (Chiroptera: Molossidae). *Zeitschrift für Säugetierkunde*, **52:** 194 - 196.
Kock, D. (1987b). *Micropteropus intermedius* Hayman 1963 und andere Fledermause vom unteren Zaire. *Senckenbergiana biologica*, **67 (4/6):** 219 - 224. [Abstract]
Kock, D. (1999a). *Tadarida (Tadarida) latouchei*, a separate species recorded from Thailand with remarks on related Asian taxa. *Senckenbergiana biologica*, **78 (1/2):** 237 - 240.

Kock, D. (1999b). The Egyptian *Vespertilio pipistrellus aegyptius* Fischer 1829, a nomen dubium (Mammalia, Chiroptera, Vespertilionidae). *Senckenbergiana biologica*, **79 (1):** 101 - 105.
Kock, D. (2001a). *Pipistrellus africanus meesteri*, nom. nov for *Pipistrellus nanus australis* Roberts, 1913 (Mammalia: Chiroptera: Vespertilionidae). *Acta Chiropterologica*, **3 (1):** 129 - 130.
Kock, D. (2001b). Identity of the African *Vespertilio hesperida* Temminck 1840 (Mammalia, Chiroptera, Vespertilionidae). *Senckenbergiana biologica*, **81 (1/2):** 277 - 283.
Kock, D. (2001c). *Rousettus aegyptiacus* (E. Geoffroy St. Hilaire; 1819) and *Pipistrellus anchietea* (Seabra, 1900), justified emendations of original spellings. *Acta Chiropterologica*, **3 (2):** 245 - 248.
Kock, D. (2004). Comment on the proposed conservation of the specific name of *Vespertilio nanus* Peters, 1852 (currently *Pipistrellus nanus*; Mammalia, Chiroptera). *Bulletin of Zoological Nomenclature*, **61 (1):** 48.
Kock, D. and V. Aellen (1987). Cimicidae parasites de Chiroptera du Muséum de Genève (Insecta: Hemiptera). *Revue suisse de zoologie*, **94 (4):** 873 - 879. [Abstract]
Kock, D., M. (M.) Al-Jumaily and A. Karim Nasher (2001). On the genus *Rhinopoma* E. Geoffroy 1818, and a record of *Rh. muscatellum* Thomas 1903 from Yemen (Mammalia, Chiroptera, Rhinopomatidae). *Senckenbergiana biologica*, **81 (1/2):** 285 - 287.
Kock, D., Z. (S.) Amr, D. Jacobs, F. P. D. Cotterill, P. J. Taylor and A. Monadjem (2008a). *Rhinolophus clivosus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Kock, D., Z. (S.) Amr, S. Mickleburgh, A. M. Hutson and W. Bergmans (2008b). *Asellia tridens*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Kock, D., Z. (S.) Amr, S. Mickleburgh, A. M. Hutson, W. Bergmans and S. Aulagnier (2008c). *Hipposideros caffer*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Kock, D., Z. (S.) Amr, S. Mickleburgh, A. M. Hutson, W. Bergmans and S. Molur (2008d). *Taphozous perforatus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Kock, D., L. (K.) Barnett, J. Fahr and C. Emms (2002). On a collection of bats (Mammalia: Chiroptera) from The Gambia. *Acta Chiropterologica*, **4 (1):** 77 - 97. doi: 10.3161/001.004.0108.
Kock, D. and H. R. Bhat (1994). *Hipposideros hypophyllus* n. sp. of the *H. bicolor*-group from peninsular India (Mammalia: Chiroptera: Hipposideridae). *Senckenbergiana biologica*, **73 (1/2):** 25 - 31. [Abstract]
Kock, D., H. Burda, W. N. Chitaukali and M. J. Overton (1998a). *Plerotes anchietae* (Seabra, 1900) in Malawi, Central Africa (Mammalia: Chiroptera). *Zeitschrift für Säugetierkunde*, **63 (2):** 114 - 116.
Kock, D., G. Csorba and K. M. Howell (2000). *Rhinolophus maendeleo* n. sp. from Tanzania, a horseshoe bat noteworthy for its systematics and biogeography (Mammalia, Chiroptera, Rhinolophidae). *Senckenbergiana biologica*, **80 (1/2):** 233 - 239.
Kock, D. and K. Dobat (2000). The bat fauna of Bali and Nusa Penida, Lesser Sunda Islands; corrections and additions (Mammalia: Chiroptera). *Acta Chiropterologica*, **2 (1):** 83 - 96.
Kock, D., D. C. D. Happold and M. Happold (1998b). Cimicidae and Polyctenidae from Malawian Chiroptera (Insecta: Hemiptera). *Senckenbergiana biologica*, **77 (2):** 235 - 239 (for 1997). [Abstract]
Kock, D. and K. M. Howell (1988). Three bats new for mainland Tanzania (Mammalia: Chiroptera). *Senckenbergiana biologica*, **68 (4/6):** 223 - 239. [Abstract]
Kock, D. and I. A. Nader (1979). Two bat flies from the Kingdom of Saudi Arabia, their nomenclature, host specificity and zoogeography (Insecta: Diptera: Nycteribiidae). *Senckenbergiana biologica*, **60 (1/2):** 65 - 73. [Abstract]
Kock, D. and I. A. Nader (1984). *Tadarida teniotis* (Rafinesque, 1814) in the W-Palaearctic and a lectotype for *Dysopes rupelii* Temminck, 1826 (Chiroptera: Molossidae). *Zeitschrift für Säugetierkunde*, **49:** 129 - 135.
Kock, D., K. Reinhardt, R. Naylor and M. T. Siva-Jothy (2005). Continued existence of Martienssen's Mastiff Bat, *Otomops martiensseni* (Matschie 1897) (Molossidae) on Mt. Suswa, Kenya. *African Bat Conservation News*, **3:** 2 - 5.
Kock, D. and W. T. Stanley (2009). Mammals of Mafia Island, Tanzania. *Mammalia*, **73 (4):** 339 - 352. doi: 10.1515/MAMM.2009.046.
Kock, D. and D. Zinner (2004). Martienssen's Mastiff Bat, *Otomops martiensseni* (Matschie 1897) (Molossidae) in Eritrea. *African Bat Conservation News*, **2:** 3 - 4.
Kofoky, A. (F.), D. Andriafidison, F. Ratrimomanarivo, H. J. Razafimanahaka, D. Rakototondravony, P. A. Racey and R. K. B. Jenkins (2007). Habitat use, roost selection and conservation of bats in Tsingy de Bemaraha National Park, Madagascar. *Biodiversity and conservation*, **16:** 1039 - 1053. doi: 10.1007/s10531-006-9059-0.
Kofoky, A. F., D. Andriafidison, H. J. Razafimanahaka, R. L. Rampilamanana and R. K. B. Jenkins (2006). The first observation of *Myzopoda* sp. (Myzopodidae) roosting in western Madagascar. *African Bat Conservation News*, **9:** 5 - 6.
Kofoky, A. F., F. Randrianandrianina, J. Russ, I. Raharinantenaina, S. G. Cardiff, R. K. B. Jenkins and P. A. Racey (2009). Forest bats of Madagascar: results of acoustic surveys. *Acta Chiropterologica*, **11 (2):** 375 - 392. doi: 10.3161/150811009X485602.
Kofron, C. P. and A. Chapman (1994). Reproduction and sexual dimorphism of the West African fruit bat, *Epomops buettikoferi*, in Liberia. *African Journal of Ecology*, **32 (4):** 308 - 316. doi: 10.1111/j.1365-2028.1994.tb00581.x. [Abstract]
Koh, H. S., J. E. Jo, J. G. Oh, G. H. Kweon, N. H. Ahn, W. H. Sin and D. S. Sin (2014). Little genetic divergence of the greater horseshoe bat *Rhinolophus ferrumequinum* from far-eastern Asia, with a preliminary report on genetic differentiation of *R. ferrumequinum* from Eurasia and northern Africa examined from cytochrome *b* sequences. *Russian Journal of Theriology*, **13 (2):** 97 - 103.
Kohar, G. and M. El Garhy (2005). Ultrastructural study on the trichostrongylid nematode *Spinostrongylus spinosus* from bats in Egypt. *Journal of the Egyptian German Society of Zoology*, **47 (D):** 59 - 66.
Kohl, C. and A. Kurth (2014). European bats as carriers of viruses with zoonotic potential. *Viruses*, **6 (8):** 3110 - 3128. doi: 10.3390/v6083110.
Kohl, C., M. Tachedjian, S. Todd, P. Monaghan, V. Boyd, G. A. Marsh, G. Crameri, H. Field, A. Kurth, I. Smith and L.-F. Wang (2018). Hervey virus: Study on co-circulation with Henipaviruses in Pteropid bats within their distribution range from Australia to Africa. *PLoS ONE*, **13 (2):** e0191933. doi: 10.1371/journal.pone.0191933.
Kolbe, J. (1887). Über die zoogeographischen Elemente in der Fauna Madagaskars. *Bericht über die Senckenbergische naturforschenden Gesellschaft in Frankfurt am Main*, **1887 (8):** 147 - 178.
Kolenati, F. A. (1856a). Europa's Chiroptern. I. Synopsis der Europäischen Chiroptern. *Allgemeine deutsche naturhistorische Zeitung*, **N.F., 2 (4):** 121 - 133.
Kolenati, F. A. (1856b). Europa's Chiroptern. II. Beschreibung der Europäischen lebenden Chiroptern. *Allgemeine deutsche naturhistorische Zeitung*, **N.F., 2 (5):** 161 - 192.

Kolenati, F. A. (1858). Eine neue österreichische Fledermaus. *Sitzungsberichte der Akademie für Wissenschaften aus Wien, mathematisch naturwissenschaftliche Klasse*, **29 (9):** 250 - 256.
Kolenati, F. A. (1860). *Monographie der Europäischen Chiroptern.* Jahrshefte der naturwissenschaftlichen Section der kais.königl. mähr. schles. Gesellschaft zur Beförderung des Ackerbaues, der Natur- und Landeskunde: 1 - 156.
Kolenati, F. A. (1863). ?? Title still needs to be checked. ?? .
Kolodny, O., M. Weinberg, L. Reshef, L. Harten, A. Hefetz, U. Gophna, M. W. Feldman and Y. Yovel (2018). Coordinated change at the colony level in fruit bat fur microbiomes through time. *Nature Ecology & Evolution*, **3:** 116 - 124. doi: 10.1038/s41559-018-0731-z.
Koneval, M. E. (1993). The systematic relationship of *Hipposideros commersoni matungensis* to other species of Rhinolophidae (Chiroptera). Honors Projects - Illinois Wesleyan University: 32 pp. URL: http://digitalcommons.iwu.edu/bio_honproj/13. [Abstract]
Konstantinov, O. K. (1984). *Rodents and bats of Guinea and their medical significance (in Russian).* Doklady - MOIB Zool. Botanik: 16 - 19.
Konstantinov, O. K., A. I. Pema, V. V. Labzin and G. V. Farafonova (2000). Records of bats from Middle Guinea, with remarks on their natural History. *Plecotus et al.*, **3:** 129 - 148.
Koopman, K. F. (1965). Status of forms described or recorded by J.A. Allen in "The American museum Congo expedition collections of bats". *American Museum Novitates*, **2219:** 1 - 34. [Abstract]
Koopman, K. F. (1966). Taxonomic and distributional notes on Southern African Bats. *The Puku*, **4:** 155 - 165. [Abstract]
Koopman, K. F. (1970). *Zoogeography of bats.* In Slaughter and Walton : *About Bats.* Dallas, Texas: 29 - 49. [Abstract]
Koopman, K. F. (1971). Taxonomic notes on *Chalinolobus* and *Glauconycteris* (Chiroptera, Vespertilionidae). *American Museum Novitates*, **2451:** 1 - 10. URL: http://hdl.handle.net/2246/2660. [Abstract]
Koopman, K. F. (1972). *Eudiscopus denticulus*. *Mammalian Species*, **19:** 1 - 2, 3 figs.
Koopman, K. F. (1975). Bats of the Sudan. *Bulletin of the American Museum of Natural History*, **154 (4):** 353 - 444. URL: http://hdl.handle.net/2246/609. [Abstract]
Koopman, K. F. (1978). Zoogeography of Peruvian bats with special emphasis on the role of the Andes. *American Museum Novitates*, **2651:** 1; 33, fig. 1., tab 1 - 3. [Abstract]
Koopman, K. F. (1981). A progress report on the systematics of African *Scotophilus* (Chiroptera, Vespertilionidae). Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 8. [Abstract]
Koopman, K. F. (1982). *Chiroptera.* In Honacki, J. H., K. E. Kinman and J. W. Koeppl : *Mammal Species of the world. A taxonomic and geographic reference.* Allen Press, Inc. and The Association of Systematic Collections - Lawrence, Kansas, USA.
Koopman, K. F. (1984a). Taxonomic and distributional notes on Tropical Australian Bats. *American Museum Novitates*, **2778:** 1 - 48, 1 fig. [Abstract]
Koopman, K. F. (1984b). A synopsis of the families of bats - Part VI. *Bat Research News*, **25 (2):** 15 - 17 (for 1984).
Koopman, K. F. (1985). A synopsis of the families of bats - Part VII. *Bat Research News*, **25 (3/4):** 25 - 27 (for 1984).
Koopman, K. F. (1986). Sudan bats revisited: An update of "Bats of the Sudan". *Cimbebasia*, **(A) 8 (2):** 9 - 13. [Abstract]
Koopman, K. F. (1989a). Distributional patterns of Indo-Malayan bats (Mammalia: Chiroptera). *American Museum Novitates*, **2942:** 1 - 19. [Abstract]
Koopman, K. F. (1989b). Systematic notes on Liberian bats. *American Museum Novitates*, **2946:** 1 - 11. [Abstract]
Koopman, K. F. (1992). Taxonomic status of *Nycteris vinsoni* Dalquest (Chiroptera, Nycteridae). *Journal of Mammalogy*, **73 (3):** 649 - 650. [Abstract]
Koopman, K. F. (1993a). *Order Chiroptera.* In Wilson, D. E. and D. M. Reeder [Eds]: *Mammal species of the world: a taxonomic and geographic reference. Second edition.* Smithsonian Institution Press - Washington, D.C. & London: 137 - 241.
Koopman, K. F. (1993b). Modern equivalents of genera in Dobson's 1878 "Catalogue of the Chiroptera of the British Museum". *Bat Research News*, **34 (4):** 82 - 86. [Abstract]
Koopman, K. F. (1994). *Chiroptera: Systematics.* In Niethammer, J., H. Schliemann and D. Starck : *Handbook of Zoology, 8 (Mammalia) (60).* W. De Gruyter - Berlin & New York: i - vii; 1 - 224.
Koopman, K. F. (1997). The subspecies of *Emballonura semicaudata* (Chiroptera: Emballonuridae). *Journal of Mammalogy*, **78 (2):** 358 - 360. [Abstract]
Koopman, K. F. and J. K. Jones (1970). *Classification of bats.* In Slaughter and Walton : *About bats.* Dallas, Texas: 22 - 28. [Abstract]
Koopman, K. F., C. P. Kofron and A. Chapman (1995). The bats of Liberia: Systematics, Ecology, and Distribution. *American Museum Novitates*, **3148:** 1 - 24. [Abstract]
Koopman, K. F. and G. T. MacIntyre (1980). *Phylogenetic analysis of Chiropteran dentition.* In Wilson, D. E. and A. L. Gardner [Eds]: *Proceedings fifth international bat research conference.* Texas Tech Press - Lubbock, Texas: 279 - 288.
Koopman, K. F., R. E. Mumford and J. F. Heisterberg (1978). Bat records from Upper Volta, West Africa. *American Museum Novitates*, **2643:** 1 - 6. [Abstract]
Korelov, M. V. (1947). Contribution to the systematics of bats of Kasachstan (in Russian). *Vestnic Akademie Nauk Kasachskii*, **1-2:** 117 - 119.
Korine, C., A. M. Adams, U. S. Amit and A. Gross (2015). Effect of water quality on species richness and activity of desert-dwelling bats. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **80 (3):** 185 - 190. doi: 10.1016/j.mambio.2015.03.009.
Korine, C. and Z. Arad (1993). Effect of water restriction on temperature regulation of the fruit-bat *Rousettus aegyptiacus*. *Journal of Thermal Biology*, **18 (2):** 61 - 69. [Abstract]
Korine, C. and Z. Arad (1999). Changes in milk composition from early to peak lactation in the Egyptian fruit bat, *Rousettus aegyptiacus*. *Journal of Mammalogy*, **80 (1):** 53 - 59.
Korine, C., S. Daniel and B. Pinshow (2013). Roost selection by female Hemprich's long-eared bats. *Behavioural Processes*, **100:** 131 - 138. doi: 10.1016/j.beproc.2013.08.013.
Korine, C., I. Izhaki and Z. Arad (1998). Comparison of fruit syndromes between the Egyptian fruit-bat (*Rousettus aegyptiacus*) and birds in East Mediterranean habitats. *Acta Oecologica*, **19 (2):** 147 - 153. doi: 10.1016/S1146-609X(98)80018-0. [Abstract]
Korine, C., I. Izhaki and D. Makin (1994). Population structure and emergence order in the fruit-bat (*Rousettus aegyptiacus*: Mammalia, Chiroptera). *Journal of Zoology*, **232 (1):** 163 - 174. doi: 10.1111/j.1469-7998.1994.tb01566.x. [Abstract]
Korine, C., B. R. Krasnov, I. S. Khokhlova and B. Pinshow (2012). Effects of host diet and thermal state on feeding performance of the flea *Xenopsylla ramesis*. *Journal of experimental biology*, **215 (5):** 1435 - 1441. doi: 10.1242/jeb.061796.

Korine, C., J. Speakman and Z. Arad (2004). Reproductive energetics of captive and free-ranging Egyptian fruit bats (*Rousettus aegyptiaca*). *Ecology*, **85 (1):** 220 - 230.

Korine, C., I. Vatnick, I. G. Van Tets and B. Pinshow (2006). The influence of ambient temperature and the energy and protein content of food on nitrogenous excretion in the Egyptian fruit bat (*Rousettus aegyptiacus*). *Physiological and Biochemical Zoology*, **79 (5):** 957 - 964.

Koselj, K. and B. Siemers (2013). Horseshoe bats can use information in echoes of conspecific calls for spatial orientation. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 81 - 82. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Kosoy, M. Y. (2010). Ecological associations between bacteria of the genus *Bartonella* and mammals. *Biology Bulletin*, **37 (7):** 716 - 724. doi: 10.1134/S1062359010070071. URL: http://www.springerlink.com/content/f3208wt8p7872888/fulltext.pdf.

Kosoy, M. Y., Y. Bai, T. Lynch, I. V. Kuzmin, M. Niezgoda, R. Franka, B. Agwanda, R. F. Breiman and C. E. Rupprecht (2010). *Bartonella* spp. in bats, Kenya. *Emerging Infectious Diseases*, **16 (12):** 1875 - 1881. doi: 10.3201/eid1612.100601. URL: http://www.cdc.gov/eid/content/16/12/pdfs/1875.pdf .

Kostron (1943). ?? Title still needs to be checked. ?? *Acta scientiarum naturalium Academiae scientiarum Bohemicae - Brno*15 (9).

Kouame, O. M. L., N. Jengre, M. Kobele, D. Knox, D. B. Ahon, J. Gbondo, J. Gamys, W. Egnankou, D. Siaffa, A. Okoni-Williams and M. Saliou (2012). Key Biodiversity Areas identification in the Upper Guinea forest biodiversity hotspot. *Journal of Threatened Taxa*, **4 (8):** 2745 - 2752.

Koubínová, D. (2013). Phylogeny of selected African bat species based on the cytogenetic and molecular approaches. Ph.D. Thesis - Charles University Prague: 54 pp.

Koubínová, D., N. Irwin, P. Hulva, P. Koubek and J. Zima (2013). Hidden diversity in Senegalese bats and associated findings in the systematics of the family Vespertilionidae. *Frontiers in Zoology*, **10 (1):** 48. doi: 10.1186/1742-9994-10-48.

Koubínová, D., N. Irwin, P. Hulva and J. Zima (2010a). Genetic diversity of vespertilionid bats from West Africa - preliminary results. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 196 - 197.

Koubínová, D., N. Irwin, P. Hulva and J. Zima (2011). Phylogeny of some vespertilionid bats from Western Africa, Senegal - comparison of molecular and cytogenetic approach. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 73 - 74. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.

Koubínová, D., K. S. Sreepada, P. Koubek and J. Zima (2010b). Karyotypic variation in rhinolophid and hipposiderid bats (Chiroptera: Rhinolophidae, Hipposideridae). *Acta Chiropterologica*, **12 (2):** 393 - 400. doi: 10.3161/150811010X537972.

Kovalyova, I. M. (2014). Key morphofunctional transformations in the evolution of bats (Mammalia, Chiroptera). *Russian Journal of Developmental Biology*, **45 (6):** 324 - 336. doi: 10.1134/S1062360414060071.

Kowalski, K., J. Gaisler, H. Bessam, C. Issaad and H. Ksantini (1986). Annual life cycle of cave bats in northern Algeria. *Acta Theriologica*, **13 (15):** 185 - 206. [Abstract]

Kowalski, K. and B. Rzebik-Kowalska (1991). *Mammals of Algeria.* Polish Academy of Sciences - Wroclaw, Warszawa, Krakow: 370 pp.

Kozhurina, E. I. (2002). Key to scientific names of bats from Russia and adjacent countries. In Russian with English summary. *Plecotus et al.*, **pars spec:** 12 - 19.

Kozhurina, E. I. (2009). Conspectus of the Russian bat fauna: systematics and distribution. In Russian with English summary. *Plecotus et al.*, **11 - 12:** 71 - 105. URL: http://zmmu.msu.ru/bats/biblio/conspect.pdf.

Kozhurina, E. I. and O. G. Ilchenko (2016). On the reproductive biology of Egyptian fruit bats (in Russian with English summary). *Plecotus et al.*, **19:** 3 - 13.

Krähling, V., O. Dolnik, L. Kolesnikova, J. Schmidt-Chanasit, I. Jordan, V. Sandig, S. Günther and S. Becker (2010). Establishment of Fruit Bat cells (*Rousettus aegyptiacus*) as a model system for the investigation of Filoviral Infection. *PLoS Neglected Tropical Diseases*, **4 (8):** e802. doi: 10.1371/journal.pntd.0000802.

Krampitz, H. and F. Anciaux de Faveaux (1960). Ueber einige Haemosporidien aus Fledermäusen der Höhlen des Berglandes von Katanga. *Zeitschrift für Tropenmedizin und Parasitologie*, **11 (4):** 391 - 400. [Abstract]

Krüger, D. H., P. T. Witkowski, B. Klempa, P. Heinemann, F. Leendertz, G. Schubert, K. Nowak, C. G. Akoua-Koffi, E. Couacy-Hymann, L. Kouadio, N. Magassouba, L. Koivogui, C. Mangu, L. Maboko, J. Kazgeba Mfune, A. Mbangu, W. Preiser, N. L. Ithete and S. Matthee (2015). Emerging viruses in West and South Africa: Molecular identification and characterization of rodent- and shrew-borne hantaviruses and assessment of their public health potential. .

Kruger, J.-L., L.-A. Dell, A. Bhagwandin, N. E. Jillani, J. D. Pettigrew and P. R. Manger (2010a). Nuclear organization of cholinergic, putative catecholaminergic and serotonergic systems in the brains of five microchiropteran species. *Journal of Chemical Neuranatomy*, **40 (3):** 210 - 222. doi: 10.1016/j.jchemneu.2010.05.007.

Kruger, J.-L., L.-A. Dell, J. D. Pettigrew and P. R. Manger (2010b). Cellular location and major terminal networks of the orexinergic system in the brains of five microchiropteran species. *Journal of Chemical Neuranatomy*, **40 (3):** 256 - 262. doi: 10.1016/j.jchemneu.2010.07.004.

Krüger, N. (2014). Interaction of bat-derived paramyxoviruses with chiropteran and non-chiropteran cells: Functional characterization of the African henipavirus and bat-derived mumps virus fusion and attachment glycoproteins. PhD Thesis - University of Veterinary Medicine, Hannover: I - xii; I - VIII; 1 - 154.

Krüger, N., M. Hoffmann, J. F. Drexler, M. A. Müller, V. M. Corman, C. Drosten and G. Herrler (2014). Attachment protein G of an African bat Henipavirus is differentially restricted in chiropteran and nonchiropteran cells. *Journal of Virology*, **88 (20):** 11973 - 11980. doi: 10.1128/JVI.01561-14.

Krüger, N., M. Hoffmann, M. Weis, J. F. Drexler, M. A. Müller, C. Winter, V. M. Corman, T. Gützkow, C. Drosten, A. Maisner and G. Herrler (2013). Surface glycoproteins of an african henipavirus induce syncytium formation in a cell line derived from an African fruit bat, *Hypsignathus monstrosus*. *Journal of Virology*, **87 (24):** 13889 - 13891. doi: 10.1128/JVI.02458-13.

Krüger, N., C. Sauder, S. Hüttl, J. Papies, K. Voigt, G. Herrler, K. Hardes, T. Steinmetzer, C. Örvell, J. F. Drexler, C. Drosten, S. Rubin, M. A. Müller and M. Hoffmann (2018). Entry, replication, immune evasion, and neurotoxicity of synthetically engineered bat-borne mumps virus. *Cell Reports*, **25 (2):** 312 - 320. doi: 10.1016/j.celrep.2018.09.018.

Krumbiegel, I. (1943). Zur Kenntnis der Säugetierfauna von Fernando Poo. (8. Beitrag zu den wissenschaftlichen Ergebnissen der Forschungsreise H. Eidmann nach Spanisch-Guinea 1939/40). *Wiegmans Archiv für Naturgeschichte München*, **NF 11 (4):** 305 - 349. [Abstract]

Kruskop, S. V. (2002). "Hotspots" in the systematics of plain-nosed bats. *Plecotus et al.*, **pars spec:** 20 - 26.

Kruskop, S. V., P. Benda, D. A. Vasenkov and L. A. Lavrenchenko (2016). First records of bats from the Alatish National Park, north-western Ethiopia (Chiroptera). *Lynx (Praha)*, **47:** 51 - 69.
Kruskop, S. V., M. Kasso and L. A. Lavrenchenko (2014). Preliminary bat survey in Dhati-Welel National Park, Ethiopia. In Lina, P.H.C., A.M. Hutson, M. Kipson, V. Zrncic and D. Hamidovic : *Book of Abstracts.* XIIIth European Bat Research Symposium. 1 - 5 September 2014, Šibenik, Croatia: 102. URL: http://13ebrs2014.com/wp-content/uploads/2014/10/13EBRS_Croatia2014_Abstracts.pdf.
Kruskop, S. V., K. Kawai and M. P. Tiunov (2019). Taxonomic status of the barbastelles (Chiroptera: Vespertilionidae: *Barbastella*) from the Japanese archipelago and Kunashir Island. *Zootaxa*, **4567 (3):** 461 - 476. doi: 10.11646/zootaxa.4567.3.3.
Kruskop, S. V. and L. A. Lavrenchenko (2000). A new species of long-eared bat (*Plecotus*; Vespertilionidae, Mammalia) from Ethiopia. *Myotis*, **38:** 5 - 17.
Kruskop, S. V. and L. A. Lavrenchenko (2006). First bat records in the Simien Mountains (Northern Ethiopia). *Russian Journal of Theriology*, **5 (2):** 59 - 62.
Kruskop, S. V. and L. A. Lavrenchenko (2009). Primary results of a bat survey in south-western Ethiopia, with a new Ethiopian record of *Kerivoula lanosa* (Chiroptera: Vespertilionidae). *Russian Journal of Theriology*, **7 (2):** 71 - 76 (for 2008).
Kruskop, S. V., E. N. Solovyeva and A. D. Kaznadzey (2018). Unusual Pipistrelle: taxonomic position of the Malayan noctule (*Pipistrellus stenopterus*; Vespertilionidae; Chiroptera). *Zoological Studies*, **57:** 60. doi: 10.6620/ZS.2018.57-60.
Krutzsch, P. H. (2000). *4. Anatomy, physiology and cyclicity of the male reproductive tract.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 91 - 155.
Kryštufek, B. (1993). Geographic variation in the Greater horseshoe bat *Rhinolophus ferrumequinum* in south-eastern Europe. *Acta Theriologica*, **38 (1):** 67 - 79.
Kryštufek, B. (1999). *Rhinolophus blasii Peters, 1866.* In Mitchell-Jones, A. J., G. Amori, W. Bogdanowicz, B. Kryštufek, P. J. H. Reijnders, F. Spitzenberger, M. Stubbe, J. B. M. Thissen, V. Vohralik and J. Zima : *The Atlas of European Mammals.* Poyser Natural History: 90 - 91.
Kryštufek, B. , Dulic, B. (2001). *Rhinolophus blasii Peters, 1866.* In Niethammer, J. and F. Krapp : *Handbuch der Säugetiere Europas.* Aula, Wiebelsheim: 75 - 90.
Krzanowski, A. (1959). Interisting twany specimens of the Long-eared bat (*Plecotus auritus* L.). *Acta Theriologica*, **2 (14):** 285.
Kühl, A., M. Hoffmann, M. A. Müller, V. J. Munster, K. Gnirß, M. Keine, T. S. Tsegaye, G. Behrens, G. Herrler, H. Feldmann, C. Drosten and S. Pöhlmann (2011). Comparative analysis of Ebola Virus glycoprotein interactions with human and bat cells. *The Journal of Infectious Diseases*, **204 (Suppl. 3):** S840 - S849. doi: 10.1093/infdis/jir306.
Kuhl, H. (1817). Die deutsche Fledermäuse. *Annalen Wetterau Gesellschaft für Naturkunde*, **1:** 11 - 49.
Kuhn, H. J. (1962a). *Scotonycteris zenkeri* Matschie, 1894 in Liberia. *Bonner zoologische Beitrage*, **12 (3-4):** 231 - 234 (for 1961). [Abstract]
Kuhn, H. J. (1962b). Zur Kenntnis der Microchiroptera Liberias. *Zoologischer Anzeiger*, **168 (5/6):** 179 - 187. [Abstract]
Kuhn, H. J. (1965). A provisional checklist of the mammals of Liberia (with notes on the status and distribution of some species). *Senckenbergiana biologica*, **46 (5):** 321 - 340.
Kuhn, H. J. (1968). Über die Innervation des Kehlkopfes einiger Flughunde (Pteropodidae, Megachiroptera, Mammalia). *Zoologischer Anzeiger*, **181 (3/4):** 168 - 181.
Kulzer, E. (1958). Untersuchungen über die Biologie von Flughunden der Gattung *Rousettus* Gray. *Zeitschrift für Morphologie und Ökologie der Tiere*, **47:** 374 - 402. [Abstract]
Kulzer, E. (1959). Fledermäuse aus Ostafrika. Ueber eine Sammlung van Chiropteren aus Kenia und Tanganyika mit ethologischen und ökologischen Beobachtungen. *Zoologische Jahrbücher: Abteilung für Systematik*, **87 (1/2):** 13 - 42. [Abstract]
Kulzer, E. (1961). Ueber die Biologie der Nil-Flughunde (*Rousettus aegyptiacus*). *Natur und Volk - Senckenbergische naturforschenden Gesellschaft*, **91 (6):** 219 - 228. [Abstract]
Kulzer, E. (1962a). Fledermäuse aus Tanganyika. *Zeitschrift für Säugetierkunde*, **27 (3):** 164 - 181.
Kulzer, E. (1962b). Ostafrikanische Fledermäuse. *Natur und Museum - Bericht der Senckenbergische naturforschenden Gesellschaft*, **92 (4):** 115 - 126.
Kulzer, E. (1965). Temperaturregulation bei Fledermäusen (Chiroptera) aus verschiedenen Klimazonen. *Zeitschrift für vergeleichende Physiologie*, **50:** 1 - 34. [Abstract]
Kulzer, E. (1979). Physiological ecology and geographical range in the fruit-eating cave bat genus *Rousettus* Gray 1821 - A review. *Bonner zoologische Beitrage*, **30 (3 - 4):** 233 - 275. URL: http://zfmk.de/BZB/1979/1979%20Kulzer%20E.%20p233.pdf.
Kulzer, E. (1982). Nektar-Lecken beim afrikanischen Langzungen-Flughund *Megaloglossus woermanni* Pagenstecher, 1885. *Bonner zoologische Beitrage*, **33 (2 - 4):** 151 - 164. URL: http://zfmk.de/BZB/1982/1982%20Kulzer%20E.%20p151%20orginal.pdf. [Abstract]
Kulzer, E., I. Helmy and G. Necker (1985). Untersuchungen über die Drusen der Gesichtsregion der agyptischen Mausschwanz-Fledermaus *R. hardwickei cystops* Thomas, 1903. *Zeitschrift für Säugetierkunde*, **50 (2):** 57 - 67.
Kulzer, E. and R. Storf (1980). Schlaf-Lethargie bei dem Afrikanischen Langzungenflughund *Megaloglossus woermanii* Pagenstecher, 1885. *Zeitschrift für Säugetierkunde*, **45:** 409 - 532. [Abstract]
Kumerloeve, H. (1974). Über die Balgsammlung Ludwig Graf von Huyns und weiteres äthiopisches Vogelmaterial im Zoologischen Forschungsinstitut und Museum Alexander Koenig. *Bonner zoologische Beitrage*, **25 (1 - 3):** 56 - 75. URL: http://zfmk.de/BZB/1974/1974%20Kumerloeve%20H.%20p56.pdf. [Abstract]
Kunz, T. H. (1983). An evaluation of fecal analysis for determining food habits of insectivorous bats. *Canadian journal of zoology*, **61:** 1317 - 1321.
Kunz, T. H. (1996). *3. Obligate and opportunistic interactions of Old-World tropical bats and plants.* In Hasan, Z.A.A. and Z. Akbar : *Conservation and faunal biodiversity in Malaysia.* Penerbit Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia: 37 - 65. [Abstract]
Kunz, T. H., A. Allgaier, J. Seyjagat and R. Caligiuri (1994). Alloparental care: helper-assisted birth in the Rodrigues fruit bat *Pteropus rodricensis* (Chiroptera: Pteropodidae). *Journal of Zoology*, **232 (4):** 691 - 700. doi: 10.1111/j.1469-7998.1994.tb04622.x. [Abstract]
Kunz, T. H. and C. E. Brock (1975). A comparison of mist nets and ultrasonic detectors for monitoring flight activity of bats. *Journal of Mammalogy*, **56 (4):** 907 - 911.
Kunz, T. H., E. B. de Torrez, D. Bauer, T. Lobova and T. H. Fleming (2011). Ecosystem service provided by bats. *Annals of the New York Acadamy of Science*, **1223:** 1 - 38. doi: 10.1111/j.1749-6632.2011.06004.x.

Kunz, T. H. and W. R. Hood (2000). *10. Parental care and postnatal growth in the Chiroptera.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 415 - 468.
Kupferschmidt, K. (2017). Bat Patrol. In the equatorial African night, the Ebola virus may be on the wing. *Science*, **356 (6341):** 901 - 903. doi: 10.1126/science.356.6341.901.
Kupferschmidt, K. (2019). This bat species may be the source of the Ebola epidemic that killed more than 11,000 people in West Africa. Science. URL: http://www.sciencemag.org/news/2019/01/bat-species-may-be-source-ebola-epidemic-killed-more-11000-people-west-africa.
Kuroda, N. (1938). *A list of Japanese mammals.* Tokyo, 122 pp.
Kurta, A. and T. H. Kunz (1987). *Size of bats at birth and maternal investment during pregnancy.* In Racey, P.A. and A. Loudon [Eds]: *Reproductive energetics of mammals.* Oxford University Press, London: 79 - 106. [Abstract]
Küster, P. C. (1835). Beiträge zur Naturgeschichte der Insel Sardinien. *Isis oder Encyclopädische Zeitung von Oken*, **1:** 75 - 88.
Kuzmin, I. V., B. Bozick, S. A. Guagliardo, R. Kunkel, J. R. Shak, S. Tong and C. E. Rupprecht (2011a). Bats, emerging infectious diseases, and the rabies paradigm revisited. *Emerging Health Threats Journal*, **4 (7159):** 1 - 17. doi: 10.3402/ehtj.v4i0.7159.
Kuzmin, I. V., A. E. Mayer, M. Niezgoda, W. Markotter, B. Agwanda, R. F. Breiman and C. E. Rupprecht (2010a). Shimoni bat virus, a new representative of the Lyssavirus genus. *Virus Research*. doi: 10.1016/j.virusres.2010.01.018.
Kuzmin, I. V., M. Niezgoda, R. Franka, B. Agwanda, W. Markotter, J. C. Beagley, O. Y. Urazova, R. F. Breiman and C. E. Rupprecht (2008a). Lagos bat virus in Kenya. *Journal of Clinical Microbiology*, **46 (4):** 1451 - 1461. doi: 10.1128/JCM.00016-08.
Kuzmin, I. V., M. Niezgoda, R. Franka, B. Agwanda, W. Markotter, J. C. Beagley, O. Y. Urazova, R. F. Breiman and C. E. Rupprecht (2008b). Possible emergence of West Caucasian bat virus in Africa. *Emerging Infectious Diseases*, **14 (12):** 1887 - 1889.
Kuzmin, I. V., M. Niezgoda, R. Franka, B. Agwanda, W. Markotter, R. F. Breiman, W. Shieh, S. R. Zaki and C. E. Rupprecht (2010b). Marburg virus in fruit bat, Kenya. *Emerging Infectious Diseases*, **16 (2):** 352 - 354. doi: 10.3201/eid1602.091269.
Kuzmin, I. V., T. M. Schwarz, P. A. Ilinykh, I. Jordan, T. G. Ksiazek, R. Sachidanandam, C. F. Basler and A. Bukreyev (2017). Innate immune responses of bat and human cells to filoviruses: commonalities and distinctions. *Journal of Virology*, **91 (8):** e02471-16. doi: 10.1128/JVI.02471-16.
Kuzmin, I. V., A. S. Turmelle, B. Agwanda, W. Markotter, M. Niezgoda, R. F. Breiman and C. E. Rupprecht (2011b). Commerson's Leaf-Nosed Bat (*Hipposideros commersoni*) is the likely reservoir of Shimoni Bat Virus. *Vector-Borne and Zoonotic Diseases*, **11 (11):** 1465 - 1470.
Kuzyakin, A. P. (1950). *Letuchiye myshi (Sistematika, obraz zhizni I pol'za dla sel'skogo I lesnogo khozyaystva) [Bats (System atics, life history and utility in agriculture and forestry)].* Sovetskaya Nauka, Moskva, 444 pp. [in Russian].
Kuzyakin, A. P. (1965). *Otryad Rukokrylye. Ordo Chiroptera [Order Bats. Ordo Chiroptera].* In Bobrinski, N.A., B.A. Kuznecov and A.P. Kuzyakin [Eds]: *Opredelitel' mle kopitayushchikh SSSR [Key to Identification of mammals of the USSR]* pp. 79-116.
Kwiecinski, G. G. and D. A. Damassa (2000). *3. Peripheral endocrines in bat reproduction.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 65 - 89.
Kwiecinski, G. G. and T. A. Griffiths (1999). *Rousettus egyptiacus*. *Mammalian Species*, **611:** 1 - 9, 3 figs.
Kyndt, T., A. E. Assogbadjo, O. J. Hardy, R. Glele Kakad, B. Sinsin, P. van Damme and G. Gheysen (2009). Spatial genetic structuring of baobab (*Adansonia digitata*, Malvaceae) in the traditional agroforestry systems of West Africa. *American Journal of Botany*, **96 (5):** 950 - 957.
Lacépède (1799). *Tableau des Divisions des Subordres, Ordres et Genres des Mammifères.* .
Lack, J. B., Z. P. Roehrs, C. E. Jr. Stanley, M. Ruedi and R. A. Van den Bussche (2010). Molecular phylogenetics of *Myotis* indicate familial-level divergence for the genus *Cistugo* (Chiroptera). *Journal of Mammalogy*, **91 (4):** 976 - 992. doi: 10.1644/09-MAMM-A-192.1.
Lack, J. B. and R. A. Van Den Bussche (2010). Identifying the confounding factors in resolving phylogenetic relationships in Vespertilionidae. *Journal of Mammalogy*, **91 (6):** 1435 - 1448. doi: 10.1644/09-MAMM-A-354.1.
Lafortune, M., S. O. Jr. Canapp and D. , Farina, L. L. Heard (2004). A vasectomy technique for Egyptian fruit bats (*Rousettus aegyptiacus*). *Journal of Zoo and Wildlife Medicine*, **35 (1):** 104 - 106. doi: 10.1638/03-020.
Lagadec, E., Y. Gomard, V. Guernier, M. Dietrich, H. Pascalis, S. Temmam, B. Ramasindrazana, S. M. Goodman, P. Tortosa and K. Dellagi (2012). Pathogenic *Leptospira* spp. in bats, Madagascar and Union of the Comoros. *Emerging Infectious Diseases*, **18 (10):** 1696 - 1698. doi: 10.3201/eid1810.111898.
Lainson, R. and R. D. Naiff (2000). On *Eimeria bragancaensis* n. sp. (Apicomplexa: Eimeriidae) and tissue-cysts of an unidentified protozoan in the bat *Peropteryx macrotis* (Chiroptera: Emballonuridae) from Amazonian Brazil. *Parasite*, **7:** 123 - 129. doi: 10.1051/parasite/2000072123.
Lalarivoniaina Noroalintseheno, O. S., F. I. Rajemison and S. M. Goodman (2017). Survie et variation temporelle de la taille de la population de *Rousettus madagascariensis* (Chiroptera: Pteropodidae) de la Grotte des Chauves-souris d'Ankarana, Nord de Madagascar. *Malagasy Nature*, **12:** 68 - 77.
Lamb, J. M., E. H. Abdel-Rahman, T. Ralph, M. B. Fenton, A. Naidoo, E. J. Richardson, C. Denys, T. Naidoo, W. Buccas, H. Kajee, N. Hoosen, D. Mallett and P. J. Taylor (2006). Phylogeography of southern and northeastern African populations of *Otomops martiensseni* (Chiroptera: Molossidae). *Durban Museum Novitates*, **31:** 42 - 53.
Lamb, J. M., T. Naidoo, P. J. Taylor, M. Napier, F. Ratrimomanarivo and S. M. Goodman (2012). Genetically and geographically isolated lineages of a tropical bat (Chiroptera: Molossidae) show demographic stability over the late Pleistocene. *Biological Journal of the Linnean Society*, **106 (1):** 18 - 40. doi: 10.1111/j.1095-8312.2011.01853.x.
Lamb, J. M., T. M. C. Ralph, S. M. Goodman, W. Bogdanowicz, J. Fahr, M. Gajewska, P. J. J. Bates, J. L. Eger, P. Benda and P. J. Taylor (2008). Phylogeography and predicted distribution of African-Arabian and Malagasy populations of giant mastiff bats, *Otomops* spp. (Chiroptera: Molossidae). *Acta Chiropterologica*, **10 (1):** 21 - 40. doi: 10.3161/150811008X331063.
Lamb, J. M., T. M. C. Ralph, T. Naidoo, P. J. Taylor, F. Ratrimomanarivo, W. Stanley and S. M. Goodman (2010). Toward a molecular phylogeny for Molossidae of Africa and Western Indian Ocean region. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 203 - 204.

Lamb, J. M., T. M. C. Ralph, T. Naidoo, P. J. Taylor, F. Ratrimomanarivo, W. T. Stanley and S. M. Goodman (2011). Toward a molecular phylogeny for the Molossidae (Chiroptera) of the Afro-Malagasy region. *Acta Chiropterologica*, **13 (1):** 1 - 16. doi: 10.3161/150811011X578589.
Lameed, G. A. (2007). Kainji Lake National Park of Nigeria: Assets and implications for sustainable development. *Biodiversity*, **8 (4):** 3 - 13. doi: 10.1080/14888386.2007.9712831.
Lameed, G. A. and A. E. Ayodele (2008). Environmental impact assessment of cement factory production on biodiversity: A case study of UNICEM, Calabar Nigeria. *World Journal of Biological Research*, **1 (1):** 1 - 7.
Laminger, F. and A. Prinz (2010). Fledertiere und andere Reservoirwirte der Filoviridae. Epidemiegefahr am afrikanischen Kontinent? - Eine deduktive Literaturanalyse. *Wiener Klinische Wochenschrift*, **122 (Suppl. 3):** 19 - 30. doi: 10.1007/s00508-010-1434-x. URL: http://www.springerlink.com/content/5786557510x1524x/fulltext.pdf.
Lamotte, M. (1942). La faune mammalogique du Mont Nimba (Haute Guinée). *Mammalia*, **6 (3/4):** 114 - 119. doi: 10.1515/mamm.1942.6.3.114.
Lampe, E. (1900). Catalog der Säugethier -Sammlung des naturhistorischen Museums zu Wiesbaden. *Jahresbücher des Vereins für Naturkunde im Herzogthum Nassau*, **53:** 1 - 39.
Lampert, K. P. (2001). Alternative life history strategies in the West African reed frog, *Hyperolius nitidulus*. Ph.D. Thesis - Bayerischen Julius-Maximilians-Universität Würzburg. URL: http://deposit.ddb.de/cgi-bin/dokserv?idn=966000757&dok_var=d1&dok_ext=pdf&filename=966000757.pdf.
Lancaster, D. G. (1953). *A check list of the mammals of Northern Rhodesia.* Lusaka: 56 pp.
Lancaster, W. C., S. C. Thomson and J. R. Speakman (1997). Wing temperature in flying bats measured by infrared thermography. *Journal of Thermal Biology*, **22 (2):** 109 - 116. [Abstract]
Landau, I. and J. P. Adam (1973). Two types of schizonts of *Hepatocystis* sp., a parasite of insectivorous bats in the Congo-Brazzaville. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **67 (1):** 6 - 7.
Landau, I. and A.-G. Chabaud (1978). Description de *Plasmodium cyclopsi* n. sp. parasite du Microchiroptère *Hipposideros cyclops* à Makokou (Gabon). *Annales de Parasitologie humaine et comparée*, **53 (3):** 247 - 253. [Abstract]
Landau, I., A.-G. Chabaud, F. Miltgen and D. Baccam (1980a). *Dionisia bunoi* n. gen. n. sp. Haemoproteidae parasite du Microchiroptère *Hipposideros cyclops* au Gabon. *Annales de Parasitologie*, **55 (3):** 271 - 280. [Abstract]
Landau, I., J. M. Chavatte, G. Karadjian, A. Chabaud and I. Beveridge (2012). The haemosporidian parasites of bats with description of *Sprattiella alecto* gen. nov., sp. nov. *Parasite*, **19:** 137 - 146.
Landau, I., G. Rosin, F. Miltgen, J.-P. Hugot, N. Leger, I. Beveridge and D. Baccam (1980b). Sur le genre *Polychromophilus* (Haemoproteidae, parasite de Microchiroptères). *Annales de Parasitologie humaine et comparée*, **55 (1):** 13 - 32. [Abstract]
Lane, H. C., N. Schönenberger and H. J. Huggel (1971). Quelques données sur l'innervation de l'artère et de la veine digitales alaires des Megachiroptères (*Rousettus aegyptiacus* et *Pteropus giganteus*). *Revue suisse de zoologie*, **78 (3) 29:** 655 - 660. [Abstract]
Lang, H. and J. P. Chapin (1917a). Part II. Notes on the distribution and ecology of Central African Chiroptera. In Allen, J. A., H. Lang and J. P. Chapin : *The American Museum Congo Expedition collection of Bats. Bulletin of the American Museum of Natural History*, **37 (18):** 479 - 496.
Lang, H. and J. P. Chapin (1917b). Part III. Field Notes. In Allen, J.A., Lang, H. & Chapin, J.P.: The American Museum Congo Expedition collection of Bats. In Allen, J. A., H. Lang and J. P. Chapin : *The American Museum Congo Expedition collection of Bats. Bulletin of the American Museum of Natural History*, **37 (18):** 497 - 563.
Langevin, P. and R. M. R. Barclay (1990). *Hypsignathus monstrosus*. *Mammalian Species*, **357:** 1 - 4, 4 figs.
Lanza, B. (1961). Alcune particolarita delle pliche palatine e dell'accrescimento postembrionale del cranio in *Epomophorus* (Mammalia: Megachiroptera). *Monitore zoologico italiana*, **68 (3/4):** 170 - 184. [Abstract]
Lanza, B. (1970). The baculum of *Pteropus* and its significance for the phylogenesis of the genus (Mammalia, Megachiroptera). *Monitore zoologico italiana*, **3 (Suppl. 3):** 37 - 68 (for 1969). doi: 10.1080/03749444.1970.10736760. [Abstract]
Lanza, B. and M. L. Azzaroli (1971). I mammiferi delle Alpi Apuane. *Lavori della Societa italiana di Biogeografia*, **n.s. 1:** 677 - 714. [Abstract]
Lanza, B. and C. Calloni (1970). The buccal pad of *Scotophilus nigrita* (Schreber) and of *Nycticeius hirundo* (De Winton) (Mammalia, Chiroptera, Vespertilionidae). *Monitore zoologico italiana*, **10 (Suppl. 3):** 227 - 233. [Abstract]
Lanza, B., U. Funaioli and M. Riccucci (2015). *The bats of Somalia and neighbouring areas.* Editions Chimaira, Frankfurt am Main: 566 pp.
Lanza, B. and D. L. Harrison (1963). A new description of the type specimen of *Nyctinomus aloysii-sabaudiae* Festa 1907. *Zeitschrift für Säugetierkunde*, **28 (2):** 102 - 107. [Abstract]
Lanza, B., M. Riccucci and U. Funaioli (2008). An interesting case of polyodontia in *Epomophorus wahlbergi*, with a review of this dental anomaly in bats (Chiroptera). *Lynx (Praha)*, **39 (1):** 109 - 127.
Largen, M. J., D. Kock and D. W. Yalden (1974). Catalogue of the mammals of Ethiopia. 1. Chiroptera. *Monitore zoologico italiana*, **(N.S.) 16 (Suppl. 5):** 221 - 298. [Abstract]
Larsen, P. A., C. E. Hayes, M. A. Wilkins, Y. Gomard, R. Sookhareea, A. D. Yoder and S. M. Goodman (2014). Population genetics of the Mauritian flying fox, *Pteropus niger*. *Acta Chiropterologica*, **16 (2):** 293 - 300. doi: 10.3161/150811014X687251.
Lassen, K. M., A. Ræbild, H. Hansen, C. J. Brødsgaard and E. N. Eriksen (2011). Bats and bees are pollinating *Parkia biglobosa* in The Gambia. *Agroforestry Systems*, **85 (3):** 465 - 475 (for 2012). doi: 10.1007/s10457-011-9409-0.
Lataste, F. (1880). Addition à la note précédente. In Dobson, G. : *Sur quelques espèces de Chiroptères provenant d'une collection faite en Algerie par M. Fernand Lataste. Bulletin de la Société zoologique de France*, **5:** 232 - 236. [Abstract]
Lataste, F. (1885). Etude de la faune des Vertébrés de Barbarie (Algérie, Tunisie et Maroc). Catalogue provisoire des mammifères apélagiques sauvages. *Actes de la Société Linné de Bordeaux*, **39:** 129 - 289.
Lataste, F. (1887a). *Exploration scientifique de la Tunisie. Catalogue critique des mammifères apélagiques sauvages de la Tunisie.* Imprimerie Nationale - Paris: xv + 42 pp. [Abstract]
Lataste, F. (1887b). Description d'une nouvelle especе de Chiroptère d'Egypte. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 4 (O.S. 24):** 625 - 630, 3 figs.
Laudisoit, A., V. Prié and J.-C. Beaucournu (2012). Une nouvelle espèce de *Lagaropsylla* Jordan & Rothschild, 1921 de Madagascar (Insecta, Siphonaptera, Ischnopsyllidae). *Zoosystema*, **34 (4):** 737 - 744. doi: 10.5252/z2012n4a5.
Laumanns, M. (2005). Höhlenforschung in den Virunga-Bergen, Ruanda. *Mitteilungen des Verbandes der deutschen Höhlen- und Karstforscher e.V.München*, **51 (3):** 93 - 95.
Laumanns, M. (2007). Virunga 2007 - deutsch-niederländische Expedition nach Ruanda. *Mitteilungen des Verbandes der deutschen Höhlen- und Karstforscher e.V.München*, **53 (4):** 111 - 113.

Laumanns, M., S. Schmassmann and H. Adrian (2004). The caves of Rwanda - Les grottes du Rwanda. *Berliner höhlenkundliche Berichte*, **11:** 1 - 89.
Laumanns, M., S. Schmassmann and H. Adrian (2005). The caves of Rwanda- Les grottes du Rwanda. *Berliner höhlenkundliche Berichte*, **15 (Supplement 1):** 1 - 62.
Laupland, K. B. and L. Valiquette (2014). Ebola virus disease. *Canadian Journal of Infectious Diseases & Medical Microbiology*, **25 (3):** 128 - 129.
Laurent, P. (1936). Une forme saharienne du genre *Plecotus, P. auritus saharae* subsp nov.. *Bulletin de la Société d'histoire naturelle de l'Afrique du nord*, **27:** 408 - 412.
Laurent, P. (1937a). Le petit rhinolophe fer à cheval au Maroc; description d'une forme nouvelle, *Rhinolophus hipposideros vespa* subsp. nov. *Bulletin de la Société d'histoire naturelle de l'Afrique du nord*, **28:** 157 - 165.
Laurent, P. (1937b). Une forme nouvelle du genre *Asellia*: *A. tridens pallida* subsp. nov. *Mammalia*, **1 (3):** 111 - 116. doi: 10.1515/mamm.1937.1.3.111.
Laurent, P. (1937c). Essai d'une clef dichotomique des chéiroptères de la Barbarie. *Mammalia*, **1 (4):** 133 - 159. doi: 10.1515/mamm.1937.1.4.133. [Abstract]
Laurent, P. (1937d). Une chauve-souris nouvelle pour le Maroc: la noctule, *Nyctalus noctula* Schreber, à Rabat. *Bulletin de la Société des Sciences Naturelles du Maroc*, **17:** 145 - 150.
Laurent, P. (1940). Le crane de *Rhinolophus maclaudi* Pousargues. *Bulletin du Muséum national d'histoire naturelle de Paris*, **(2) 12 (6):** 224 - 231.
Laurent, P. (1941a). Recherches sur les chauves-souris du genre *Rhinolophus* Lac. (Note préliminaire). *Bulletin de la Société zoologique de France*, **66:** 65 - 68.
Laurent, P. (1941b). Une addition à la faune mammalogique nord-africaine: *Rhinopoma cystops arabium* Thomas. *Mammalia*, **5 (1):** 11 - 17. doi: 10.1515/mamm.1941.5.1.11.
Laurent, P. (1941c). A propos de la Rhinopome tunisienne. *Mammalia*, **5 (3):** 99 - 100. doi: 10.1515/mamm.1941.5.3.99.
Laurent, P. (1942). La chauve-souris trident d'Etienne Geoffroy Saint Hilaire (*Asellia tridens* E. Geoffroy, 1813), déscription complémentaire. *Bulletin du Muséum national d'histoire naturelle de Paris*, **(2) 14 (1):** 43 - 48.
Laurent, P. (1944a). Observations sur le comportement des petits mammifères en captivité (suite). Le rhinolophe euryale. *Mammalia*, **8 (1):** 7 - 15. doi: 10.1515/mamm.1944.8.1.7.
Laurent, P. (1944b). ?? Title still needs to be checked. ?? *Bulletin du Muséum national d'histoire naturelle de Paris*(2) 16.
Laurie, E. M. O. and J. E. Hill (1954). *List of land mammals of New Guinea, Celebes and adjacent islands 1758-1952.* Trustees of the British Museum (Natural History). London: 165 pp.
Lausen, C. L. and R. M. R. Barclay (2005). *Pipistrellus nanus*. *Mammalian Species*, **784:** 1 - 7, 3 figs.
LaVal, R. K. (1973). A revision of the neotropical bats of the genus *Myotis*. *Bulletin of the Natural History Museum of Los Angeles County*, **15:** 1 - 51. [Abstract]
LaVal, R. K. and M. L. LaVal (1977). Reproduction and behavior of the African banana bat, *Pipistrellus nanus*. *Journal of Mammalogy*, **58 (3):** 403 - 410. [Abstract]
LaVal, R. K. and M. L. LaVal (1980). Prey selection by the Slit-faced bat *Nycteris thebaica* (Chiroptera: Nycteridae) in Natal, South Africa. *Biotropica*, **12 (4):** 241 - 246. [Abstract]
Lavin, S. R., Z. Chen and S. A. Abrams (2009). Effect of tannic acid on iron absorption in straw-colored fruit bats (*Eidolon helvum*). *Zoo Biology*, **29 (3):** 335 - 343. doi: 10.1002/zoo.20258. URL: http://onlinelibrary.wiley.com/doi/10.1002/zoo.20258/pdf.
Lavocat, R. (1961). Le gisement de vertebras miocènes de Beni Mellal (Maroc). Étude systematique de la faune de mammifères. *Notes Mem. Serv. Mines Carte geol. Maroc*, **155:** 29 - 94.
Lavrenchenko, L. A. (2013). *Plecotus balensis Bale Long-eared Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 661 - 662.
Lavrenchenko, L. (A.), J. Juste and P. Benda (2004a). *Plecotus balensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.
Lavrenchenko, L. (A.), J. Juste and P. Benda (2008). *Plecotus balensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Lavrenchenko, L. A., S. V. Kruskop, A. Bekele, G. Belay, P. N. Morozon, Y. F. Ivlev and A. A. Warshavsky (2011). Mammals of the Babille Elephant Sanctuary (Eastern Ethiopia). *Russian Journal of Theriology*, **9 (2):** 47 - 60 (for 2010).
Lavrenchenko, L. A., S. V. Kruskop and P. N. Morozov (2004b). Notes on the bats (Chiroptera) collected by the joint Ethiopian-Russian biological expedition, with remarks on their systematics, distribution, and ecology. *Bonner zoologische Beitrage*, **52 (1/2):** 127 - 147.
Lawer, E. A. and E. L. Darkoh (2016). Effects of agroecosystems on insect and insectivorous bat activity: a preliminary finding based on light trap and mist net captures. *Turkish Journal of Zoology*, **40 (3):** 423 - 432. doi: 10.3906/zoo-1507-17.
Lawer, E. A., A. Luguterah and S. Nasiru (2014). Comparison of artificial neural network and binary logistic regression for classification of chiropteran dietary specializations. *International Journal of Statistics and Applications*, **4 (4):** 204 - 211.
Lawrence, B. (1948). A new bat, *Otomops*, from Papua. *Journal of Mammalogy*, **29 (4):** 413 - 414.
Lawrence, B. (1964). Notes on the horseshoe bats *Hipposideros caffer*, *ruber* and *beatus*. *Breviora*, **207:** 5 pp. [Abstract]
Lawrence, B. and A. Loveridge (1953). Zoological results of a fifth expedition to East Africa. Mammals from Nyasaland and Tete. With notes on the genus *Otomys*. *Bulletin of the Museum of Comparative Zoology*, **110 (1):** 3 - 80.
Lawrence, B. and A. Novick (1963). Behavior as a taxonomic clue: relationships of *Lissonycteris* (Chiroptera). *Breviora*, **184:** 16 pp. [Abstract]
Lawson, E. T., J. S. Ayivor, F. Ohemeng and Y. Ntiamoa-Baidu (2018). Avoiding bites and scratches? Understanding the public health implication of human-bat interactions in Ghana. *Zoonoses and Public Health*, **66 (1):** 108 - 116 (for 2019). doi: 10.1111/zph.12540.
Lawson, E. T., F. Ohemeng, J. Ayivor, M. Leach, L. Waldman and Y. Ntiamoa-Baidu (2017). Understanding framings and perceptions of spillover: Preventing future outbreaks of bat-borne zoonoses. *Disaster Prevention and Management*, **26 (4):** 396 - 411. doi: 10.1108/DPM-04-2016-0082.
Lay, D. M. (1967). A study of the mammals of Iran resulting from the Street Expeditions of 1962-1963. *Fieldiana: zoology*, **54:** 1 - 282. [Abstract]
Laycock, P.(A.) (1973). Distribution and abundance of bats in the Natal Midlands (Mammalia: Chiroptera). *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **28 (12):** 207 - 228. [Abstract]
Laycock, P. A. (1976). A study of cave-dwelling microchiroptera in the Natal midlands. Masters thesis, University of Natal, Pietermaritzburg.

Lazzeroni, M. E., F. T. Burbrink and N. B. Simmons (2018). Hibernation in bats (Mammalia: Chiroptera) did not evolve through positive selection of leptin. *Ecology and Evolution*, **8 (24):** 12576 - 12596. doi: 10.1002/ece3.4674.

Leach, M., B. Bett, M. Said, S. Bukachi, R. Sang, N. Anderson, N. Machila, J. Kuleszo, K. Schaten, V. Dzingirai, L. Mangwanya, Y. Ntiamoa-Baidu, E. Lawson, K. Amponsah-Mensah, L. M. Moses, A. Wilkinson, D. S. Grant and J. Koninga (2017). Local disease-ecosystem-livelihood dynamics: reflections from comparative case studies in Africa. *Philosophical transactions of the Royal Society of London*, **B 372:** 20160163. doi: 10.1098/rstb.2016.0163.

Leach, W. E. (1816). *Systematical Catalogue of Species of Indigenous Mammals in the British Museum.* .

Leach, W. E. (1821). VIII. The Characters of three new Genera of Bats without foliaceous Appendages to the Nose. *Transactions of the Linnean Society, London*, **13:** 69-72.

Leach, W. E. (1825). Description of the *Vespertilio Pygmaeus*, a new species, recently discovered in Devonshire by Dr. Leach. *Zoological Journal*, **1 (4):** 559 - 561.

Leader, N., O. Mokady and Y. Yom-Tov (2006). Indirect flight of an African bat to Israel: An example of the potential for Zoonotic Pathogens to move between continents. *Vector-Borne and Zoonotic Diseases*, **6 (4):** 347 - 350.

Lebarbenchon, C., B. Ramasindrazana, L. Joffrin, S. Bos, E. Lagadec, G. Le Minter, Y. Gomard, P. Tortosa, D. A. Wilkinson, S. M. Goodman and P. Mavingui (2017). Astroviruses in bats, Madagascar. *Emerging microbes & infections*, **6 (6):** e58. doi: 10.1038/emi.2017.47.

Le Berre, M. (1990). *Faune du Sahara. 2. Mammifères.* Lechevalier - R. Chabaud - Paris: 359 pp.

Lebreton, M., E. M. Bakwo Fils, J. M. Takuo and J. Le Doux Diffo (2014). The first record of the African Sheath-tailed Bat *Coleura afra* (Peters, 1852) (Mammalia, Chiroptera) in Cameroon with information on its ecology. *African Bat Conservation News*, **36:** 2 - 4.

Leconte, J. (1855). Observations on the North American species of Bats. *Proceedings of the Academy of Natural Sciences of Philadelphia*431 - 438. [Abstract]

Leconte, J. (1857). Descriptions of several new mammals from Western Africa. *Proceedings of the Academy of Natural Sciences of Philadelphia*10 - 11.

Lee, A. K., K. A. Kulcsar, O. Elliott, H. Khiabanian, E. R. Nagle, M. E. B. Jones, B. R. Amman, M. Sanchez-Lockhart, J. S. Towner, G. Palacios and R. Rabadan (2015). De novo transcriptome reconstruction and annotation of the Egyptian rousette bat. *BMC Genomics*, **16:** 1033. doi: 10.1186/s12864-015-2124-x.

Lee, T. E. , Jr., J. W. Bickham and D. A. Schlitter (1989). Karyotypes of two Nycterid bats from Somalia. *Mammalia*, **53 (1):** 120 - 121, 1 pl.

Lee, W.-J., B. Falk, C. Chiu, A. Krishnan, J. H. Arbour and C. F. Moss (2017). Tongue-driven sonar beam steering by a lingual-echolocating fruit bat. *PLoS Biology*, **15 (12):** e2003148. doi: 10.1371/journal.pbio.2003148.

Leendertz, S. A. J. (2016). Testing new hypotheses regarding Ebolavirus reservoirs. *Viruses*, **8:** 30. doi: 10.3390/v8020030.

Leendertz, S. A. J., J. F. Gogarten, A. Düx, S. Calvignac-Spencer and F. H. Leendertz (2015). Assessing the evidence supporting fruit bats as the primary reservoirs for Ebola viruses. *EcoHealth*, **13 (1):** 18 - 25 (for 2016). doi: 10.1007/s10393-015-1053-0.

Legendre, S. (1982). Hipposideridae (Mammalia: Chiroptera) from the Mediterranean Middle and Late Neogene, and evolution of the genera *Hipposideros* and *Asellia*. *Journal of Vertebrate Paleontology*, **2 (3):** 372 - 385. [Abstract]

Legendre, S. (1984). Étude odontologique des représentants actuels du groupe *Tadarida* (Chiroptera, Molossidae). Implications phylogéniques, systématiques et zoogéographiques. *Revue suisse de zoologie*, **91 (2):** 399 - 442. [Abstract]

le Grange, A., M. Van der Merwe and M. Bester (2011). Reproductive strategy of the Egyptian free-tailed bat, *Tadarida aegyptiaca*, from a subtropical latitude (25°S) in South Africa. *African Zoology*, **46 (1):** 169 - 175. doi: 10.3377/004.046.0107.

Lehmann, E. von (1964). *Die Säugetier-ausbeute der 6 Reisen (1897-1913).* In Niethammer, G. : *Alexander Koenigs Reisen am Nil.* Bonn: 74 pp - 20 figs, 20 pls.

Lei, B. R. and K. J. Olival (2014). Contrasting patterns in mammal-bacteria coevolution: *Bartonella* and *Leptospira* in bats and rodents. *PLoS Neglected Tropical Diseases*, **8 (3):** e2738. doi: 10.1371/journal.pntd.000273.

Lei, M. and D. Dong (2016). Phylogenomic analyses of bat subordinal relationships based on transcriptome data. *Scientific Reports*, **6:** 27726. doi: 10.1038/srep27726.

Leirs, H., J. N. Mills, J. W. Krebs, J. E. Childs, D. Akaibe, N. Woollen, G. Ludwig, C. J. Peters, T. G. Ksiazek and other study group members (1999). Search for the Ebola virus reservoir in Kikwit, Democratic Republic of the Congo: Reflections on a Vertebrate collection. *The Journal of Infectious Diseases*, **179 (2 - Suppl 1):** 155 - 163. doi: 10.1086/514299.

Lekagul, B. and J. A. McNeely (1977). *Mammals of Thailand.* Kuruspha Ladprao Press - Bangkok: 758 pp.

Lelant, V. and N. Chenaval (2011a). Bilan succinct des espèces de chauves-souris inventoriées au Mali lors de la mission de janvier-février 2011. Electronic Report: 5 pp. URL: http://storage.canalblog.com/56/43/738905/63677769.pdf.

Lelant, V. and N. Chenaval (2011b). Bilan succinct des espèces de chauves-souris inventoriées en Mauritanie lors de la mission de décembre 2010/janvier 2011. Electronic Report: 5 pp. URL: http://storage.canalblog.com/66/65/738905/63677801.pdf.

Lelant, V. and N. Chenaval (2011c). Bilan succinct des espèces de chauves-souris inventoriées au Sénégal lors de la mission de novembre-décembre 2010. Electronic Report: 5 pp. URL: http://storage.canalblog.com/44/45/738905/63677824.pdf.

Lelant, V. and N. Chenaval (2011d). Bilan d'une étude chiroptérologique dans trois pays d'Afrique de l'Ouest (Mali, Mauritanie et Sénégal) de novembre 2010 à février 2011. Electronic report: 22 pp. URL: http://storage.canalblog.com/91/09/738905/69947035.pdf.

Lelant, V. and N. Chenaval (2012). Note on a meeting with a marabout from Fadial, Senegal, Western Africa, who uses bats in his medicine. *African Bat Conservation News*, **28:** 15 - 16.

Leleup, N. (1956). La faune cavernicole du Congo belge et considérations sur les coleoptères reliques d'Afrique intertropicale. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 46:** 1 - 171.

Lelli, D., A. Moreno, A. Lavazza, M. Bresaola, E. Canelli, M. B. Boniotti and P. Cordioli (2012). Identification of mammalian orthoreovirus type 3 in Italian bats. *Zoonoses and Public Health*, **60 (1):** 84 - 92 (for 2013). doi: 10.1111/zph.12001.

Lengkong, H. J., E. Arisoesilaningsih, L. Hakim and Sudarto (2016). Morphological variations and new species description of genus *Rousettus* bat from Gunung Duasudara Sanctuary, North Sulawesi, Indonesia. *OnLine Journal of Biological Sciences*, **16 (2):** 90 - 101. doi: 10.3844/ojbsci.2016.90.101.

Leonard, M. L. and M. B. Fenton (1983). Habitat use by spotted bats (*Euderma maculatum*, Chiroptera: Vespertillionidae): roosting and foraging behaviour. *Canadian journal of zoology*, **61:** abstract.

Leone, A. M., G. J. Crawshaw, M. M. Garner, S. Jr. Frasca, I. Stasiak, K. Rose, D. Neal and L. L. Farina (2016). A retrospective study of the lesions associated with iron storage disease in captive Egyptian fruit bats (*Rousettus aegyptiacus*). *Journal of Zoo and Wildlife Medicine*, **47 (1):** 45 - 55. doi: 10.1638/2015-0224.1.

Leopardi, S., E. C. Holmes, M. Gastaldelli, L. Tassoni, P. Priori, D. Scaravelli, G. Zamperin and P. De Benedictis (2018). Interplay between co-divergence and cross-species transmission in the evolutionary history of bat coronaviruses. *Infection, Genetics and Evolution*, **58:** 279 - 289. doi: 10.1016/j.meegid.2018.01.012.

Leopardi, S., D. Oluwayelu, C. Meseko, S. Marciano, L. Tassoni, S. Bakarey, I. Monne, G. Cattoli and P. De Benedictis (2016). The close genetic relationship of lineage D *Betacoronavirus* from Nigerian and Kenyan straw-colored fruit bats (*Eidolon helvum*) is consistent with the existence of a single epidemiological unit across sub-Saharan Africa. *Virus Genes*, **52 (4):** 573 - 577. doi: 10.1007/s11262-016-1331-0.

Leroy, E. M., A. Epelboin, V. Mondonge, X. Pourrut, J.-P. Gonzalez, J. J. Muyembe-Tamfum and P. Formenty (2009). Human Ebola outbreak resulting from direct exposure to fruit bats in Luebo, Democratic Republic of Congo, 2007. *Vector-Borne and Zoonotic Diseases*, **9 (6):** 723 - 728. doi: 10.1089/vbz.2008.0167.

Leroy, E. (M.) and J.-P. Gonzalez (2012). Filovirus research in Gabon and Equatorial Africa: The experience of a research center in the heart of Africa. *Viruses*, **4 (9):** 1592 - 1604. doi: 10.3390/v4091592.

Leroy, E. M., J.-P. Gonzalez and S. Baize (2011). Ebola and Marburg haemorrhagic fever viruses: major scientific advances, but a relatively minor public health threat for Africa. *Clinical Microbiology and Infection*, **17 (7):** 964 - 976. doi: 10.1111/j.1469-0691.2011.03535.x.

Leroy, E. M., B. Kumulungui, X. Pourrut, P. Rouquet, A. Hassanin, P. Yaba, A. Délicat, J. T. Paweska, J-P. Gonzalez and R. Swanepoel (2005). Fruit bats as reservoirs of Ebola virus. *Nature*, **438 (7068):** 575 - 576. doi: 10.1038/438575a.

Leroy, E. M., I. Labouba, G. D. Maganga and N. Berthet (2014). Ebola in West Africa: the outbreak able to change many things. *Clinical Microbiology and Infection*, **20 (10):** O597 - O599. doi: 10.1111/1469-0691.12781.

Leroy, E. (M.), X. Pourrut and J.-P. Gonzalez (2006). Les chauves-souris, réservoirs du virus Ebola. Le mystère se dissipe. *M/S: médicine sciences*, **22 (1):** 78 - 79. URL: http://id.erudit.org/iderudit/012237ar.

Lesson, R. P. (1827). *Manuel de mammalogie, ou, Histoire naturelle des mammife`res.* Paris, Roret, Libraire: i - xv; 1 - 441.

Lesson, (R.) P. (1838). *Compléments de Buffon. Races humaines et mammifères.* P. Pourrat, frères, Paris. 1 - 660.

Lesson, R. P. (1842). *Nouveau tableau du Règne Animale. Mammifères.* Arthus Betrand, Paris: 1 - 204.

Leulmi, H., A. Aouadi, I. Bitam, A. Bessas, A. Benakhla, D. Raoult and P. Parola (2016). Detection of *Bartonella tamiae, Coxiella burnetii* and rickettsiae in arthropods and tissues from wild and domestic animals in northeastern Algeria. *Parasites & Vectors*, **9:** 27. doi: 10.1186/s13071-016-1316-9.

Levin, E., A. Barnea, Y. Yovel and Y. Yom Tov (2006). Have introduced fish initiated piscivory among the long-fingered bat? *Mammalian biology (Zeitschrift für Säugetierkunde)*, **71:** 139–143.

Levin, E., B. Plotnik, E. Amichai, L. J. Braulke, S. Landau, Y. Yom-Tov and N. Kronfeld-Schor (2015). Subtropical mouse-tailed bats use geothermally heated caves for winter hibernation. *Proceedings of the Royal Society of London*, **B 282 (1804):** 20142781. doi: 10.1098/rspb.2014.2781.

Levin, E., U. Roll, A. Dolev, Y. Yom-Tov and N. Kronfeld-Shcor (2013). Bats of a gender flock together: sexual segregation in a subtropical bat. *PLoS ONE*, **8(2):** e54987. doi: 10.1371/journal.pone.0054987.

Levin, E., Y. Yom-Tov and A. Barnea (2008). Frequent summer nuptial flights of ants provide a primary food source for bats. *Die Naturwissenschaften*, **xx:** e1-7. doi: 10.1007/s00114-008-0496-3.

Levin, E., Y. Yom-Tov, A. Barnea and D. Huchon (2009). Genetic diversity and phylogeography of the greater mouse-tailed bat *Rhinopoma microphyllum* (Brü□nnich, 1782) in the Levant. *Acta Chiropterologica*, **10 (2):** 207 - 212 (for 2008). doi: 10.3161/150811008X414791.

Levin, E., Y. Yom-Tov, A. Hefetz and N. Kronfeld-Schor (2012). Changes in diet, body mass and fatty acid composition during pre-hibernation in a subtropical bat in relation to NPY and AgRP expression. *Journal of Comparative Physiology*, **B 183 (1):** 157 - 166 (for 2013). doi: 10.1007/s00360-012-0689-0.

Li, G., J. Wang, S. J. Rossiter, G. Jones and S. Zhang (2007). Accelerated FoxP2 evolution in echolocating bats. *PLoS ONE*, **2 (9) e900:** 1 - 10. doi: 10.1371/journal.pone.0000900.

Li, N., A. B. Ayinmode, H. Zhang, Y. Feng and L. Xiao (2019). Host-adapted *Cryptosporidium* and *Enterocytozoon bieneusi* genotypes in straw-colored fruit bats in Nigeria. *International Journal for Parasitology - Parasites and Wildlife*, **8:** 19 - 24. doi: 10.1016/j.ijppaw.2018.12.001.

Li, Q., F. Lu, C. Dai, M. Fan, W. Wang and K. Wang (2016). Simulating the potential role of media coverage and infected bats in the 2014 Ebola outbreak. *Journal of theoretical biology*, **412 (10):** 123 - 129 (for 2017). doi: 10.1016/j.jtbi.2016.10.009.

Lichtenstein, H. (1823). *Verzeichniss der Doubletten des Zoologischen Museums der Konigl. Universitat zu Berlin nebst Beschreibung vieler bisher unbekannter Arten von Saugethieren, Vogeln. Amphibien und Fischen.* T. Tautwein, Berlin: 1 - 118.

Lieron, V., E. Poulouin, M. Amezian, A. Qninba and M. Thevenot (2008). Inventaire des Chiroptères de l'arrière-pays du port Tanger-Méditerranée (Nord-Ouest du Maroc). *Bulletin de l'Institut Scientifique, Rabat, Sciences de la Vie*, **30:** 53 - 54.

Lim, B. K. (2007). Divergence times and origin of neotropical sheath-tailed bats (Tribe Diclidurini) in South America. *Molecular phylogenetics and evolution*, **45 (3):** 777 - 791. doi: 10.1016/j.ympev.2007.09.003.

Lim, B. K. and J. M. Dunlop (2007). Evolutionary patterns of morphology and behavior as inferred from a molecular phylogeny of New World emballonurid bats (Tribe Diclidurini). *Journal of Mammalian Evolution*, **15:** 79 - 121 (for 2008). doi: 10.1007/s10914-007-9068-0.

Lim, B. K. and P. J. Van Coeverden de Groot (1997). Taxonomic report of small mammals from Côte d'Ivoire. *Journal of African Zoology*, **111 (4):** 261 - 279.

Lima, L., O. Espinosa-Álvarez, P. B. Hamilton, L. Neves, C. S. A. Takata, M. Campaner, M. Attias, W. d. Souza, E. P. Camargo and M. M. G. Teixeira (2013). *Trypanosoma livingstonei*: a new species from African bats supports the bat seeding hypothesis for the *Trypanosoma cruzi* clade. *Parasites & Vectors*, **6:** 221. doi: 10.1186/1756-3305-6-221.

Lima, L., F. M. d. Silva, L. Neves, M. Attias, C. S. A. Takata, M. Campaner, W. d. Souza, P. B. Hamilton and M. M. G. Teixeira (2012). Evolutionary insights from bat trypanosomes: Morphological, developmental and phylogenetic evidence of a new species, *Trypanosoma (Schizotrypanum) erneyi* sp. nov., in African bats closely related to *Trypanosoma (Schizotrypanum) cruzi* and allied species. *Protist*, **163 (6):** 856 - 872. doi: 10.1016/j.protis.2011.12.003.

Lin, L.-K., M. Motokawa and M. Harada (2002). Karyological study of the house bat *Pipistrellus abramus* (Mammalia: Chiroptera) from Taiwan with comments on its taxonomic status. *Raffles Bulletin of Zoology*, **50 (2):** 507 - 510.

Lina, P. H. C. (2017). *Common names of European bats (2nd edition).* EUROBATS Publication Series No. 7. UNEP / EUROBATS Secretariat, Bonn, Germany: 104 pp.

Lindblom, G. (1928). A noose-trap appliance for the capture of the fruit-eating bats of the Lower Congo region. *Man*, **28 (69):** 93 - 95.

Linden, V. M. G., S. M. Weier, I. Gaigher, H. J. Kuipers, M. J. A. Weterings and P. J. Taylor (2014). Changes of bat activity, species richness, diversity and community composition over an altitudinal gradient in the Soutpansberg range, South Africa. *Acta Chiropterologica*, **16 (1):** 27 - 40. doi: 10.3161/150811014X683246.
Lindeque, M. (1987). Observations on mating behaviour in the common slit-faced bat *Nycteris thebaica*. *Madoqua: Tydskrif vir natuurbewarings- en Woestynnavoring = Journal of nature conservation and desert research*, **15:** 183 - 185.
Lindhe Norberg, U. M., A. P. Brooke and W. J. Trewhella (2000). Soaring and non-soaring bats of the family Pteropodidae (flying foxes, *Pteropus* spp.): wing morphology and flight performance. *Journal of experimental biology*, **203:** 651 - 664.
Lips, M. and J. Rodhain (1956). Quelques hématozoaires de petits mammifères du Haut-Katanga. *Annales de Parasitologie humaine et comparée*, **31 (5 - 6):** 481 - 488.
Lisón, F. and J. F. Calvo (2013). Ecological niche modelling of three pipistrelle bat species in semiarid Mediterranean landscapes. *Acta Oecologica*, **47:** 68 - 73. doi: 10.1016/j.actao.2013.01.002.
Lisón, F. and J. F. Calvo (2014). Bat activity over small ponds in dry Mediterranean forests: implications for conservation. *Acta Chiropterologica*, **16 (1):** 95 - 101. doi: 10.3161/150811014X683309.
Lisón, F., A. Haz and J. F. Calvo (2014). Preferencia de hábitat del murciélago hortelano meridional *Eptesicus isabellinus* (Temminck, 1840) en ambientes mediterráneos semiáridos. *Animal Biodiversity and Conservation*, **37 (1):** 59 - 67.
Liu, F.-G. R., M. M. Miyamoto, N. P. Freire, P. Q. Ong, M. R. Tennant, T. S. Young and K. F. Gugel (2001). Molecular and morphological supertrees for Eutherian (Placental) Mammals. *Science*, **291:** 1786 - 1789.
Liu, Y., W. Metzner and J. Feng (2013a). Vocalization during copulation behavior in greater horseshoe bats, *Rhinolophus ferrumequinum*. *Chinese Science Bulletin*, **58 (18):** 2179 - 2184. doi: 10.1007/s11434-013-5793-3.
Liu, Z., W. Wang, T.-Z. Zhang, G.-H. Li, K. He, J.-F. Huang, X.-L. Jiang, R. W. Murphy and P. Shi (2013b). Repeated functional convergent effects of $Na_V1.7$ on acid insensitivity in hibernating mammals. *Proceedings of the Royal Society of London*, **B 281 (1776):** 20132950 (for 2014). doi: 10.1098/rspb.2013.2950.
Locatelli, A. G., D. Jebb and E. C. Teeling (2016). The complete mitochondrial genome of Kuhl's pipistrelle, *Pipistrellus kuhlii* (Chiroptera: Vespertilionidae). *Mitochondrial DNA*, **B 1 (1):** 423 - 424. doi: 10.1080/23802359.2016.1176886.
Loche, V. (1858). *Catalogue des mammifères et des oiseaux observés en Algérie par le capitaine Loche.* Librarie d'Arthus Bertrand - Paris: i - xi; 1 - 158. [Abstract]
Loche, V. (1867). *Exploration scientifique de l'Algerie pendant les années 1840, 1841, 1842. Histoire naturelle des mammifères. Ordre des Chéiropteres Chiroptera (pp. 73 - 83).* Arthus Bertrand - Paris: 123 pp. [Abstract]
Long, E. (2002). The feeding ecology of *Pteropus rufus* in a remnant gallery forest surrounded by sisal plantations in South-east Madagascar. PhD thesis, University of Aberdeen - Aberdeen.
Long, E. and P. A. Racey (2007). An exotic plantation crop as a keystone resource for an endemic megachiropteran, *Pteropus rufus*, in Madagascar. *Journal of Tropical Ecology*, **23:** 397 - 407. doi: 10.1017/S0266467407004178.
Long, J. K. (1995). *Otomops martiensseni. Mammalian Species*, **493:** 1 - 5, 3 figs.
Lönnberg, E. (1908a). *Wissenschaftliche Ergebnisses Swedischen Zoologische Expedition unter Leitung Sjöstedt, Kilimandjaro.* .
Lönnberg, E. (1908b). *Sjöstedts Kilimanjaro-Meru Expedition. 2.* Uppsalla.
Lönnberg, E. (1908c). Notes on some mammals collected in the Congo Free State. *Arkiv för zoologi, Stockholm*, **4 (16):** 1 - 14. [Abstract]
Lönnberg, E. (1912). Mammals collected by the Swedish zoological expedition to British East Africa 1911. *Kongliga Svenska Vetenskaps-Akademiens Handlingar*, **48 (5):** 1 - 188.
Lönnberg, E. (1917a). Mammals collected by H.R.H. Prince Vilhelm's Expedition to British East Africa, 1914. *Arkiv för zoologi, Stockholm*, **10 (12):** 1 - 32. [Abstract]
Lönnberg, E. (1917b). Mammals collected in Central Africa by captain E. Arrhenius. *Kongliga Svenska Vetenskaps-Akademiens Handlingar*, **58 (2):** 1 - 110.
Lönnberg, E. and N. Gyldenstolpe (1925). Zoological results of the Swedish expedition to Central Africa 1921. Vertebrata. 3. Preliminary diagnoses of four new mammals. *Arkiv för zoologi, Stockholm*, **17B (9):** 1 - 6. [Abstract]
Lopes, F. J. and J. Crawford-Cabral (1992). Catálogo dos Chiroptera em colecçao no Centro de Zoologia. *Garcia de Orta, Série de Zoologia, Lisboa*, **17 (for 1990) (1-2):** 1 - 20. [Abstract]
López-Baucells, A., C. Flaquer, X. Puig-Montserrat, L. Freixas and L. Mohamed (2012). Actualización del inventario de quirópteros y refugios en Ceuta: primera cita de *Pipistrellus pygmaeus* en el norte de África. *Barbastella*, **5 (1):** 43 - 50.
López-Baucells, A., R. Rocha, Z. Andriatafika, T. Tojosoa, J. Kemp, K. M. Forbes and M. Cabeza (2018). Roost selection by synanthropic bats in rural Madagascar: what makes non-traditional structures so tempting? *Hystrix, Italian Journal of Mammalogy*, **28 (1):** 28 - 35 (for 2017). doi: 10.4404/hystrix–28.1-12046.
López-Baucells, A., R. Rocha, P. Webala, A. Nair, R. Uusitalo, T. Sironen and K. M. Forbes (2017). Rapid assessment of bat diversity in the Taita Hills Afromontane cloud forests, southeastern Kenya. *Barbastella*, **9 (1):** 17 - 28 (for 2016).
López-García, J. M., J. Agustí and H. Aouraghe (2012). The small mammals from the Holocene site of Guenfouda (Jerada, Eastern Morocco): chronological and paleoecological implications. *Historical Biology*, **25 (1):** 51 - 57 (for 2013). doi: 10.1080/08912963.2012.688198.
López-González, C. (1998). *Micronycteris minuta*. *Mammalian Species*, **583:** 1 - 4, 3 figs.
Louchart, A., H. Wesselman, R. J. Blumenschine, L. J. Hlusko, J. K. Njau, M. T. Black, M. Asnakw and T. D. White (2009). Taphonomic, avian, and small-vertebrate indicators of *Ardipithecus ramidus* habitat. *Science*, **326 (5949):** 66, 66e1-66e4.
Louette, M. (1999). Lafaune terrestre de Mayotte. *Museum Royal de l'Afrique Centrale*, **284:** 1-247.
Louette, M. (2004). *Mammifères.* In Louette, M., D. Meirte and R. Joqu : *La faune terrestre de l'archipel des Comores.* 65 - 87.
Lough-Stevens, M., N. G. Schultz and M. D. Dean (2017). The baubellum is more developmentally and evolutionarily labile than the baculum. *Ecology and Evolution*, **8 (2):** 1073 - 1083 (for 2018). doi: 10.1002/ece3.3634.
Loumassine, H.-E., B. Allegrin, F. Bounaceur, O. Peyre and S. Aulagnier (2017a). A new mammal species for Algeria, *Rhinopoma microphyllum* (Chiroptera: Rhinopomatidae): morphological and acoustic identification (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 137. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.
Loumassine, H. E., B. Allegrini, F. Bounaceur, O. Peyre and S. Aulagnier (2017b). A new mammal species for Algeria, *Rhinopoma microphyllum* (Chiroptera: Rhinopomatidae): morphological and acoustic identification. *Mammalia*, **82 (1):** 85 - 88 (for 2018). doi: 10.1515/mammalia-2016-0153.
Loumassine, H. E., F. Bounaceur and S. Aulagnier (2017c). Premières données sur les populations de chauves-souris de la région de Boukais (Bechar, Sud-Ouest Algérien). *Revue Écologie-Environnement*, **13:** 27 - 30.

Lourenço, S. I. and J. [M.] Palmeirim (2004). Ectoparasite load and their impact on the physical condition of Schreiber's bat, *Miniopterus schreibersii*. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 17.

Louzada, N. S. V., M. R. Nogueira and L. M. Pessôa (2019). Comparative morphology and scaling of the femur in yangochiropteran bats. *Journal of Anatomy*, **235 (1):** 124 - 150. doi: 10.1111/joa.12996.

Lovegrove, B. G. (2011). The evolution of endothermy in Cenozoic mammals: a plesiomorphic-apomorphic continuum. *Biological Reviews*, **87 (1):** 128 - 162 (for 2012). doi: 10.1111/j.1469-185X.2011.00188.x.

Loveridge, A. (1922). Notes on East African Mammalia (other than horned ungulates) collected or kept in captivity 1915-1919. Part II. *Journal of the East African Natural History Society and National Museum*, **17:** 39 - 69.

Loveridge, A. (1923). Notes on East African mammals, collected 1920 - 1923. *Proceedings of the Zoological Society of London*, **1923, IV (2):** 685 - 739. [Abstract]

Loveridge, A. (1936). Scientific results of an expedition to rain forest regions in eastern Africa. V. Reptiles. *Bulletin of the Museum of Comparative Zoology*, **79 (5):** 209 - 337, with 9 plates.

Loveridge, A. (1944). Scientific results of a fourth expedition to forested areas in East and Central Africa. VI. Itinerary and comments. *Bulletin of the Museum of Comparative Zoology*, **94 (5):** 192 - 214, with 4 plates.

Lucan, R. K., T. Bartonicka, P. Benda, R. Bilgin, P. Jedlicka, H. Nicolaou, A. Reiter, W. M. Shohdi, M. Šálek, Š. Rerucha, M. Uhrin, M. Abi-Said and I. Horácek (2014a). Seasonal polyoestry in a temperate bat: reproductive seasonality of the Egyptian fruit bat, *Rousettus aegyptiacus*, at the northern limits of its distribution. In Lina, P.H.C., A.M. Hutson, M. Kipson, V. Zrncic and D. Hamidovic : *Book of Abstracts.* XIIIth European Bat Research Symposium. 1 - 5 September 2014, Šibenik, Croatia: 110. URL: http://13ebrs2014.com/wp-content/uploads/2014/10/13EBRS_Croatia2014_Abstracts.pdf.

Lucan, R. K., T. Bartonicka, P. Benda, R. Bilgin, P. Jedlicka, H. Nicolaou, A. Reiter, W. M. Shohdi, M. Šálek, S. Rerucha, M. Uhrin, M. Abi-Said and I. Horácek (2014b). Reproductive seasonality of the Egyptian fruit bat (*Rousettus aegyptiacus*) at the northern limits of its distribution. *Journal of Mammalogy*, **95 (5):** 1036 - 1042. doi: 10.1644/14-MAMM-A-035.

Lucan, R. K., T. Bartonicka, M. Cížek, P. Jedlicka, Š. Rerucha, M. Šálek, H. Nicolaou and I. Horácek (2010). Spatial activity and diet of *Rousettus aegyptiacus* in Cyprus: Does conservation of the only European fruit bat depend on supporting alien plants? In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 215.

Lucan, R. K., T. Bartonicka, I. Horácek, M. Weiser and H. Nicolaou (2014c). The sole European fruit bats on the brink of extinction. In Lina, P.H.C., A.M. Hutson, M. Kipson, V. Zrncic and D. Hamidovic : *Book of Abstracts.* XIIIth European Bat Research Symposium. 1 - 5 September 2014, Šibenik, Croatia: 111. URL: http://13ebrs2014.com/wp-content/uploads/2014/10/13EBRS_Croatia2014_Abstracts.pdf.

Lucan, R. K., T. Bartonicka, P. Jedlicka, S. Rerucha, M. Šálek, M. Cížek, H. Nicolaou and I. Horácek (2016). Spatial activity and feeding ecology of the endangered northern population of the Egyptian fruit bat (*Rousettus aegyptiacus*). *Journal of Mammalogy*, **97 (3):** 815 - 822. doi: 10.1093/jmammal/gyw014.

Lucan, R. (K.), T. Bartonicka, P. Jedlicka, S. Rerucha, W. Shohdi and I. Horácek (2011). Population structure, spatial pattern, and foraging tactics of an isolated population of *Rousettus aegyptiacus* living at the margin of the species' distribution. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 36. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.

Lucan, R. K. and M. Šálek (2012). Observation of successful mobbing of an insectivorous bat, *Taphozous nudiventris* (Emballonuridae), on an avian predator, *Tyto alba* (Tytonidae). *Mammalia*, **77 (2):** 235 - 236 (for 2013). doi: 10.1515/mammalia-2012-0067.

Lucati, F. and A. López-Baucells (2016). Chromatic disorders in bats: a review of pigmentation anomalies and the misuse of terms to describe them. *Mammal Review*, **47 (2):** 112 - 123 (for 2017). doi: 10.1111/mam.12083.

Luguterah, A. and E. A. Lawer (2015). Effect of dietary guild (frugivory and insectivory) and other host characteristics on ectoparasite abundance (mite and nycteribiid) of chiropterans. *Folia Parasitologica*, **62:** 021. doi: 10.14411/fp.2015.021.

Luis, A. D., D. T. S. Hayman, T. J. O'Shea, P. M. Cryan, A. T. Gilbert, J. R. C. Pulliam, J. N. Mills, M. E. Timonin, C. K. R. Willis, A. A. Cunningham, A. R. Fooks, C. E. Rupprecht, J. L. N. Wood and C. T. Webb (2013). A comparison of bats and rodents as reservoirs of zoonotic viruses: are bats special? *Proceedings of the Royal Society of London*, **B 280 (1756):** 20122753. doi: 10.1098/rspb.2012.2753.

Luis, A. D., T. J. O'Shea, D. T. S. Hayman, J. L. N. Wood, A. A. Cunningham, A. T. Gilbert, J. N. Mills and C. T. Webb (2015). Network analysis of host-virus communities in bats and rodents reveals determinants of cross-species transmission. *Ecology Letters*, **18 (11):** 1153 - 1162. doi: 10.1111/ele.12491.

Luiselli, L., E. M. Hema, G. H. Segniagbeto, V. Ouattara, E. A. Eniang, M. Di Vittorio, N. Amadi, G. Parfait, N. Pacini, G. C. Akani, D. Sirima, W. Guenda, B. B. Fakae, D. Dendi and J. E. Fa (2017). Understanding the influence of non-wealth factors in determining bushmeat consumption: Results from four West African countries. *Acta Oecologica*, **94:** 47 - 56 (for 2019). doi: 10.1016/j.actao.2017.10.002.

Lundberg, K. and R. Gerell (1986). Territorial advertisement and mate attraction in the bat *Pipistrellus pipistrellus*.. *Ethology*, **71:** 115 - 124. [Abstract]

Lunde, D. P. and P. Beresford (1997). Noteworthy records of bats from the Central African Republic. *Bat Research News*, **38 (2):** 19 - 20. [Abstract]

Lunde, D. P., T. M. Conway and P. Beresford (2001). Notes on a collection of bats (Chiroptera) from Dzanga-Sangha, Central African Republic. *Mammalia*, **65 (4):** 535 - 540.

Luo, B., S. E. Santana, Y. Pang, M. Wang, Y. Xiao and J. Feng (2019). Wing morphology predicts geographic range size in vespertilionid bats. *Scientific Reports*, **9:** 4526. doi: 10.1038/s41598-019-41125-0.

Lutz, H. L., B. D. Patterson, J. C. Kerbis Peterhans, W. T. Stanley, P. W. Webala, T. P. Gnoske, S. J. Hackett and M. J. Stanhope (2016). Diverse sampling of East African haemosporidians reveals chiropteran origin of malaria parasites in primates and rodents. *Molecular and Phylogenetic Evolution*, **99:** 7 - 15. doi: 10.1016/j.ympev.2016.03.004.

Lynch, C. D. (1975). The distribution of mammals in the Orange Free State, South Africa. *Navorsinge van die Nasionale Museum Bloemfontein*, **3 (6):** 109 - 139. [Abstract]

Lynch, C. D. (1983). The mammals of the Orange Free State. *Navorsinge van die Nasionale Museum Bloemfontein*, **18:** 1 - 218.

Lynch, C. D. (1989). The mammals of the North-Eastern Cape Province. *Navorsinge van die Nasionale Museum Bloemfontein*, **25:** 1 - 116.

Lynch, C. D. (1994). Mammals of Lesotho. *Navorsinge van die Nasionale Museum Bloemfontein*, **10 (4):** 177 - 241. [Abstract]

Lynch, C. D. and J. P. Watson (1990). The mammals of Sehlabathebe National Park, Lesotho. *Navorsinge van die Nasionale Museum Bloemfontein*, **6 (12):** 523 - 554. [Abstract]
Lyon, M. W. Jr. and W. H. Osgood (1909). Catalogue of the type-specimens of mammals in the United States National Museum, including the Biological Survey Collection. *Bulletin of the United States National Museums*, **62:** i - x; 1 - 325.
Ma, J., K. Kobayasi, S. Zhang and W. Metzner (2006). Vocal communication in adult greater horseshoe bats, *Rhinolophus ferrumequinum*. *Journal of Comparative Physiology*, **A 192:** 535 - 550. doi: 10.1007/s00359-006-0094-9.
Maa, T. C (1965). Ascodipterinae of Africa (Diptera: Streblidae). *Journal of medical entomology*, **1:** 311-326.
Maas, B., D. S. Karp, S. Bumrungsri, K. Darras, D. Gonthier, J. C.-C. Huang, C. A. Lindell, J. J. Maine, L. Mestre, N. L. Michel, E. B. Morrison, I. Perfecto, S. M. Philpott, Ç. H. Sekercioglu, R. M. Silva, P. J. Taylor, T. Tscharntke, S. A. Van Bael, C. J. Whelan and K. Williams-Guillén (2015). Bird and bat predation services in tropical forests and agroforestry landscapes. *Biological Reviews*, **91 (4):** 1081 - 1101 (for 2016). doi: 10.1111/brv.12211.
MacDonald, D. W., P. J. Johnson, L. Albrechtsen, A. Dutton, S. Seymour, J. Dupain, A. Hall and J. E. Fa (2011). Association of body mass with price of bushmeat in Nigeria and Cameroon. *Conservation Biology*, **25 (6):** 1220 - 1228. doi: 10.1111/j.1523-1739.2011.01741.x.
MacDonald, K., E. Matsui, R. Stevens and M. B. Fenton (1994). Echolocation calls and field identification of the Eastern Pipistrelle (*Pipistrellus subflavus*: Chiroptera: Vespertilionidae), using ultrasonic bat detectors. *Journal of Mammalogy*, **75 (2):** 462 - 465. [Abstract]
MacEwan, K. L. (2016). Fruit bats and wind turbine fatalities in South Africa. *African Bat Conservation News*, **41:** 3 - 5.
MacEwan, K. (L.), D. (S.) Jacobs, (M.) C. Schoeman, L. (R.) Richards, L. Cohen, A. Monadjem, T. Sethusa and P. J. Taylor (2016a). *A conservation assessment of Tadarida aegyptiaca.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
MacEwan, K. (L.), L. R. Richards, L. Cohen, D. (S.) Jacobs, A. Monadjem, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016b). *A conservation assessment of Miniopterus natalensis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
MacEwan, K. (L.), (M.) C. Schoeman, A. Monadjem, L. Cohen, D. (S.) Jacobs, L. (R.) Richards, T. Sethusa and P. J. Taylor (2016c). *A conservation assessment of Miniopterus fraterculus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
MacKinnon, J. L., C. E. Hawkins and P. A. Racey (2003). *Pteropodidae, Fruit Bats, Fanihy, Angavo.* In Goodman, S.M. and J.P. Benstead [Eds]: *The Natural History of Madagascar.* The University of Chicago Press, Chicago: 1299 - 1302.
Maclaud, Ch (1906). *Notes sur les mammifères et les oiseaux de l'Afrique occidentale.* G. Vilette - Paris - Vendome.
MacPhee, R. D. E. and C. Flemming (1999). *Requiem Æternam. The last five hundred years of mammalian species extinctions.* In MacPhee, R. D. E. : *Extinctions in Near Time.* Kluwer Academic/Plenum Publishers, New York: 333 - 371.
Madej, J. P., L. Mikulová, A. Gorošová, Š. Mikula, Z. Rehák, F. Tichý and M. Buchtová (2012). Skin structure and hair morphology of different body parts in the Common Pipistrelle (*Pipistrellus pipistrellus*). *Acta Zoologica (Stockholm)*, **94 (4):** 478 - 489 (for 2013). doi: 10.1111/j.1463-6395.2012.00578.x.
Madkour, G. A. (1961). The structure of the facial area in the mouse-tailed bat, *Rhinopoma hardwickei cystops* Thomas. *Bulletin of the Zoological Society of Egypt*, **16:** 50 - 54.
Madkour, G. A. (1977). A comparative study of certain features of the alimentary canal and disposition of the viscera in egyption bats. *Annals of Zoology (Agra)*, **13 (2):** 63 - 82. [Abstract]
Madkour, G. A. (1978). Significance of the distal part of the humerus in the identification of Egyptian bats. *Zoologischer Anzeiger*, **201 (5/6):** 387 - 390. [Abstract]
Madkour, G. A. (1988). Faces of Microchiroptera from Egypt. *Zoologischer Anzeiger*, **220 (1/2):** 82 - 92. [Abstract]
Madsen, O., M. Scalley, C. J. Douady, D. J. Kao, R. W. Debry, R Adkins, H. M. Amrine, M. J Stanhope, W. W. De Jong and M. S. Springer (2001). Parallel adaptive radiations in teo major clades of placental mammals. *Nature*, **409:** 610 - 614.
Maeda, K. (1972). Growth and development of large noctule, *Nyctalus lasiopterus* Schreber. *Mammalia*, **36 (2):** 269 - 278. doi: 10.1515/mamm.1972.36.2.269. [Abstract]
Maeda, K. (1982). Studies on the classification of *Miniopterus* in Eurasia, Australia, and Melanesia. *Honyurui Kagaku (Mammalian Science)*, **Suppl. 1:** 1 - 176.
Maganga, G. D., M. Bourgarel, G. E. Ella, J. F. Drexler, J.-P. Gonzalez, C. Drosten and E. M. Leroy (2011). Is Marburg virus enzootic in Gabon? *The Journal of Infectious Diseases*Is Marburg Virus Enzootic in Gabon?. doi: 10.1093/infdis/jir358.
Maganga, G. D., M. Bourgarel, J. O. Nkoghe, N. N'Dilimabaka, C. Drosten, C. Paupy, S. Morand, J. F. Drexler and E. M. Leroy (2014b). Identification of an unclassified Paramyxovirus in *Coleura afra*: A potential case of host specificity. *PLoS ONE*, **9 (12):** e115588. doi: 10.1371/journal.pone.0115588.
Maganga, G. D., M. Bourgarel, P. Vallo, T. D. Dallo, C. Ngoagouni, J. F. Drexler, C. Drosten, E. R. Nakouné, E. M. Leroy and S. Morand (2014a). Bat distribution size or shape as determinant of viral richness in African bats. *PLoS ONE*, **9 (6):** e100172. doi: 10.1371/journal.pone.0100172.
Magloire, N. C. J., K. Blaise, D. D. Noël, K. Inza and N. K. Eliézer (2017). Preliminary study on *Eidolon helvum* (Kerr, 1792) population dynamic in Côte d'Ivoire, West Africa. *Journal of Experimental Biology and Agricultural Sciences*, **5 (6):** 890 - 898. doi: 10.18006/2017.5(6).890.898.
Mahmoud, Y. I., A. Taha and S. Soliman (2018). 3-Monochloropropane-1,2-diol (alpha-chlorohydrin) disrupts spermatogenesis and causes spermatotoxicity in males of the Egyptian fruit-bat (*Rousettus aegyptiacus*). *Biotechnic & Histochemistry*, **93 (4):** 293 - 300. doi: 10.1080/10520295.2018.1437471.
Mahnert, V. (2000). Villy Aellen. *Archives des Sciences, Genève*, **53:** 59 - 60.
Mahoney, J. A. and D. W. Walton (1988a). *Emballonuridae.* In Walton, D.W. : *Zoological Catalogue of Australia, 5, Mammalia.* Australian Government Publishing Service, Vol. 5: Canberra: 114 - 118.
Mahoney, J. A. and D. W. Walton (1988b). *Vespertilionidae.* In Walton, D.W. : *Zoologial Catalogue of Australia. Mammaia.* Australian Government Publishing Service Vol. 5: Canberra: 128 - 145.
Mahoney, J. A. and D. W. Walton (1988c). *Molossidae.* In Walton, D.W. : *Zoological Catalogue of Australia, 5, Mammalia.* Australian Government Publishing Service, Vol. 5: Canberra: 114 - 118; 146 - 150.
Maillard, L. (1862). *Notes sur l'Ile de la Réunion.* Dentu, éditeur - Paris: 1 - 344.

Mainoya, J. R. and K. M. Howell (1979). Histology of the neck 'glandular' skin patch in *Eidolon helvum, Rousettus aegyptiacus* and *R. angolensis* (Chiroptera: Pteropodidae). *African Journal of Ecology*, **17 (3):** 159 - 164. doi: 10.1111/j.1365-2028.1979.tb00251.x. [Abstract]
Maiorano, L., A. Falcucci, N. E. Zimmermann, A. Psomas, J. Pottier, D. Baisero, C. Rondinini, A. Guisan and L. Boitani (2011). The future of terrestrial mammals in the Mediterranean basin under climate change. *Philosophical transactions of the Royal Society of London*, **B 366 (1578):** 2681 - 2692. doi: 10.1098/rstb.2011.0121.
Maisels, F. (1997). Synthesis of information concerning the Park National d'Odzala, Congo. Projet ECOFAC - Composante Congo.: 1; 97, i - lxxxvii.
Maitre, E., B. Sigé and G. Escarguel (2008). A new family of bats in the Paleogene of Europe: Systematics and implications for the origin of emballonurids and rhinolophoids. *Neues Jahrbuch für Geologie und Paläontologie. Abhandlungen.*, **250 (2):** 119 - 216. doi: 10.1127/0077-7749/2008/0250-0199.
Makanga, B., C. Costantini, N. Rahola, P. Yangari, V. Rougeron, D. Ayala, F. Prugnolle and C. Paupy (2017). "Show me which parasites you carry and I will tell you what you eat", or how to infer the trophic behavior of hematophagous arthropods feeding on wildlife. *Ecology and Evolution*, **7 (19):** 7578 - 7584. doi: 10.1002/ece3.2769.
Makanya, A. N. and J. N. Maina (1994). The morphology of the intestine of the insectivorous horseshoe bat *Rhinolophus hildebrandti*, Peters): a scanning electron and light microscopic study. *African Journal of Ecology*, **32 (2):** 158 - 168. doi: 10.1111/j.1365-2028.1994.tb00566.x. [Abstract]
Makanya, A. N. and J. P. Mortola (2007). The structural design of the bat wing web and its possible role in gas exchange. *Journal of Anatomy*, **211 (6):** 687 - 697. doi: 10.1111/j.1469-7580.2007.00817.x.
Makanya, A. N., T. J. Self, C. N. Warui and D. K. Mwangi (2001). Gut morphology and morphometry in the epauletted Wahlberg's fruit bat (*Epomophorus wahlbergi*, Sundevall, 1846). *Acta Biologica Hungarica*, **52 (1):** 75 - 89. doi: 10.1556/ABiol.52.2001.1.8.
Makau, R. K. (2016). The role of fruit bat *Eidolon helvum* and avian frugivores in guava seed dispersal and tree establishment in agricultural landscapes in Vihga, western Kenya. MS Thesis - University of Nairobi, School of Biological Sciences: 101 pp.
Makin, D. (1979). The quest for Israel's bats. *Israel Land Naturalist*, **5 (1):** 28 - 34.
Makin, D. (1989). Age groups in the fruit bat *Rousettus aegyptiacus*. Abstract. Eigth International Bat Research Conference, Sydney, Australia, 9 - 15 July 1989. *Macroderma*, **5:** 20 - 21. [Abstract]
Makin, D. (1990). Annual weight cycle in the fruit bat *Rousettus aegyptiacus*. Abstract. Fifth European Bat Research Symposium: 20 - 25 august 1990 - Nyborg Strand, Denmark: no 5. [Abstract]
Makin, D. and D. L. Harrison (1988). Occurrence of *Pipistrellus ariel* Thomas, 1904 (Chiroptera: Vespertilionidae) in Israel. *Mammalia*, **52 (3):** 419 - 421.
Makin, D. and H. Mendelssohn (1985). Insectivorous bats victims of Israeli campaign. *Bats*, **2:** 1 - 2.
Makino, S. (1948). A study of the chromosomes in two species of bats (Chiroptera). *Biology Bulletin*, **94 (3):** 275 - 282.
Malbrant, R. (1952). *Faune du Centre Africain français (Mammifères et Oiseaux)*. Encyclopédie Biologique. XV - Paris: 616 pp.
Malbrant, R. and A. Maclatchy (1949). *Faune de l'Equateur Africain français. II. Mammifères.* Encyclopédie Biologique. 36 - Paris: 323 pp.
Malekani, A. B., P. A. Musaba, G.-C. T. Gembu, E. P. Bugentho, A. S. Toengaho, G. B. Badjedjea, J. C. Ngabu, P. K. Mutombo, A. Laudisoit, C. N. Ewango, V. Van Cakenberghe, E. Verheyen, J. A. Asimonyo, F. M. Masudi, G. N. Bongo and K. t. N. Ngbolua (2018). Preliminary inventory of bats (Mammalia, Chiroptera) in three protected areas of the Democratic Republic of the Congo. *Nature Conservation Research*, **3 (1):** 92 - 96. doi: 10.24189/ncr.2018.006.
Malinicová, L., L. Hrehová, E. Maxinová, M. Uhrin and P. Pristaš (2017). The dynamics of Mediterranean horseshoe bat (*Rhinolophus euryale*, Chiroptera) gut microflora during hibernation. *Acta Chiropterologica*, **19 (1):** 211 - 218. doi: 10.3161/15081109ACC2017.19.1.017.
Malmlov, A., C. Bantle, T. Aboellail, K. Wagner, C. L. Campbell, M. Eckley, N. Chotiwan, R. C. Gullberg, R. Perera, R. Tjalkens and T. Schountz (2019). Experimental Zika virus infection of Jamaican fruit bats (*Artibeus jamaicensis*) and possible entry of virus into brain via activated microglial cells. *PLoS Neglected Tropical Diseases*, **13 (2):** e0007071. doi: 10.1371/journal.pntd.0007071.
Maloney, S. K., G. N. Bronner and R. Buffenstein (1999). Thermoregulation in the Angolan free-tailed bat *Mops condylurus*: A small mammal that uses hot roosts. *Physiological and Biochemical Zoology*, **72 (4):** 385 - 396. URL: http://www.jstor.org/stable/10.1086/316677 .
Maluleke, T., D. S. Jacobs and H. Winker (2017). Environmental correlates of geographic divergence in a phenotypic trait: A case study using bat echolocation. *Ecology and Evolution*, **7 (18):** 7347 - 7361. doi: 10.1002/ece3.3251.
Mandl, J. N., C. Schneider, D. S. Schneider and M. L. Baker (2018). Going to bat(s) for studies of disease tolerance. *Frontiers in Immunology*, **9:** 2112. doi: 10.3389/fimmu.2018.02112.
Manfredi Romanini, M. G., C. Pellicciari, F. Bolchi and E. Capanna (1975). Donnees nouvelles sur le contenu en ADN desnoyaux postkinetiques ches les chiroptees. *Mammalia*, **39 (4):** 675 - 683. [Abstract]
Manga Mongombe, A. (2012). The characterization of echolocation signals of insectivorous bats in the Far-North region of Cameroon. Master's thesis. University of Maroua, Cameroon: 1 - 101. URL: http://www.le-vespere.org/docs/telechargements/AAron%20Manga_2012_EcholocationFruitBatsCameroon.pdf.
Maniakas, I. and D. Youlatos (2012). Myological adaptations to fast enduring flight in European free-tailed bats, *Tadarida teniotis* (Molossidae, Chiroptera). *Italian Journal of Zoology*, **79 (4):** 574 - 581. doi: 10.1080/11250003.2012.718374.
Mann, O., V. Lieberman, A. Köhler, C. Korine, H. E. Hedworth and S. L. Voigt-Heucke (2011). Finding your friends at densely populated roosting places: male Egyptian fruit bats (*Rousettus aegyptiacus*) distinguish between familiar and unfamiliar conspecifics. *Acta Chiropterologica*, **13 (2):** 411 - 417. doi: 10.3161/150811011X624893.
Mannerings, A. O., L. M. Osikowicz, O. Restif, E. Nyarko, R. Suu-Ire, A. A. Cunningham, J. L. N. Wood and M. Y. Kosoy (2016). Exposure to bat-associated *Bartonella* spp. among humans and other animals, Ghana. *Emerging Infectious Diseases*, **22 (5):** 922 - 924. doi: 10.3201/eid2205.151908.
Mansour, S. A., S. S. Soliman and K. M. Soliman (2016). Monitoring of heavy metals in the environment using bats as bioindicators: first study in Egypt. *Vespertilio*, **18:** 61 - 78.
Mansour, S. A., S. S. Soliman and K. M. Soliman (2017). Biomonitoring of persistent organic pollutants in Egypt using *Taphozous perforatus* (Chiroptera: Emballonuridae). *Lynx (Praha)*, **n.s. 48:** 109 - 124.
Mao, X., S. Bailey, J. Parker, G. Tsagkogeorga and S. Rossiter (2013). Comparative genomic and phylogeographic analysis of horseshoe bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 91. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Marais, W. C. (2009). The potential of using insectivorous bats (Microchiroptera) as a means of insect pest control in agricultural areas. Master thesis - University of Johannesburg: i - xvii; 1 - 120. URL: ujdigispace.uj.ac.za:8080/dspace/bitstream/10210/3294/1/Marais.pdf.

Marais, W. (C.) (2010). Specialist bat (Chiroptera) sensitivity assessment. For the proposed Deep River Wind Energy Facility on Portion 4 & 16 of the farm Diepriviermond 358 and the remaining extent of Farm 891, near Humansdorp, Eastern Cape. Animalia - Zoological & Ecological Consultation - Weltevredenpark, Gauteng: 32 pp. URL: http://www.savannahsa.com/documents/1441/Deep%20River%20DEIR%20Appendix%20H%20-%20Bats.pdf.

Marais, W. (C.) (2011a). Scoping phase assessment with regards to bat (Chiroptera) sensitivity. For the proposed Kleinzee Wind Energy Facility in the Northern Cape. Animalia - Zoological & Ecological Consultation - Weltevredenpark, Gauteng: 22 pp. URL: http://www.savannahsa.com/documents/2600/Appendix%20J%20Bat%20Study.pdf.

Marais, W. (C.) (2011b). Specialist bat (Chiroptera) sensitivity assessment. For the proposed Koekenaap Wind Energy Facility on the remainder of Farm 629, Western Cape (project nr 107086). Animalia - Zoological & Ecological Consultation - Weltevredenpark, Gauteng: 33 pp. URL: http://aurecon.webfoundryza.com/assets/files/107086%20Koekenaap/107086_Bat%20Assessment-final.pdf.

Marais, W. C. and J. F. Durand (2009). The potential of using insectivorous bats (Microchiroptera) as a means of insect pest control in agricultural areas. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 52. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.

Marandat, B. (1994). Premier catalogue des spécimens-types paléontologiques déposés dans les collections de l'Université de Montpellier II (Sciences et techniques du Languedoc). *Paleovertebrata*, **Mém. extr.:** 3 - 113. [Abstract]

Maree, S. and S. W. Grant (1997). Origins of horseshoe bats (*Rhinolophus*, Rhinolophidae) in Southern Africa: evidence from allozyme variablity. *Journal of Mammalian Evolution*, **4(3):** 195-215.

Maree, S. and W. S. Grant (1996). Description of electrophoretic loci and tissue specific gene expression in the horseshoe bat genus *Rhinolophus* (Rhinolophidae). *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **31 (2):** 43 - 52. [Abstract]

Markotter, W. (2008). My midday encounter with a *Myotis welwitchii*: editorial response. *African Bat Conservation News*, **17:** 3.

Markotter, W., I. Kuzmin, C. E. Rupprecht, J. Randles, C. T. Sabeta, A. I. Wandeler and L. H. Nel (2006a). Isolation of Lagos bat virus from water mongoose. *Emerging Infectious Diseases*, **12 (12):** 1913 - 1918.

Markotter, W., K. (L.) MacEwan, W. White, L. Cohen, D. (S.) Jacobs, A. Monadjem, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016). *A conservation assessment of Rousettus aegyptiacus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Markotter, W., A. Monadjem and L. H. Nel (2013). Antibodies against Duvenhage virus in insectivorous bats in Swaziland. *Journal of wildlife diseases*, **49 (4):** 1000 - 1003. doi: 10.7589/2012-10-257.

Markotter, W., J. Randles, C. E. Rupprecht, C. T. Sabeta, A. I. Wandeler, P. J. Taylor and L. H. Nel (2006b). Recent Lagos bat virus isolations from bats (suborder Megachiroptera) in South Africa. *Emerging Infectious Diseases*, **12 (3):** 504 - 506.

Marom, S., C. Korine, M. S. Wojciechowski, C. R. Tracy and B. Pinshow (2006). Energy metabolism and evaporative water loss in the European free-tailed bat and Hemprich's long-eared bat (Microchiroptera): Species sympatric in the Negev Desert. *Physiological and Biochemical Zoology*, **79 (5):** 944 - 956.

Marques, J. T., A. Rainho, M. Carapuço, P. Oliveira and J. M. Palmeirim (2004). Foraging behaviour and habitat use by the European free-tailed bat *Tadarida teniotis*. *Acta Chiropterologica*, **6 (1):** 99 - 110. doi: 10.3161/001.006.0108.

Marshall, A. G. (1983). Bats, flowers and fruit: evolutionary relationships in the Old World. *Biological Journal of the Linnean Society*, **20:** 115 - 135. [Abstract]

Marshall, A. G. (1985). Old World phytophagous bats (Megachiroptera) and their food plants: a survey. *Zoological Journal of the Linnean Society*, **83:** 351 - 369. [Abstract]

Marshall, A. G. and A. N. McWilliam (1982). Ecological observations on epomophorine fruit bats (Megachiroptera) in west African savanna woodland. *Journal of Zoology*, **1 (198):** 53 - 67.

Marshall, A. J. and P. S. Corbet (1959). The breeding biology of equatorial vertebrates: Reproduction of the bat *Chaerephon hindei* Thomas at latitude 0° 26'N. *Proceedings of the Zoological Society of London*, **132 (4):** 607 - 616. doi: 10.1111/j.1469-7998.1959.tb05539.x.

Martin, C., O. Bain, N. Jouvenet, V. Raharimanga, V. Robert and D. Rousset (2006). First report of *Litomosa* spp. (Nematoda: Filarioidea) from Malagasy bats; review of the genus and relationships between species. *Parasite*, **13 (1):** 3 - 10.

Martin, L. and R. T. F. Bernard (2000). *2. Endocrine regulation of reproduction in bats: the role of circulating gonadal hormones.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 27 - 64.

Martin, W. (1838). ?? Title still needs to be checked. ?? *Proceedings of the Zoological Society of London*, **1837, V (lviii):** 91?.

Martin, W. (1839). Description of a new bat (*Rhinolophus landeri*) from Fernado Po, and a new hedgehog (*Erinaceus concolor*) from Trebizond. *Proceedings of the Zoological Society of London*, **1838, VI (lxviii):** 101 - 103.

Maseko, B. C., J. A. Bourne and P. R. Manger (2007). Distribution and morphology of cholinergic, putative catecholaminergic and serotonergic neurons in the brain of the Egyptian rousette flying fox, *Rousettus aegyptiacus*. *Journal of Chemical Neuranatomy*, **34 (3-4):** 108 - 127. doi: 10.1016/j.jchemneu.2007.05.006.

Maseko, B. C. and P. R. Manger (2007). Distribution and morphology of cholinergic, catecholaminergic and serotonergic neurons in the brain of Schreiber's long-fingered bat, *Miniopterus schreibersii*. *Journal of Chemical Neuranatomy*, **34 (3-4):** 80 - 94. doi: 10.1016/j.jchemneu.2007.05.004.

Masing, M. (2004). The single pulse analysis - a method for quick identification of 'peak frequency bats' (Chiroptera, Vespertilionidae) based on ultrasound. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 7.

Masing, M. (2011). *Tadarida* high, *Pipistrellus* low in La Gomera. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 80 - 81. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.

Mason, G. E. (1907). On an extinct undescribed fruit-bat of the genus *Pteropus* from the Mascarenes. *Annals and Magazine of Natural History*, **ser. 7, 20 (117):** 220 - 222.

Mason, M. K., D. Hockman, L. Curry, T. J. Cunningham, G. Duester, M. Logan, D. S. Jacobs and N Illing (2015). Retinoic acid-independent expression of *Meis2* during autopod patterning in the developing bat and mouse limb. *EvoDevo*, **6:** 6. doi: 10.1186/s13227-015-0001-y.

Mason, M. K., D. Hockman, D. S. Jacobs and N. Illing (2009). Cross-species microarray analysis of limb development in the bat, *Miniopterus natalensis*. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July

2009 - Natalia, Illovo Beach, KwaZulu-Natal: 15. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.
Mason, M. K., D. Hockman, D. S. Jacobs and N. Illing (2010). Evaluation of maternal features as indicators of asynchronous embryonic development in *Miniopterus natalensis*. *Acta Chiropterologica*, **12 (1):** 161 - 171. doi: 10.3161/150811010X504662.
Masseti, M. (2009). Holocene mammals of Libya: A biogeographical, historical and archaeozoological approach. *Journal of Arid Environments*, **74 (7):** 784 - 805 (for 2010). doi: 10.1016/j.jaridenv.2009.07.008.
Masseti, M. (2010). Mammals of the Macaronesian islands (the Azores, Madeira, the Canary and Cape Verde islands): redefinition of the ecological equilibrium. *Mammalia*, **74 (1):** 3 - 34. doi: 10.1515/MAMM.2010.011.
Mata, V., F. Amorim, P. Alves, P. Beja and H. Rebelo (2014). Bridging the droughts: adaptations of a Mediterranean bat species. In Lina, P.H.C., A.M. Hutson, M. Kipson, V. Zrncic and D. Hamidovic : *Book of Abstracts.* XIIIth European Bat Research Symposium. 1 - 5 September 2014, Šibenik, Croatia: 115. URL: http://13ebrs2014.com/wp-content/uploads/2014/10/13EBRS_Croatia2014_Abstracts.pdf.
Mata, V. A., F. Amorim, M. F. V. Corley, G. F. McCracken, H. Rebelo and P. Beja (2016). Female dietary bias towards large migratory moths in the European free-tailed bat (*Tadarida teniotis*). *Biology Letters*, **12:** 20150988. doi: 10.1098/rsbl.2015.0988.
Mata, V. A., F. Amorim, A. Guillén-Servent, P. Beja and H. Rebelo (2017). First complete mitochondrial genomes of molossid bats (Chiroptera: Molossidae). *Mitochondrial DNA*, **B 2 (1):** 152 - 154. doi: 10.1080/23802359.2017.1298419.
Mathias, M. da Luz (1988). An annotated list of the mammals recorded from the Madeira islands. *Boletim do Museu Municipal do Funchal*, **40 (201):** 111 - 137. [Abstract]
Mathias, M. L., M. G. Ramalhinho, M. Santos-Reis, F. Petrucci-Fonseca, R. Libois, R. Fons, G. Ferraz de Carvalho, M. M. Oom and M. Collares-Pereira (1998). Mammals from the Azores islands (Portugal): an updated overview. *Mammalia*, **62 (3):** 397 - 407. [Abstract]
Matschie, P. (1893). Beiträge zur Fauna des Togolandes. Nach den Sammlungen der Herren Hauptmann, E. Kling und Dr. R. Büttner. Die Säugethiere des Togogebietes. *Mitteilungen Deutsches Schutzgebietes*, **6 (3):** 162 - 180.
Matschie, P. (1894). ?? Title still needs to be checked. ?? *Sitzungsberichte Gesellschaft naturforschenden Freunde Berlin*.
Matschie, P. (1895). *Säugethiere Deutsch-Ost-Afrikas. Wissenschaftliche Forschungsresultate über Land und Leute unseres ostafrikanischen Schutzgebietes und der angrenzenden Lander.* In Moibius, K. : *Deutsch-Ost-Afrika. Band III. Die Tierwelt Ost-Afrikas und der Nachbargebieten.* Dietrich Reimer - Berlin.
Matschie, P. (1897). Zur Faunistik Deutsch-Ost-Afrikas. 5. Säugethiere. *Wiegmans Archiv für Naturgeschichte München*63 (1). [Abstract]
Matschie, P. (1899a). Einige Beitrage zur Kenntniss von *Hypsignatus monstrosus* Allen. *Sitzungsberichte Gesellschaft naturforschenden Freunde Berlin*28 - 30.
Matschie, P. (1899b). *Die Fledermäuse des Berliner Museums für Naturkunde. 1. Lieferung. Die Megachiroptera des Berliner Museums für Naturkunde.* Georg Reimer - Berlin: viii - 102 pp. [Abstract]
Matschie, P. (1907a). *Eine Worte über die von Herrn V.B. Schillings in Ostafrika gesammelten Säugetiere.* In Schillings, V. B. : *Mit Blitzlicht und Büchse. Neue Beobachtungen und Erlebnisse in der Wildnis inmitten der Tierwelt von Aequatorial-Ostafrika. Dritter Abdruck.* R. Voigtländer Verlag - Leipzig: 529 - 533.
Matschie, P. (1907b). *Liste der von Herrn V.B. Schillings gesammelten Säugetier-Arten.* In Schillings, V. B. : *Mit Blitzlicht und Büchse. Neue Beobachtungen und Erlebnisse in der Wildnis inmitten der Tierwelt von Aequatorial-Ostafrika. Dritter Abdruck.* R. Voigtländer Verlag - Leipzig: 534 - 536.
Matson, J. O. (1975). *Myotis planiceps*. *Mammalian Species*, **60:** 1 - 2, 3 figs.
Mattey, R. (1962). Les nombers diploides de mammiferes eutheriens. Liste critique. *Mammalian Chromosomes Newsletter*, **8:** 17 - 25.
Matthee, C. A., G. Eick, S. Willows-Munro, C. Montgelard, A. T. Pardini and T. J. Robinson (2006). Indel evolution of mammalian introns and the utility of non-coding nuclear markers in eutherian phylogenetics. *Molecular phylogenetics and evolution*, **42 (3):** 827 - 837 (for 2007). doi: 10.1016/j.ympev.2006.10.002.
Matthews, L. H. (1937). The form of the penis in the British rhinolophid bats compared with that in some of the vespertilionid bats. *Transactions of the Zoological Society of London*, **23 (3):** 213 - 223. doi: 10.1111/j.1096-3642.1937.tb00338.x. [Abstract]
Matthews, L. H. (1941). Notes on the genitalia and reproduction of some African bats. *Proceedings of the Zoological Society of London*, **111B:** 289 - 346. [Abstract]
Matthews, L. H. (1950). La dentition de lait chez *Nyctalus Leisleri* (Kühl). *Mammalia*, **14 (1):** 11 - 13. doi: 10.1515/mamm.1950.14.1.11.
Matthews, T., C. Denys and J. E. Parkington (2005). The palaeoecology of the micromammals from the late middle Pleistocene site of Hoedjiespunt 1 (Cape Province, South Africa). *Journal of Human Evolution*, **49 (4):** 432 - 451.
Matthews, T., C. Denys and J. E. Parkington (2007). Community evolution of Neogene micromammals from Langebaanweg 'E' Quarry and other west coast fossil sites, south-western Cape, South Africa. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **245 (3-4):** 332 - 352.
Matthey, R. and R. Bovey (1948). La formule chromosomique chez cinq espèces de chiroptères. *Experientia*, **4 (1):** 26 - 27.. URL: http://www.springerlink.com/content/f2k4444t18vw5883/fulltext.pdf.
Matyot, P. (1996). The sheath-tailed bat *Coleura seychellensis* Peters, 1868 (Chiroptera: Emballonuridae) rediscovered on Silhouette Island. *Phelsuma*, **4:** 67 - 68. URL: http://islandbiodiversity.com/Phelsuma%204-7.pdf.
Maxinová, E., A. Arrizabalaga-Escudero, M. Arriolabengoa, K. Aloria, B. Zaldibar, S. Boldogh, M. Uhrin, U. Goiti, J. Aihartza and I. Garin (2017a). Faeces of *Rhinolophus euryale* (Chiroptera) from the winter season contain inorganic matter. *Hystrix, Italian Journal of Mammalogy*, **28 (1):** 98 - 103. doi: 10.4404/hystrix-28.1-11874.
Maxinová, E., V. Šustr and M. Uhrin (2017b). Digestive enzymes in *Rhinolophus euryale* (Rhinolophidae, Chiroptera) are active also during hibernation. *European Journal of Ecology*, **3 (1):** 91 - 96. doi: 10.1515/eje-2017-0010.
Mayaux, P., E. Bartholomé, S. Fritz and A. Belward (2004). A new land-cover map of Africa for the year 2000. *Journal of Biogeography*, **31 (6):** 861 - 877.
Mayaux, P., E. Bartholomé, M. Massart, C. Van Cutsem, A. Cabral, A. Nonguierma, O. Diallo, C. Pretorius, M. Thompson, M. Cherlet, J-F. Pekel, P. Defourny, M. Vasconcelos, A. Di Gregorio, S. Fritz, G. De Grandi, C. Elvidge, P. Vogt and A. Belward (2003). A land cover map of Africa - Carte de l'occupation du sol de l'Afrique. European Commission - Joint Research Centre, Luxembourg: 56 pp.
Mayer, F., C. Dietz and A. Kiefer (2007). Molecular species identification boosts bat diversity. *Frontiers in Zoology*, **4 (4):** 5 pp.. doi: 10.1186/1742-9994-4-4. URL: http://www.frontiersinzoology.com/content/4/1/4.

Mayer, F. and O. von Helversen (2001). Cryptic diversity in European bats. *Proceedings of the Royal Society of London*, **B 268 (1478):** 1825 - 1832. doi: 10.1098/rspb.2001.1744.

Mayoux, A., E.-R. Brygoo and J.-R. Simond (1971). Bilan d'une année d'étude de *Pteropus rufus* à Madagascar son rôle comme réservoir de virus d'entérobactéries. *Archives de l'Institut Pasteur de Madagascar.*, **40 (1):** 29 - 37. [Abstract]

Mbu'u, C. M., W. F. Mbacham, P. Gontao, S. L. S. Kamdem, A. M. N. Nlôga, M. H. Groschup, A. Wade, K. Fischer and A. Balkema-Buschmann (2019). Henipaviruses at the interface between bats, livestock and human population in Africa: A review. *Vector-Borne and Zoonotic Diseases*, **xXX (xxx):** 11 pp. doi: 10.1089/vbz.2018.2365.

McBee, K., J. W. Bickham, S. Yehbutra, J. Nabhitabhata and D. A. Schlitter (1986). Standard karyology of nine species of Vespertilionid Bats (Chiroptera: Vespertilionidae) from Thailand. *Annals of Carnegie Museum*, **55 (5):** 95 - 116. [Abstract]

McBee, K., D. A. Schlitter and R. L. Robbins (1987). Systematics of African bats of the genus *Eptesicus* (Mammalia: Vespertilionidae). 2. Karyotypes of African species and their generic relationships. *Annals of Carnegie Museum*, **56 (11):** 213 - 222. [Abstract]

McCleery, R., A. Monadjem, B. Baiser, R. Jr, Vickers, K. Fletcher and L. Kruger (2018). Animal diversity declines with broad-scale homogenization of canopy cover in African savannas. *Biological Conservation*, **226:** 54 - 62. doi: 10.1016/j.biocon.2018.07.020.

McColl, K. A., N. Tordo and A. Aguilar Setién (2000). Bat lyssavirus infections. *Revue scientifique et technique (International Office of Epizootics)*, **19 (1):** 177 - 196.

McConkey, K. R. and D. R. Drake (2006). Flying Foxes cease to function as seed dispersers long before they become rare. *Ecology*, **87 (2):** 271 - 276.

McCoy, R. H. (1974). Bacterial diseases of bats: a review. *Laboratory Animal Science*, **24:** 530 - 534.

McCracken, G. F. and G. S. Wilkinson (2000). *8. Bat mating systems.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 321 - 362.

McDonald, J. T., I. L. Rautenbach and J. A. J. Nel (1990a). Foraging ecology of bats observed at De Hoop Provincial Nature Reserve, southern Cape Province. *South African Journal of Wildlife Research*, **20 (4):** 133 - 145. [Abstract]

McDonald, J. T., I. L. Rautenbach and J. A. J. Nel (1990b). Roosting requirements and behaviour of five bat species at De Hoop Guano Cave, southern Cape Province of South Africa. *South African Journal of Wildlife Research*, **20 (4):** 157 - 161. [Abstract]

McElhinney, L. M., D. A. Marston, S. Leech, C. M. Freuling, W. H. M. Van der Poel, J. Echevarria, S. Vázquez-Moron, D. L. Horton, T. Müller and A. R. Fooks (2012). Molecular epidemiology of bat lyssaviruses in Europe. *Zoonoses and Public Health*, **60 (1):** 35 - 45 (for 2013). doi: 10.1111/zph.12003.

McFarland, D. C. (1998). *Forest vertebrate fauna study for a comprehensive regional assessment in south-east Queensland. Stage IA: Data audit and gap assessment.* Queensland CRA/RFA Steering Committee - Indooroopilly: i - vii; 1 - 136. [Abstract]

McFarlane, D. A. and J. Lundberg (2010). A note on the thermal ecology and foraging behaviour of the Egyptian fruit bat, *Rousettus aegyptiacus*, at Mt. Elgon, Kenya. *African Journal of Ecology*, **48 (3):** 816 - 818. doi: 10.1111/j.1365-2028.2009.01146.x. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2028.2009.01146.x/pdf.

McGuire, L. P. and C. G. Guglielmo (2009). What can birds tell us about the migration physiology of bats? *Journal of Mammalogy*, **90 (6):** 1290 - 1297. doi: 10.1644/09-MAMM-S-084R.1.

McGuire, L. P. and J. M. Ratcliffe (2010). Light enough to travel: migratory bats have smaller brains, but not larger hippocampi, than sedentary species. *Biology Letters*, **7 (2):** 233 - 236 (for 2011). doi: 10.1098/rsbl.2010.0744.

McKechnie, A., I. Minnaar and D. C. Toussaint (2013). Evaporative water loss in a warming world: respiratory and cutaneous partitioning, and interspecific variation in heat tolerance. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 96. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

McKee, C. D., D. T. S. Hayman, M. Y. Kosoy and C. T. Webb (2016). Phylogenetic and geographic patterns of bartonella host shifts among bat species. *Infection, Genetics and Evolution*, **44:** 382 - 394. doi: 10.1016/j.meegid.2016.07.033.

McKee, C. D., M. Y. Kosoy, Y. Bai, L. M. Osikowicz, R. Franka, A. T. Gilbert, S. Boonmar, C. E. Rupprecht and L. F. Peruski (2017). Diversity and phylogenetic relationships among *Bartonella* strains from Thai bats. *PLoS ONE*, **12 (7):** e0181696. doi: 10.1371/journal.pone.0181696.

McKenna, M. C. and S. K. Bell (1997). *Classification of mammals above the species level.* Columbia University Press, New York.: i - xii, 1 - 631.

McKnight, C. A., A. G. Wise, R. K. Maes, C. Howe, A. Rector, M. Van Ranst and M. Kiupel (2006). Papillomavirus-associated basosquamous carcinoma in an Egyptian fruit bat (*Rousettus aegyptiacus*). *Journal of Zoo and Wildlife Medicine*, **37 (2):** 193 - 196. doi: 10.1638/05-101.1.

McLean, B. S., K. C. Bell, J. L. Dunnum, B. Abrahamson, J. P. Colella, E. R. Deardorff, J. A. Weber, A. K. Jones, F. Salazar-Miralles and J. A. Cook (2016). Natural history collections-based research: progress, promise, and best practices. *Journal of Mammalogy*, **97 (1):** 287 - 297 (for 2017). doi: 10.1093/jmammal/gyv178.

McLellan, L. J. (1986). Notes on bats of Sudan. *American Museum Novitates*, **2839:** 1 - 12. [Abstract]

McLelland, D. J., C. J. Dutton and I. K. Barker (2009). Sarcomatoid carcinoma in the lung of an Egyptian fruit bat (*Rousettus aegyptiacus*). *Journal of Veterinary Diagnosis and Investigation*, **21 (1):** 160 - 163. doi: 10.1177/104063870902100129.

McNab, B. K. (2009). *Physiological adaptation of bats and birds to island life.* In Fleming, T.H. and P.A. Racey [Eds]: *Island Bats - Evolution, Ecology, and Conservation.* The University of Chicago Press - Chicago and London: 153 - 175.

McNab, B. K. and M. I. Armstrong (2001). Sexual dimorphism and scaling of energetics in flying foxes of the genus *Pteropus*. *Journal of Mammalogy*, **82 (3):** 709 - 720. doi: 10.1644/1545-1542(2001)082<0709:SDASOE>2.0.CO;2.

McWilliam, A. and M. Happold (2013). *Taphozous hildegardeae Hildegarde's Tomb Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 429 - 431.

McWilliam, A. N. (1982). Adaptive responses to seasonality in four species of Microchiroptera in coastal Kenya. PhD Thesis - University of Aberdeen: 1 - 290. [Abstract]

McWilliam, A. N. (1987a). Territorial and pair behaviour of the African false vampire bat, *Cardioderma cor* (Chiroptera: Megadermatidae), in coastal Kenya. *Journal of Zoology*, **213 (2):** 243 - 252. doi: 10.1111/j.1469-7998.1987.tb03700.x. [Abstract]

McWilliam, A. N. (1987b). *The reproduction and social biology of Coleura afra in a seasonal environment.* In Fenton, M. B., P. A. Racey and J. M. V. Rayner : *Recent advances in the study of bats.* Cambridge University Press, Cambridge, United Kingdom: 324 - 350.

McWilliam, A. N. (1988a). Social organisation of the bat *Tadarida (Chaerephon) pumila* (Chiroptera: Molossidae) in Ghana, West Africa. *Ethology*, **77 (2):** 115 - 124. doi: 10.1111/j.1439-0310.1988.tb00197.x. [Abstract]
McWilliam, A. N. (1988b). The reproductive cycle of male tomb bats, *Taphozous hildegardeae* (Chiroptera: Emballonuridae), in a seasonal environment of the African tropics. *Journal of Zoology*, **215 (3):** 433 - 442. doi: 10.1111/j.1469-7998.1988.tb02850.x. [Abstract]
Medina (1889). ?? Title still needs to be checked. ?? *Acta Soc. Esp. Hist. Nat.*18.
Medway, Lord (1978). *The wild mammals of Malaya (Peninsular Malaysia) and Singapore. 2nd edition.* Kuala Lumpur - Oxford Univ. Press: 128 pp.
Meehan, K. A., E. J. Truter, J. P. Slabbert and M. I. Parker (2004). Evaluation of DNA damage in a Population of bats (Chiroptera) residing in an abandonded monazite mine. *Mutation Research. Genetic toxicology and environmental mutagenesis*, **557:** 183 - 190. doi: 10.1016/j.mrgentox.2003.10.013.
Meester, J. A. J. (1960). Mammals of the Loskop Dam Nature Reserve. *Fauna & flora*, **11:** 75 - 83.
Meester, J. A. J. (1962). Some mammals from the Namib Desert. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **24 (2/3):** 241 - 248. [Abstract]
Meester, J. (A. J.) (1965). The origins of the southern African mammal fauna. *Zoologica Africana*, **1 (1):** 87 - 93. [Abstract]
Meester, J. A. J. (1973). Mammals collected during the Bernhard Carp expedition to the Western Province of Zambia. *The Puku*, **7:** 137 - 149.
Meester, J. A. J. (1988). Chromosomal speciation in Southern African small mammals. *South African Journal of Sciences*, **84:** 721 - 724.
Meester, J. A. J., I. L. Rautenbach, N. J. Dippenaar and C. M. Baker (1986). *Classification of Southern African Mammals.* Transvaal Museum Monograph - Pretoria: 1 - 359.
Megali, A., G. Yannic and P. Christe (2010). Disease in the dark: molecular characterization of *Polychromophilus murinus* in temperate zone bats revealed a worldwide distribution of this malaria-like disease. *Molecular Ecology*, **20 (5):** 1039 - 1048 (for 2011). doi: 10.1111/j.1365-294X.2010.04905.x.
Mehdizadeh, M., H. Eghbali and M. Sharifi (2018). Postnatal growth and vocalization sevelopment in the Long-fingered bat, *Myotis capaccinii* (Chiroptera, Vespertilionidae). *Zoological Studies*, **57:** 37. doi: 10.6620/ZS.2018.57-37.
Méhely, L. (1900). *Magyarország denevéreinek monographiája. (Monographia Chiropterorum Hungariae.).* A Magyar Tudományos Akadémia támogatásával kiadja a Magyar Nemzeti Muzeum, Budapest. Vol. 1 - 22, 1 - 372.
Mehl, C., G. Marsden, M. C. Schoeman and D. Vosloo (2016). Coping with environmental stress: The effects of wastewater pollutants on energy stores and leptin levels in insectivorous bats. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **81 (5):** 527 - 533. doi: 10.1016/j.mambio.2016.07.004.
Mein, P. and Y. Tupinier (1977). Formule dentaire et position systématique du Minioptère (Mammalia, Chiroptera). *Mammalia*, **41 (2):** 207 - 211. doi: 10.1515/mamm.1977.41.2.207. [Abstract]
Meinig, H. (2000). Notes on the mammal fauna of the southern part of the Republic of Mali, West Africa. *Bonner zoologische Beitrage*, **49 (1/4):** 101 - 114.
Meirte, D. (1981). New data on *Casinycteris argynnis* Thomas, 1910 (Megachiroptera - Pteropodidae). Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 40. [Abstract]
Meirte, D. (1983). New data on *Casinycteris argyinnis* Thomas 1910 (Megachiroptera, Pteropidae). In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 9 - 12. [Abstract]
Meirte, D. (1983). New data on *Casinycteris argynnis* Thomas, 1910 (Megachiroptera, Pteropidae). *[Add New]*, **237:** 9 - 17.
Meirte, D. (1987). New data on *Rousettus obliviosus*. *African Small Mammal Newsletter*, **9:** 21.
Mélade, J., S. McCulloch, B. Ramasindrazana, E. Lagadec, M. Turpin, H. Pascalis, S. M. Goodman, W. Markotter and K. Dellagi (2016a). Serological evidence of Lyssaviruses among bats on southwestern Indian Ocean Islands. *PLoS ONE*, **11 (8):** e0160553. doi: 10.1371/journal.pone.0160553.
Mélade, J., N. Wieseke, B. Ramasindrazana, O. Flores, E. Lagadec, Y. Gomard, S. M. Goodman, K. Dellagi and H. Pascalis (2016b). An eco-epidemiological study of Morbilli-related paramyxovirus infection in Madagascar bats reveals host-switching as the dominant macro-evolutionary mechanism. *Scientific Reports*, **6:** 23752. doi: 10.1038/srep23752.
Meng, F., L. Zhu, W. Huang, D. M. Irwin and S. Zhang (2016). Bats: Body mass index, forearm mass index, blood glucose levels and SLC2A2 genes for diabetes. *Scientific Reports*, **6:** 29960. doi: 10.1038/srep29960.
Mengual-Chuliá, B., R. García-Pérez, M. Gottschling, I. Nindl and I. G. Bravo (2012). Novel animal papillomavirus sequences and accurate phylogenetic placement. *Molecular and Phylogenetic Evolution*, **65 (3):** 883 - 891. doi: 10.1016/j.ympev.2012.08.011.
Menu, H. (1984). Révision du statut de *Pipistrellus subflavus* (F. Cuvier, 1832). Proposition d'un taxon generique nouveau: *Perimyotis* nov. gen. *Mammalia*, **48 (3):** 409 - 416. [Abstract]
Menu, H. (1985). Morphotypes dentaires actuels et fossiles des chiropteres vespertilionines. I Partie: Etude des morphologies dentaires. *Palaeovertebrata, Montpelier*, **15 (2):** 71 - 128, 43 figs. [Abstract]
Menu, H. (1987). Morphotypes dentaires actuels et fossiles des chiroptères vespertilioninés. 2eme partie: Implications systematiques et phylogeniques. *Palaeovertebrata, Montpelier*, **17 (3):** 77 - 150, 5 pls. [Abstract]
Menu, H., S. Hand and B. Sigé (2002). Oldest Australian vespertilionid (Microchiroptera) from the early Miocene of Riversleigh, Queensland. *Alcheringa*, **26:** 319 - 331.
Menzies, A. K., Q. M. R. Webber, D. E. Baloun, L. P. McGuire, K. A. Muise, D. Coté, S. Tinkler and C. K. R. Willis (2016). Metabolic rate, latitude and thermal stability of roosts, but not phylogeny, affect rewarming rates of bats. *Physiology & Behavior*, **164:** 361 - 368. doi: 10.1016/j.physbeh.2016.06.015.
Menzies, J. I. (1973). A study of Leaf-nosed Bats (*Hipposideros caffer* and *Rhinolophus landeri*) in a cave in northern Nigeria. *Journal of Mammalogy*, **54 (4):** 930 - 945. [Abstract]
Meredith, C. D. and E. Standing (1981). Lagos bat virus in South Africa. *The Lancet*, **11:** 832 - 833.
Mertens, R. (1925). Verzeichnis der Säugetier-Typen des Seckenbergischen Museums. *Senckenbergiana biologica*, **7 (1/2):** 18 - 37. [Abstract]
Mertens, R. (1938). Zoologische Eindrucke von einer Kamerun-Reise. 3. Der Hammerkopf-Flughund (*Hypsignathus monstrosus*). *Natur und Volk - Senckenbergische naturforschenden Gesellschaft*, **68:** 594 - 597.
Messana, G., L. Chelazzi and N. Baccetti (1985). Biospeleology of Somalia. Mugdile and Showli Berdi caves. *Monitore zoologico italiana*, **Suppl. 20 (15):** 325 - 340. doi: 10.1080/03749444.1985.10736702. [Abstract]
Metcalfe, K., R. Ffrench-Constant and I. Gordon (2009). Sacred sites as hotspots for biodiversity: The Three Sisters Cave complex in coastal Kenya. *Oryx*, **44 (1):** 118 - 123.

Metselaar, D., M. C. Williams, D. I. H. Simpson, R. West and F. A. Mutere (1969). Mount elgon bat virus: A hitherto undescribed virus from Rhinolophus hildebrandtii eloquens K. Anderson. *Archives of Virology*, **26 (1-2):** 183 - 193. doi: 10.1007/BF01241186. URL: http://www.springerlink.com/content/p066xx51763747r7/fulltext.pdf. [Abstract]

Meyer, C. F. J., L. M. S. Aguiar, L. F. Aguirre, J. Baumgarten, F. M. Clarke, J.-F. Cosson, S. Estrada Villegas, J. Fahr, D. Faria, N. Furey, M. Henry, R. Hodgkison, R. K. B. Jenkins, K. G. Jung, T. Kingston, T. H. Kunz, M. C. MacSwiney Gonzalez, I. Moya, B. D. Patterson, J.-M. Pons, P. A. Racey, K. Rex, E. M. Sampaio, S. Solari, K. E. Stoner, C. C. Voigt, D. von Staden, C. D. Weise and E. K. V. Kalko (2011). Accounting for detectability improves estimates of species richness in tropical bat surveys. *Journal of Applied Ecology*, **48 (3):** 777 - 787. doi: 10.1111/j.1365-2664.2011.01976.x.

Meyer, C. F. J., L. M. S. Aguiar, L. F. Aguirre, J. Baumgarten, F. M. Clarke, J.-F. Cosson, S. Estrada Villegas, J. Fahr, D. Faria, N. Furey, M. Henry, R. Hodgkison, R. K. B. Jenkins, K. G. Jung, T. Kingston, T. H. Kunz, M. C. MacSwiney Gonzalez, I. Moya, J.-M. Pons, P. A. Racey, K. Rex, E. M. Sampaio, K. E. Stoner, C. C. Voigt, D. von Staden, C. D. Weise and E. K. V. Kalko (2010). Long-term monitoring of tropical bats for anthropogenic impact assessment: Gauging the statistical power to detect population change. *Biological Conservation*, **143 (11):** 2797 - 2807. doi: 10.1016/j.biocon.2010.07.029. URL: http://www.sciencedirect.com/science?_ob=Mimg&_imagekey=B6V5X-50T94F2-2-D&_cdi=5798&_user=1378557&_pii=S0006320710003356&_origin=gateway&_coverDate=11%2F30%2F2010&_sk=998569988&view=c&wchp=dGLbVtb-zSkzV&md5=3038bf05a1c0831608718861826bd3f2&ie=/sdarticle.pdf.

Meyer, C. F. J., L. M. S. Aguiar, L. F. Aguirre, J. Baumgarten, F. M. Clarke, J.-F. Cosson, S. Estrada Villegas, J. Fahr, D. Faria, N. Furey, M. Henry, R. K. B. Jenkins, T. H. Kunz, M. C. MacSwiney González, I. Moya, J.-M. Pons, P. A. Racey, K. Rex, E. M. Sampaio, K. E. Stoner, C. C. Voigt, D. von Staden, C. D. Weise and E. K. V. Kalko (2014). Species undersampling in tropical bat surveys: effects on emerging biodiversity patterns. *Journal of Animal Ecology*, **84 (1):** 113 - 123 (for 2015). doi: 10.1111/1365-2656.12261.

Meyer, C. F. J., C. J. Schwarz and J. Fahr (2004). Activity patterns and habitat preferences of insectivorous bats in a West African forest-savanna mosaic. *Journal of Tropical Ecology*, **20:** 397 - 407. doi: 10.1017/S0266467404001373.

Michahelles (1839). ?? Title still needs to be checked. ?? .

Michelmore, A. J., D. J. Keegan and B. Kramer (1998). Immunoctochemical identification of endocrine cells in the pancreas of the fruit bat, *Rousettus aegyptiacus*. *General & Comparative Endocrinology*, **110 (3):** 319-325. doi: 10.1006/gcen.1998.7077. [Abstract]

Mickleburgh, S., A. Hutson and W. Bergmans (2004a). *Cardioderma cor*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004b). *Epomophorus angolensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004c). *Epomophorus crypturus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004d). *Epomophorus labiatus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004e). *Epomophorus grandis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004f). *Epomophorus wahlbergi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004g). *Coleura seychellensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004h). *Coleura afra*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004l). *Epomophorus gambianus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004j). *Epomophorus minimus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004k). *Casinycteris argynnis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004l). *Asellia tridens*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004m). *Nycteris hispida*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004n). *Nycteris aurita*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004o). *Mops nanulus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004p). *Pteropus livingstonii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004q). *Pteropus rodricensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004r). *Taphozous hildegardeae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004s). *Micropteropus pusillus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004t). *Micropteropus intermedius*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004u). *Lissonycteris smithi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004v). *Hipposideros gigas*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004w). *Megaloglossus woermanni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004x). *Taphozous hamiltoni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species*. . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson and W. Bergmans (2004y). *Lavia frons*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson and W. Bergmans (2004z). *Lissonycteris angolensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson and W. Bergmans (2004aa). *Taphozous perforatus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson and W. Bergmans (2004ab). *Lissonycteris petraea*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S, A. Hutson and W. Bergmans (2004ac). *Hipposideros camerunensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson and W. Bergmans (2004ad). *Asellia patrizii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and S. Aulagnier (2004ae). *Hipposideros caffer*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004af). *Chaerephon nigeriae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004ag). *Chaerephon chapini*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004ah). *Chaerephon pumila*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004ai). *Chaerephon gallagheri*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004aj). *Chaerephon russata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004ak). *Chaerephon shortridgei*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004al). *Chaerephon ansorgei*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004am). *Chaerephon major*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004an). *Chaerephon bivittata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004ao). *Tadarida ventralis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004ap). *Nycteris woodi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004aq). *Mops condylurus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004ar). *Lissonycteris goliath*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004as). *Triaenops persicus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004at). *Nycteris macrotis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and F. W. Cotterill (2004au). *Hipposideros marungensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and J. Fahr (2004ba). *Chaerephon bemmeleni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and J. Fahr (2004av). *Mops petersoni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and J. Fahr (2004aw). *Mops trevori*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and J. Fahr (2004ax). *Mops midas*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and J. Fahr (2004ay). *Platymops setger*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S, A. Hutson, W. Bergmans, F. W. Cotterill and J. Fahr (2004az). *Mops demonstrator*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill, J. Fahr and D. S. Jacobs (2004bb). *Tadarida aegyptiaca*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill, M. Griffin and D. S. Jacobs (2004bc). *Sauromys petrophilus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and D. S. Jacobs (2004bd). *Myonycteris relicta*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and D. S. Jacobs (2004be). *Nycteris vinsoni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, F. W. Cotterill and D. S. Jacobs (2004bf). *Nycteris parisii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bg). *Epomops buettikoferi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bh). *Eidolon helvum*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bi). *Chaerephon aloysiisabaudiae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bj). *Mops niangarae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bk). *Scotonycteris zenkeri*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bl). *Taphozous mauritianus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bm). *Nycteris intermedia*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bn). *Saccolaimus peli*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bo). *Mops brachypterus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bp). *Taphozous nudiventris*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bq). *Hipposideros abae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004br). *Hipposideros jonesi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bs). *Hipposideros lamottei*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bt). *Hipposideros marisae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bv). *Hipposideros ruber*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bw). *Hypsignathus monstrosus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bu). *Hipposideros megalotis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bx). *Mops congicus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004by). *Nycteris arge*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004bz). *Myonycteris torquata*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004ca). *Myopterus daubentonii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004cb). *Nanonycteris veldkampi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004cc). *Nycteris nana*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004cd). *Nycteris grandis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004ce). *Nycteris thebaica*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004cf). *Myopterus whitleyi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Fahr (2004cg). *Nycteris major*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr, W. Chitaukali and F. W. Cotterill (2004ch). *Plerotes anchietae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and J. Juste (2004ci). *Epomops franqueti*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and J. Juste (2004cj). *Epomops dobsoni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and J. Juste (2004ck). *Hipposideros beatus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and J. Juste (2004cl). *Mops thersites*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and J. Juste (2004cm). *Mops spurrelli*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and J. Juste (2004cn). *Hipposideros cyclops*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and J. Juste (2004co). *Scotonycteris ophiodon*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and J. Juste (2004cp). *Hipposideros fuliginosus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, J. Fahr and P. Taylor (2004cq). *Otomops martiensseni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and K. Howell (2004cr). *Rousettus obliviosus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and K. Howell (2004cs). *Pteropus seychellensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and K. Howell (2004ct). *Rousettus aegyptiacus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and K. Howell (2004cu). *Pteropus subniger*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and K. Howell (2004cv). *Pteropus aldabrensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.

Mickleburgh, S., A. Hutson, W. Bergmans and K. Howell (2004cw). *Pteropus voeltzkowi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and K. Howell (2004cx). *Rousettus lanosus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Juste (2004cy). *Chaerephon tomensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans and J. Juste (2004cz). *Hipposideros thomensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S, A. Hutson, W. Bergmans and J. Juste (2004da). *Hipposideros curtus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. Hutson, W. Bergmans, P. Taylor, S. Aulagnier and J. Fahr (2004db). *Cloeotis percivali*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008a). *Asellia patrizii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008b). *Cardioderma cor*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008c). *Casinycteris argynnis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008d). *Epomophorus angolensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008e). *Epomophorus crypturus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008f). *Epomophorus gambianus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008h). *Epomophorus grandis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008l). *Epomophorus labiatus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008j). *Epomophorus minimus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008k). *Epomophorus wahlbergi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008l). *Hipposideros camerunensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008m). *Hipposideros gigas*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008n). *Lavia frons*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008o). *Lissonycteris angolensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008p). *Megaloglossus woermanni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008q). *Micropteropus pusillus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008r). *Nycteris aurita*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008s). *Nycteris hispida*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008t). *Pteropus livingstonii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008u). *Pteropus rodricensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008v). *Rousettus obliviosus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008w). *Tadarida nanula*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008x). *Taphozous hamiltoni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and W. Bergmans (2008y). *Taphozous hildegardeae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008z). *Hipposideros vittatus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008aa). *Nycteris macrotis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ab). *Nycteris woodi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ac). *Tadarida ansorgei*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ad). *Tadarida bivittata*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ae). *Tadarida chapini*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008af). *Tadarida condylura*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ag). *Tadarida gallagheri*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ah). *Tadarida major*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ai). *Tadarida nigeriae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008aj). *Tadarida ventralis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and F. P. D. Cotterill (2008ak). *Triaenops persicus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A.M. Hutson, W. Bergmans, F.P.D. Cotterill and J. Fahr (2008al). *Platymops setiger*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, F. P. D. Cotterill and J. Fahr (2008am). *Tadarida bemmeleni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, F. P. D. Cotterill, M. Griffin and D. Jacobs (2008an). *Sauromys petrophilus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, F. P. D. Cotterill and D. Jacobs (2008ao). *Myonycteris relicta*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, F. P. D. Cotterill and D. Jacobs (2008ap). *Nycteris parisii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, F. P. D. Cotterill and D. Jacobs (2008aq). *Nycteris vinsoni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, F. W. Cotterill, J. Fahr and D. Jacobs (2008ar). *Tadarida aegyptiaca*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008as). *Epomops buettikoferi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008at). *Hipposideros abae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008au). *Hipposideros jonesi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008av). *Hipposideros lamottei*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008aw). *Hipposideros marisae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008ax). *Hipposideros megalotis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008ay). *Hipposideros ruber*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008az). *Hypsignathus monstrosus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008ba). *Micropteropus intermedius*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bb). *Myonycteris torquata*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bc). *Myopterus daubentonii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bd). *Myopterus whitleyi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008be). *Nanonycteris veldkampii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bf). *Nycteris arge*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bg). *Nycteris grandis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bh). *Nycteris intermedia*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bi). *Nycteris major*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bj). *Nycteris nana*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bk). *Nycteris thebaica*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bl). *Saccolaimus peli*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bm). *Scotonycteris zenkeri*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bn). *Tadarida aloysiisabaudiae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bo). *Tadarida brachyptera*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bp). *Tadarida congica*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2008bq). *Tadarida niangarae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Fahr (2014). *Mops niangarae*. The IUCN Red List of Threatened Species 2014: e.T13844A67364351. doi: 10.2305/IUCN.UK.2014-3.RLTS.T13844A67364351.en.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr, W. Chitaukali and F. P. D. Cotterill (2008br). *Plerotes anchietae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.

Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and F. P. D. Cotterill (2008bs). *Tadarida demonstrator*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and F. P. D. Cotterill (2008bt). *Tadarida petersoni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and F. P. D. Cotterill (2008bu). *Tadarida russata*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr, F. P. D. Cotterill and J. Fahr (2008bv). *Tadarida trevori*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and J. Juste (2008bw). *Hipposideros cyclops*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and J. Juste (2008bx). *Epomops dobsonii*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and J. Juste (2008by). *Epomops franqueti*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and J. Juste (2008bz). *Hipposideros beatus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and J. Juste (2008da). *Hipposideros fuliginosus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and Juste. J. (2008db). *Scotonycteris ophiodon*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and P. A. Racey (2008dc). *Eidolon helvum*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Fahr and P. J. Taylor (2008dd). *Otomops martiensseni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and K. Howell (2008de). *Pteropus subniger*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and K. Howell (2008df). *Pteropus voeltzkowi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and K. Howell (2008dg). *Rousettus lanosus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, K. Howell and J. Gerlach (2008dh). *Pteropus aldabrensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, K. Howell and J. Gerlach (2008di). *Pteropus seychellensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Juste (2008dj). *Hipposideros curtus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Juste (2008dk). *Hipposideros thomensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans and J. Juste (2008dl). *Tadarida tomensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Juste and J. Fahr (2008dm). *Tadarida spurrelli*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, J. Juste and J. Fahr (2008dn). *Tadarida thersites*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, W. Bergmans, P. J. Taylor, S. Aulagnier and J. Fahr (2008do). *Cloeotis percivali*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson and P. A. Racey (2008dp). *Pipistrellus hesperidus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>. doi: 10.2305/IUCN.UK.2008.RLTS.T136741A4334244.en.
Mickleburgh, S., A. M. Hutson, P. A. Racey, S. Cardiff and W. Bergmans (2008dq). *Coleura afra*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S., A. M. Hutson, P. A. Racey, J. Ravino, W. Bergmans, F. P. D. Cotterill and J. Gerlach (2008dr). *Tadarida pumila*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Mickleburgh, S. P., A. M. Hutson and P. A. Racey (1992). *Old World Fruit-Bats - An Action Plan for their Conservation*. IUCN, Gland, Switzerland: i - viii; 1 - 252.
Mickleburgh, S. P., A. M. Hutson and P. A. Racey (2002a). A review of the global conservation status of bats. *Oryx*, **36 (1):** 18 - 28. doi: 10.1017/S0030605301000011.
Mickleburgh, S. P., A. M. Hutson and P. A. Racey (2002b). A review of the global conservation status of bats. *Oryx*, **36 (2):** 206 - 211.
Mickleburgh, S. P., K. Waylen and P. A. Racey (2009). Bats as bushmeat: A global review. *Oryx*, **43 (2):** 217 - 234.
Middleton, G. J. (1998). Lava caves of the republic of Mauritius, Indian Ocean. *International Journal of Speleology*, **27 B (1/4):** 87 - 93. [Abstract]
Middleton, G. J. (2005). *Lava caves of Grande Comore, Indian Ocean: further investigations, July 1998.* IXth International Symposium On Vulcanospeleology, 2005: 92 - 107. doi: http://www.vulcanospeleology.org/sym09/ISV9Eq.pdf.
Middleton, G. (J.) and J. Hume (2010). *Lava cave investigations, Anjouan, Comoro Islands, April 2009.* Proceedings 14th International Symposium on Vulcanospeleology, 2010: 131 - 141. URL: http://www.vulcanospeleology.org/sym14/papers/Middleton-et-al.pdf.
Mikkola, H. (2018). Introductory chapter: Bats eaten by owls. IntechOpen: 6 pp. doi: 10.5772/intechopen.76099. URL: https://www.intechopen.com/books/bats/introductory-chapter-bats-eaten-by-owls.
Miková, E., K. Varcholová, S. Boldogh and M. Uhrin (2013). Winter diet analysis in *Rhinolophus euryale* (Chiroptera). *Central European Journal of Biology*, **8 (9):** 848 - 853. doi: 10.2478/s11535-013-0199-9.
Mikula, P., F. Morelli, R. K. Lucan, D. N. Jones and P. Tryjanowski (2016). Bats as prey of diurnal birds: a global perspective. *Mammal Review*, **46 (3):** 160 - 174. doi: 10.1111/mam.12060.
Mildenstein, T. (2011). *Chapter 3. Bat population abundance assessment and monitoring.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 29- 46. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Mildenstein, T. and C. de Jong (2011). *Chapter 2. Natural history, ecological and socio-economic value of bats.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 15 - 27. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Miller, C. A. and D. E. Wilson (1997). *Pteropus tonganus*. *Mammalian Species*, **552:** 1 - 6, 3 figs.

Miller, G. S. , Jr. (1897). Revision of the North American bats of the family Vespertilionidae. *North American Fauna*, **13:** 1 - 185. [Abstract]

Miller, G. S. , Jr. (1898). ?? Title still needs to be checked. ?? *Proceedings of the Academy of Natural Sciences of Philadelphia*50.

Miller, G. S. , Jr. (1900). A collection of small mammals from Mount Coffee, Liberia. *Proceedings of the Washington Academy of Sciences*, **2:** 631 - 649. [Abstract]

Miller, G. S. , Jr. (1905). A new bat from German East Africa. *Proceedings of the Biological Society of Washington*, **18:** 227 - 228. [Abstract]

Miller, G. S. , Jr. (1906). ?? Title still needs to be checked. ?? *Proceedings of the Biological Society of Washington*19.

Miller, G. S. , Jr. (1907). The families and genera of bats. *Bulletin of the United States National Museums*, **57:** 1 - 282. doi: 10.5962/bhl.title.16306. [Abstract]

Miller, G. S. , Jr. (1910). The generic name *Nycteris*. *Proceedings of the Biological Society of Washington*, **22:** 90.

Miller, G. S. , Jr. (1911). Descriptions of six new mammals from the Malay archipelago. *Proceedings of the Biological Society of Washington*, **24:** 25 - 28.

Miller, G. S. , Jr. (1912). *Catalogue of the mammals of western Europe (Europe exclusive of Russia) in the collection of the British Museum.* London: i - xv; 1 - 1019.

Miller, G. S. Jr. (1913). Some overlooked names of Sicilian mammals. *Proceedings of the Biological Society of Washington*, **26:** 80.

Miller, L. A. and H. J. Degn (1981). The Acoustic behavior of four species of vespertilionid bats studied in the field. *Journal of Comparative Physiology*, **A 142:** 67 - 74.

Miller-Butterworth, C. M., G. Eick, D. S. Jacobs, M. C. Schoeman and E. H. Harley (2005). Genetic and phenotypic differences between South African Long-fingered bats, with a global Miniopterine phylogeny. *Journal of Mammalogy*, **86 (6):** 1121 - 1135.

Miller-Butterworth, C. M., D. S. Jacobs and E. H. Harley (2002). Isolation and characterization of highly polymorphic microsatellite loci in Schreibers' long-fingered bat, *Miniopterus schreibersii* (Chiroptera: Vespertilionidae). *Molecular Ecology Notes*, **2 (1):** 139 - 141.

Miller-Butterworth, C. M., D. S. Jacobs and E. H. Harley (2003). Strong population substructure is correlated with morphology and ecology in a migratory bat. *Nature*, **424:** 187 - 191.

Miller-Butterworth, C. M., W. J. Murphy, S. J. O'Brien, D. S. Jacobs, D. S. Springer and E. C. Teeling (2007). A family matter: Conclusive resolution of the taxonomic position of the long-fingered bats, *Miniopterus*. *Molecular biology and evolution*, **24 (7):** 1553 - 1561.

Mills, M. S. L., U. franke, G. Joseph, F. Miato, S. Milton, A. Monadjem, D. Oschadleus and W. R. J. Dean (2010). Cataloguing the Lubango bird skin collection: Towards an atlas of Angolan bird distributions. *Bulletin of the African Bird Club*, **17 (1):** 43 - 53. URL: http://birdsangola.org/downloads/millsetal2010lubangoskincollection.pdf.

Milne-Edwards, A. (1881). Observations sur quelques animaux de Madagascar. *Comptes Rendus des séances de l'Academie des Sciences*, **91 (for 1880):** 1034 - 1038.

Milne-Edwards, A. and A. Grandidier (1878). Note sur un nouveau genre de Chiroptère. *Bulletin Scientifique de la Société Philom. de Paris*, **ser. 7, 2:** 220 - 221.

Miltgen, F., I. Landau and J. Bradbury (1980). *Hepatocystis* d'*Hypsignathus monstrosus* (Pteropinae) au Gabon. II. Description d'*Hepatocystis carpenteri* n. sp. *Annales de Parasitologie*, **55 (5):** 485 - 490. [Abstract]

Miltgen, F., I. Landau, G. Rosin and C. Erard (1977). *Hepatocystis brosseti* n. sp., Haemoproteidae, parasite d'*Epomops franqueti*, Pteropinae, au Gabon. *Annales de Parasitologie humaine et comparée*, **52 (6):** 589 - 596. [Abstract]

Minnaar, C., J. G. Boyles, I. A. Minnaar, C. L. Sole and A. E. McKechnie (2014a). Stacking the odds: light pollution may shift the balance in an ancient predator-prey arms race. *Journal of Applied Ecology*, **52 (2):** 522 - 531 (for 2015). doi: 10.1111/1365-2664.12381.

Minnaar, I. A., N. C. Bennett, C. T. Chimimba and A. E. McKechnie (2014b). Partitioning of evaporative water loss into respiratory and cutaneous pathways in Wahlberg's Epauletted fruit bats (*Epomophorus wahlbergi*). *Physiological and Biochemical Zoology*, **87 (3):** 475 - 485. doi: 10.1086/675342.

Minnaar, I. A., N. C. Bennett, C. T. Chimimba and A. E. McKechnie (2014c). Summit metabolism and metabolic expansibility in Wahlberg's epauletted fruit bats (*Epomophorus wahlbergi*): seasonal acclimatisation and effects of captivity. *Journal of experimental biology*, **217 (8):** 1363 - 1369. doi: 10.1242/jeb.098400.

Mishra, N., S. F. Fagbo, A. N. Alagaili, A. Nitido, S. H. Williams, J. Ng, B. Lee, A. Durosinlorun, J. A. Garcia, K. Jain, V. Kapoor, J. H. Epstein, T. Briese, Z. A. Memish, K. J. Olival and W. I. Lipkin (2019). A viral metagenomic survey identifies known and novel mammalian viruses in bats from Saudi Arabia. *PLoS ONE*, **14 (4):** e0214227. doi: 10.1371/journal.pone.0214227.

Mishra, N., S. D. Rout and T. Panda (2011). Ethno-zoological studies and medicinal values of Similipal Biosphere Reserve, Orissa, India. *African Journal of Pharmacy and Pharmacology*, **5 (1):** 6 - 11.

Mitchell, P. C. (1911). 24. On longevity and relative viability in mammals and birds ; with a note on the theory of longevity. *Proceedings of the Zoological Society of London*, **1911, II:** 425 - 548.

Mitchell-Jones, A. J., G. Amori, W. Bogdanowicz, B. Krystufek, P. J. H. Reijnders, F. Spitzenberger, M. Stubbe, J. B. M. Thissen, V. Vohralik and J. Zima (1999). *The Atlas of European Mammals.* Academic Press, London, UK.

Miyamoto, M. M., C. A. Porter and M. Goodman (2000). c-*Myc* gene sequences and the phylogeny of bats and other Eutherian mammals. *Systematic Biology*, **49 (3):** 501 - 514.

Mlíkovský, J., P. Benda, J. Moravec and R. Šanda (2011). Type specimens of recent vertebrates in the collections of the National Museum, Prague, Czech Republic. *Journal of the National Museum (Prague), Natural History Series*, **180 (10):** 133 - 164.

Moeschler, P., I. A. Nader and P. Gaucher (1990). First record of *Asellia patrizii* De Beaux, 1931 (Chiroptera: Hipposideridae) in Saudi Arabia. *Mammalia*, **54 (4):** 654 - 655.

Mohammed, S. A. (2015). Differentiation between the anterior pituitary cells of the Egyptian insectivorous bats *Rhinopoma hardwickei* using transmission electron microscope. *Endocrinology & Metabolic Syndrome*, **4:** 1 (7 pages). doi: 10.4172/21611017.1000151.

Möhres, F. P. and E. Kulzer (1956). Untersuchungen über die Ultraschallorientierung von vier afrikanischen Fledermausfamilien. *Verhandlungen der Deutschen Zoologischen Gesellschaft*, **19:** 59 - 65.

Molur, S., G. Marimuthu, C. Srinivasulu, M. Sharoukh, A. M. Hutson, P. J. J. Bates, S. Walker, K. P. Priya and A. R. B. Priya (2002). *Status of South Asian Chiroptera: Conservation Assessment and Management Plan (C. A. M. P.) Workshop Report, 2002.* Conservation Breeding Specialist Group, South Asia, Department of Animal Behaviour and Physiology, School of Biological Sciences, Madurai Kamaraj University, Madurai, Tamil Nadu, India: i - viii; 1 - 320.

Monadjem, A. (1998a). *Mammals of Swaziland.* Manzini, Conservation Trust of Swaziland and Big Game Parks, Swaziland.

Monadjem, A. (1998b). Distributional patterns and conservation status of mammals of Swaziland, southern Africa. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **41 (2):** 45 - 59. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/252. [Abstract]

Monadjem, A. (2001). Sexual dimorphism, sex ratio and preliminary recapture rates of *Nycteris thebaica* (Nycteridae: Chiroptera) in Swaziland. *Durban Museum Novitates*, **26:** 49 - 52.

Monadjem, A. (2004). Research on survival and movements of the Common Slit-faced bat (*Nycteris thebaica*) in north-eastern Swaziland. *African Bat Conservation News*, **1:** 4 - 5.

Monadjem, A. (2005). Recording of the call of the Peak-saddle Horseshoe Bat (*Rhinolophus blasii* Peters, 1867) from Swaziland. *African Bat Conservation News*, **3:** 5 - 6.

Monadjem, A. (2006a). Longevity and movement of the Common Slit-faced bat *Nycteris thebaica*. *African Bat Conservation News*, **9:** 7.

Monadjem, A. (2006b). Survival and roost-site selection in the African bat *Nycteris thebaica*. *Belgian Journal of Zoology*, **135 (Suppl.):** 103 - 107 (for 2005).

Monadjem, A., R. C. Boycott, V. Parker and J. Culverwell (2003). *Threatened Vertebrates of Swaziland. Swaziland Red Data Book: Fishes, Amphibians, Reptiles, Birds and Mammals.* Ministry of Tourism, Environment and Communications - Swaziland - 256.

Monadjem, A., L. Cohen and K. De Wet (2005). Rediscovery of the Short-eared Trident bat (*Cloeotis percivali* Thomas 1901) in Swaziland. *African Bat Conservation News*, **6:** 2 - 3.

Monadjem, A., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. (R.) Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016a). *A conservation assessment of Chaerephon pumilus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. (R.) Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016b). *A conservation assessment of Mops condylurus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016c). *A conservation assessment of Nycteris hispida.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016d). *A conservation assessment of Nycteris thebaica.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016e). *A conservation assessment of Eidolon helvum.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016f). *A conservation assessment of Kerivoula argentata.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016g). *A conservation assessment of Kerivoula lanosa.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., I. Conenna, P. J. Taylor and M. C. Schoeman (2017a). Species richness patterns and functional traits of the bat fauna of arid southern Africa. *Hystrix, Italian Journal of Mammalogy*, **29 (1):** 19 - 24 (for 2018). doi: 10.4404/hystrix–00016-2017.

Monadjem, A., J. Decher, W.-Y. Crawley and R. A. McCleery (2018a). The conservation status of a poorly known range-restricted mammal, the Nimba otter-shrew *Micropotamogale lamottei*. *Mammalia*, **83 (1):** 1 - 10 (for 2019). doi: 10.1515/mammalia-2017-0144.

Monadjem, A., M. Ellstrom, C. Maldonald and N. Fasel (2010a). The activity of an insectivorous bat *Neoromicia nana* on tracks in logged and unlogged forest in tropical Africa. *African Journal of Ecology*, **48 (4):** 1083 - 1091. doi: 10.1111/j.1365-2028.2010.01219.x. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2028.2010.01219.x/pdf.

Monadjem, A. and J. Fahr (2007). *Rapid survey of bats of North Lorma, Gola and Grebo National Forests, with notes on shrews and rodents.* In Hoke, P., R. Demey and A. Peal : *A Rapid Biological Assessment of North Lorma, Gola and Grebo National Forests, Liberia.* Conservation International - Arlington, Virginia: 47 - 58, 101 - 106.

Monadjem, A., S. M. Goodman, W. T. Stanley and B. Appleton (2013a). A cryptic new species of *Miniopterus* from south-eastern Africa based on molecular and morphological characters. *Zootaxa*, **3746(1):** 123 - 142. doi: 10.11646/zootaxa.3746.1.5.

Monadjem, A., N. Higgins, T. Smith and E. Herrmann (2008). Bats recorded from Koegelbeen cave and selected other sites in the Northern Cape, South Africa. *African Bat Conservation News*, **18:** 2 - 4.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016h). *A conservation assessment of Rhinolophus landeri.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016i). *A conservation assessment of Hypsugo anchietae.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016j). *A conservation assessment of Myotis bocagii.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016k). *A conservation assessment of Myotis tricolor.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016l). *A conservation assessment of Myotis welwitschii.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016m). *A conservation assessment of Neoromicia nana.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016n). *A conservation assessment of Neoromicia zuluensis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016o). *A conservation assessment of Nycticeinops schlieffeni.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016p). *A conservation assessment of Pipistrellus hesperidus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016q). *A conservation assessment of Pipistrellus rueppellii.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016r). *A conservation assessment of Pipistrellus rusticus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016s). *A conservation assessment of Scotophilus dinganii.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, L. Cohen, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016t). *A conservation assessment of Hipposideros caffer.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, K. (L.) MacEwan, L. Cohen, L. R. Richards, (M.) C. Schoeman, D. Raimondo and P. J. Taylor (2016v). *A conservation assessment of Hipposideros vittatus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, K. (L.) MacEwan, L. Cohen, L. (R.) Richards, (M.) C. Schoeman, T. Sethusa and M. F. Child (2016u). *A conservation assessment of Taphozous mauritianus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., D. (S.) Jacobs, K. (L.) MacEwan, L. Cohen, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016w). *A conservation assessment of Neoromicia capensis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South

African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., A. Kane, P. Taylor, L. R. Richards, G. Hall and S. Woodborne (2018b). Morphology and stable isotope analysis demonstrate different structuring of bat communities in rainforest and savannah habitats. *Royal Society Open Science*, **B 5 (12):** 180849. doi: 10.1098/rsos.180849.

Monadjem, A., R. A. McCleery and B. Collier (2015). Patterns of survival and roost switching in an African insectivorous bat. *Journal of Zoology*, **296 (1):** 15 - 22. doi: 10.1111/jzo.12210.

Monadjem, A., T. Raabe, B. Dickerson, N. Silvy and R. McCleery (2010b). Roost use by two sympatric species of *Scotophilus* in a natural environment. *South African Journal of Wildlife Research*, **40 (1):** 73 - 76.

Monadjem, A., M. Rasmussen and D. C. van der Made (2011). Echolocation calls and wing morphology of selected bats in western Uganda. *Durban Museum Novitates*, **34:** 29 - 34.

Monadjem, A. and A. (E.) Reside (2009). The influence of riparian vegetation on the distribution and abundance of bats in an African savanna. *Acta Chiropterologica*, **10 (2):** 339 - 348 (for 2008). doi: 10.3161/150811008X414917.

Monadjem, A. and A. E. Reside (2012). Breeding season of *Epomophorus walhbergi* in the Lowveld of Swaziland. *African Zoology*, **47 (2):** 321 - 325. doi: 10.3377/004.047.0217.

Monadjem, A., A. (E.) Reside, J. Cornut and M. R. Perrin (2009). Roost selection and home range of an African insectivorous bat *Nycteris thebaica* (Chiroptera, Nycteridae). *Mammalia*, **73:** 353 - 359. doi: 10.1016/j.ympev.2009.09.021.

Monadjem, A., A. (E.) Reside and L. Lumsden (2007a). Echolocation calls of rhinolophid and hipposiderid bats in Swaziland. *South African Journal of Wildlife Research*, **37 (1):** 9 - 15.

Monadjem, A., A. (E.) Reside and P. J. Taylor (2007c). Bats recorded from Tembe Elephant Park, KwaZulu-Natal, South Africa. *African Bat Conservation News*, **13:** 2 - 3.

Monadjem, A., L. R. Richards, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016x). *A conservation assessment of Epomophorus crypturus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., L. (R.) Richards and C. Denys (2016y). An African bat hotspot: The exceptional importance of Mount Nimba for bat diversity. *Acta Chiropterologica*, **18 (2):** 359 - 375. doi: 10.3161/15081109ACC2016.18.2.005.

Monadjem, A., L. (R.) Richards, P. J. Taylor, C. Denys, A. Dower and S. Stoffberg (2013b). Diversity of Hipposideridae in the Mount Nimba massif, West Africa, and the taxonomic status of *Hipposideros lamottei*. *Acta Chiropterologica*, **15 (2):** 341 - 352. doi: 10.3161/150811013X678964.

Monadjem, A., L. (R.) Richards, P. J. Taylor and S. Stoffberg (2013c). High diversity of pipistrelloid bats (Vespertilionidae: *Hypsugo, Neoromicia*, and *Pipistrellus*) in a West African rainforest with the description of a new species. *Zoological Journal of the Linnean Society*, **167 (1):** 191 - 207. doi: 10.1111/j.1096-3642.2012.00871.x.

Monadjem, A. and C. Schoeman (2013). The distribution of bat species richness in Sub-Saharan Africa. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 104. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Monadjem, A., (M.) C. Schoeman, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, T. Sethusa and P. J. Taylor (2016z). *A conservation assessment of Tadarida fulminans.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., M. C. Schoeman, A. Reside, D. V. Pio, S. Stoffberg, J. Bayliss, F. P. D. Cotterill, M. Curran, M. Kopp and P. J. Taylor (2010c). A recent inventory of the bats of Mozambique with documentation of seven new species for the country. *Acta Chiropterologica*, **12 (2):** 371 - 391. doi: 10.3161/150811010X537963.

Monadjem, A., J. T. Shapiro, F. Mtsetfwa, A.(E.) Reside and R. A. McCleery (2017b). Detection distances for bats in southern African savannas (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 148. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.

Monadjem, A., J. T. Shapiro, F. Mtsetfwa, A. E. Reside and R. A. McCleery (2017c). Acoustic call library and detection distances for bats of Swaziland. *Acta Chiropterologica*, **19 (1):** 175 - 187. doi: 10.3161/15081109ACC2017.19.1.014.

Monadjem, A., P. J. Taylor, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. (R.) Richards, (M.) C. Schoeman and T. Sethusa (2016aa). *A conservation assessment of Chaerephon ansorgei.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monadjem, A., P. (J.) Taylor, F. P. D. Cotterill, R. Kityo and J. Fahr (2007b). Conservation status of bats in sub-Saharan Africa. *Bat Research News*, **48 (4):** 267.

Monadjem, A., P. (J.) Taylor, F. P. D. Cotterill and M. C. Schoeman (2010d). *Bats of Southern and Central Africa. A biogeographic and taxonomic synthesis.* Wits University Press, Johannesburg. i-xii-596p. URL: http://sudartomas.files.wordpress.com/2012/11/batsofsouthernandcentralafrica.pdf.

Monadjem, A., P. J. Taylor, L. R. Richards, W. White, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, (M.) C. Schoeman and M. F. Child (2016ab). *A conservation assessment of Neoromicia rendalli.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Monard, A. (1933). ?? Title still needs to be checked. ?? *Bulletin de la Société neuchâteloise des sciences naturelles*57.

Monard, A. (1935). Contribution à la mammalogie d'Angola et prodrome d'une faune d'Angola. *Arquivos do Museu Bocage*, **6:** 1 - 134. [Abstract]

Monard, A. (1939). Résultats de la mission scientifique du Dr. Monard en Guinée Portugaise 1937-38. III. Chiroptères. *Arquivos do Museu Bocage*, **10:** 49 - 80. [Abstract]

Monard, A. (1943). Note sur la faune de la Guinée portugaise. *Revue suisse de zoologie*, **50 (2) 9:** 249 - 256.

Montfort, A. (1992). Première liste commentée des mammifères du Rwanda. *Revue de zoologie africaine*, **106:** 141 - 151. [Abstract]

Monticelli, F. S. (1885). ?? Title still needs to be checked. ?? *Annali del Accademia O. Costa de Aspir. Naturale di Napoli*ser. 1, 1.

Monticelli, F. S. (1886). I Chirotteri del mezzogiorno d'Italia. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **28 (3-4):** 169 - 214.
Monticelli, F. S. (1887). Note chirotterologiche. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 5 (O.S. 25):** 517 - 524.
Moonsamy, S., C. M. Schoeman and R. L. Mackey (2009). Testing the allotonic frequency hypothesis in an urban landscape: the effects of ecological light pollution. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 61 - 62. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.
Moores, R. and D. Brown (2014). A range reinforcement of Lesser Leaf-nosed Bat *Hipposideros (caffer) tephrus* to the lower reaches of the Oued Noun and further mammal records from the Lower Draa. *Go-South Bulletin*, **11:** 19 - 30.
Moores, R. and D. Brown (2017). New records of bats from southern Morocco (Atlantic Sahara) and notes on echolocation. *Mammalia*, **81 (6):** 611 - 614. doi: 10.1515/mammalia-2016-0028.
Morales, J. C., S. W. Ballinger, J. W. Bickham, I. F. Greenbaum and D. A. Schlitter (1991). Genetic relationships among eight species of *Eptesicus* and *Pipistrellus* (Chiroptera: Vespertilionidae). *Journal of Mammalogy*, **72 (2):** 286 - 291. [Abstract]
Morales Agacino, E. (1933). Datos y observaciones sobre algunos mamiferos marroquies. *Boletín de la Real Sociedad Española de Historia Natural: sección Biologica*, **33:** 257 - 266. [Abstract]
Morales Agacino, E. (1943). Algunos datos y observaciones sobre mamiferos marroquies. *Boletín de la Real Sociedad Española de Historia Natural: sección Biologica*, **41:** 37 - 47. [Abstract]
Moratelli, R. and C. H. Calisher (2015). Bats and zoonotic viruses: can we confidently link bats with emerging deadly viruses? *Memorias do Instituto Oswaldo Cruz*, **110 (1):** 1 - 22. doi: 10.1590/0074-02760150048.
Moreau, R. E., G. H. E. Hopkins and R. W. Hayman (1946). The type-localities of some African mammals. *Proceedings of the Zoological Society of London*, **115:** 387 - 447. doi: 10.1111/j.1096-3642.1946.tb00101.x.
Moreau, R. E. and R. H. W. Pakenham (1940). The land vertebrates of Pemba, Zanzibar and Mafia: a zoogeographic study. *Proceedings of the Zoological Society of London*, **A 110:** 97 - 128.
Morel, P.-C. and J. Mouchet (1965). Les tiques du Cameroun (Ixodidae et Argasidae) (2e note). *Annales de Parasitologie*, **40 (4):** 477 - 496. [Abstract]
Mori (1928). ?? Title still needs to be checked. ?? *Zoological Magazine; Tokyo*40.
Mori and Chosen (1933). ?? Title still needs to be checked. ? .
Morris, B. (1964). Mammals of Zoa Estate, Cholo. *The Nyasaland Journal*, **2 (17):** 71 - 78.
Morrison, D. W. (1980). Efficiency of food utilization by fruit bats. *Oecologia*, **45:** 270-273.
Morrison-Scott, T. C. S. (1939). Some Arabian mammals collected by Mr. H.StJ.B. Philby, C.I.E. *Novitates Zoologicae*, **41:** 181 - 211. [Abstract]
Morse, S. F., S. E. Bush, B. D. Patterson, C. W. Dick, M. E. Gruwell and K. Dittmar (2013). Evolution, multiple acquisition, and localization of endosymbionts in bat flies (Diptera: Hippoboscoidea: Streblidae and Nycteribiidae). *Applied and Environmental Microbiology*, **79 (9):** 2952 - 2961. doi: 10.1128/AEM.03814-12.
Morse, S. F., K. J. Olival, M. Kosoy, S. Billeter, B. D. Patterson, C. W. Dick and K. Dittmar (2012). Global distribution and genetic diversity of *Bartonella* in bat flies (Hippoboscoidea, Streblidae, Nycteribiidae). *Infection, Genetics and Evolution*, **12 (8):** 1717 - 1723. doi: 10.1016/j.meegid.2012.06.009.
Morsy, K., F. Abdel-Ghaffar, A.-R. Bashtar, S. Abdel-Gaber, R. Bin Dajem and M. Mostafa (2018). Light microscopy and surface topography of *Urotrema scabridum* and *Renschetrema indicum* (Digenea) from *Rhinopoma hardwickii* (Chiroptera): first report in Egypt. *Brazilian Journal of Veterinary Parasitology*, **27 (3):** 319 - 326. doi: 10.1590/S1984-296120180039.
Mortlock, M., M. Dietrich, J. Weyer, J. (T.) Paweska and W. Markotter (2019a). Excretion dynamics of Henipa-related viruses in the Egyptian Rousette bat and triggers for potential spillover. *International Journal of Infectious Diseases*, **79 (S1):** 29. doi: 10.1016/j.ijid.2018.11.086.
Mortlock, M., M. Dietrich, J. Weyer, J. T. Paweska and W. Markotter (2019b). Co-circulation and excretion dynamics of diverse rubula- and related viruses in Egyptian rousette bats from South Africa. *Viruses*, **11:** 37. doi: 10.3390/v11010037.
Mortlock, M., I. V. Kuzmin, J. Weyer, A. T. Gilbert, B. Agwanda, C. E. Rupprecht, L. H. Nel, T. Kearney, J. M. Malekani and W. Markotter (2015). Novel paramyxoviruses in bats from sub-Saharan Africa, 2007–2012. *Emerging Infectious Diseases*, **21 (10):** 1840 - 1843. doi: 10.3201/eid2110.140368.
Morvan, J. M., V. Deubel, P. Gounon, E. Nakouné, P. Barrière, S. Murri, O. Perpète, B. Selekon, D. Goudrier, A. Gautier-Hion, M. Colyn and V. Volehkov (1999). Identification of Ebola virus sequences present as RNA or DNA in organs of terrestrial small mammals of the Central African Republic. *Microbes and Infection*, **1:** 1193 - 1201.
Moussy, C., D. J. Hosken, F. Mathews, G. C. Smith, J. N. Aegerter and S. Bearhop (2012). Migration and dispersal patterns of bats and their influence on genetic structure. *Mammal Review*, **43 (3):** 183 - 195 (for 2013). doi: 10.1111/j.1365-2907.2012.00218.x.
Moutou, F. (1982). Note sur les chiroptères de l'île de la Réunion (Océan Indien). *Mammalia*, **46 (1):** 35 - 51.
Moyer, D. C. (2005). Biodiversity of Mahale Mountains National Park, Tanzania. Wildlife Conservation Society - Tanzania Program: 69 pp. URL: http://www.zgf.de/download/1360/Biodiversity+of+MMNP.pdf.
Moyers Arévalo, R. L., L. I. Amador, F. C. Almeida and N. P. Giannini (2018). Evolution of body mass in bats: insights from a large supermatrix phylogeny. *Journal of Mammalian Evolution*, **xx (x):** xxx - xxx (for xxxx). doi: 10.1007/s10914-018-9447-8.
Mqokeli, B. R. and C. T. Downs (2012a). Blood plasma glucose regulation in Wahlberg's epauletted fruit bat. *African Zoology*, **47 (2):** 348 - 352. doi: 10.3377/004.047.0218.
Mqokeli, B. R. and C. T. Downs (2012b). Palatal and lingual adaptations for frugivory and nectarivory in the Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*). *Zoomorphology: evolutionary, comparative and functional morphology*, **132 (1):** 111 - 119 (for 2013). doi: 10.1007/s00435-012-0170-3.
Mqokeli, B. R. and C. T. Downs (2014). Is protein content in the diet of Wahlberg's epauletted fruit bats, *Epomophorus wahlbergi*, important? *African Zoology*, **49 (1):** 161 - 166. doi: 10.3377/004.049.0111.
Mtsetfwa, F., R. A. McCleery and A. Monadjem (2018). Changes in bat community composition and activity patterns across a conservation-agriculture boundary. *African Zoology*, **53 (3):** 99 - 106. doi: 10.1080/15627020.2018.1531726.
Muhmenthaler, M., J. P. Müller and A. Wehrli (1999a). Altitudinal distribution (3100-4430 masl) of small mammals on Mt. Bwahit (Ethiopia). Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 121.
Muhmenthaler, M., A. Wehrli and J. P. Müller (1999b). Human impact on small mammals in the highlands of Simen Mountains National Park (Ethiopia). Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 120.

Muldoon, K. M., D. D. de Blieux, E. L. Simons and P. S. Chatrath (2009). The subfossil occurrence and paleoecological significance of small mammals at Ankilitelo cave, southwestern Madagascar. *Journal of Mammalogy*, **90 (5):** 1111 - 1131. doi: 10.1644/08-MAMM-A-242.1.

Muleya, W., M. Sasaki, Y. Orba, A. Ishii, Y. Thomas, E. Nakagawa, H. Ogawa, B. Hang'Ombe, B. Namangala, A. Mweene, A. Takada, T. Kimura and H. Sawa (2013). Molecular epidemiology of paramyxoviruses in frugivorous *Eidolon helvum* bats in Zambia. *Journal of Veterenary Medical Science*, **76 (4):** 611 - 614 (for 2014). doi: 10.1292/jvms.13-0518.

Müller, B., S. M. Goodman and L. Peichl (2007a). Cone photoreceptor diversity in the retinas of fruit bats (Megachiroptera). *Brain; Behavior and Evolution*, **70:** 90 - 104. doi: 10.1159/000102971.

Müller, J. (1858). Eine neue Fledermausart aus Nordafrika. *Lotos (Prag)*, **8:** 75 - 79. [Abstract]

Müller, J. P., M. Muhmenthaler and A. Wehrli (1999). Small mammals checklist of the highlands of the Simen Mountains National Park (Ethiopia). Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 119.

Müller, M. A., S. Devignot, E. Lattwein, V. M. Corman, G. D. Maganga, F. Gloza-Rausch, T. Binger, P. Vallo, P. Emmerich, V. M. Cottontail, M. Tschapka, S. Oppong, J. F. Drexler, F. Weber, E. M. Leroy and C. Drosten (2016). Evidence for widespread infection of African bats with Crimean-Congo hemorrhagic fever-like viruses. *Scientific Reports*, **6:** 26637. doi: 10.1038/srep26637.

Müller, M. A., J. T. Paweska, P. A. Leman, C. Drosten, K. Grywna, A. Kemp, L. E. O. Braack, K. Sonnenberg, M. Niedrig and R. Swanepoel (2007b). Coronavirus antibodies in African bat species. *Emerging Infectious Diseases*, **13 (9):** 1367 - 1370.

Müller, M. A., V. S. Raj, D. Muth, B. Meyer, S. Kallies, S. L. Smits, R. Wollny, T. M. Bestebroer, S. Specht, T. Suliman, K. Zimmermann, T. Binger, I. Eckerle, M. Tschapka, A. M. Zaki, A. D. M. E. Osterhaus, R. A. M. Fouchier, B. L. Haagmans and C. Drosten (2012). Human coronavirus EMC does not require the SARS-coronavirus receptor and maintains broad replicative capability in mammalian cell lines. *mBio*, **3 (6):** e00515-12. doi: 10.1128/mBio.00515-12.

Müller, P. L. S. (1776). *Des Ritters C.von Linné...vollständige Natursystem nach dem zwölften Latinischen Aufgabe.* Besch. Berlin. Ges. Naturf. Fr. 2 584-592.

Munang'andu, H. M., A. S. Mweene, V. Siamudaala, J. B. Muma and W. Matandiko (2011). Rabies status in Zambia for the period 1985-2004. *Zoonoses and Public Health*, **58 (1):** 21 - 27. doi: 10.1111/j.1863-2378.2010.01368.x. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1863-2378.2010.01368.x/pdf.

Muñoz-Garcia, A., M. Ben-Hamo, B. Pinshow, J. B. Williams and C. Korine (2012). The relationship between cutaneous water loss and thermoregulatory state in Kuhl's Pipistrelle *Pipistrellus kuhlii*, a Vespertillionid Bat. *Physiological and Biochemical Zoology*, **85 (5):** 516 - 525. doi: 10.1086/666989.

Muñoz-Garcia, A., P. Larraín, M. Ben-Hamo, A. Cruz-Neto, J. B. Williams, B. Pinshow and C. Korine (2015). Metabolic rate, evaporative water loss and thermoregulatory state in four species of bats in the Negev desert. *Comparative Biochemistry and Physiology*, **A 191:** 156 - 165 (for 2016). doi: 10.1016/j.cbpa.2015.10.010.

Murphy, W. J., E. Elzirik, W. E. Johnson, Zhang, Ya-Phing, O. A. Ryder and S. J. O'Brien (2001a). Molecular phylogenetics and the origin of placental mammals. *Nature*, **409:** 614 - 618.

Murphy, W. J., E. Elzirik, S. J. O'Brien, O. Madsen, M. Scalley, C. J. Douady, E. Teeling, O. A. Ryder, M. J Stanhope, W. W. De Jong and M. S. Springer (2001b). Resolution of the early placental mammal radiation using Bayesian phylogenetics. *Science*, **294:** 2348 - 2351.

Murray, A. (1862). Description of *Sphyrocephalus labrosus*, a new bat from Old Calabar River, Western Africa. *Proceedings of the Zoological Society of London*, **1862, I:** 8 - 11.

Murray, M. J. (2015). Ebola virus disease: a review of its past and present. *Anesthesia & Analgesia*, **121 (3):** 798 - 809. doi: 10.1213/ANE.0000000000000866.

Murray, P. F. and T. Strickler (1975). Notes on the structure and function of cheek pouches within the Chiroptera. *Journal of Mammalogy*, **56 (3):** 673 - 676.

Musa, J. Y. (1994). *The Sisia cave bats of Bamenda, Cameroon.* Notes, News & Comments: 275.

Musaba Akawa, P., M. A. Bendeki, F. Kirongozi Botelanyele, I. Shabani, C. Nebesse Mololo, V. Van Cakenberghe, E. Verheyen, G.-C. Gembu Tungaluna, J. A. Asimonyio, C. Masengo Ashande and J.-P. Koto-te-Nyiwa Ngbolua (2017). A survey of the bushmeat trade of the straw-coloured fruit bat (*Eidolon helvum* Kerr, 1792) at Maele Island (Kisangani city, Democratic Republic of the Congo). *Journal of Advanced Botany and Zoology*, **4 (4):** 1 - 6.

Musila, S., W. Bogdanowicz, R. Syingi, A. Zuhura, P. Chylarecki and J. Rydell (2019). No lunar phobia in insectivorous bats in Kenya. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **95:** 77 - 84. doi: 10.1016/j.mambio.2019.03.002.

Musila, S., A. Monadjem, P. W. Webala, B. D. Patterson, R. Hutterer, Y. A. De Jong, T. M. Butynski, G. Mwangi, Z.-Z. Chen and X.-L. Jiang (2018a). An annotated checklist of mammals of Kenya. *Zoological Research (China)*, **40 (1):** 3 - 52 (for 2019). doi: 10.24272/j.issn.2095-8137.2018.059.

Musila, S., P. Prokop and N. Gichuki (2018b). Knowledge and perceptions of, and attitudes to, bats by people living around Arabuko-Sokoke Forest, Malindi-Kenya. *Anthrozoös*, **31 (2):** 247 - 262. doi: 10.1080/08927936.2018.1434065.

Musila, S., R. Syingi, N. Gichuki and I. Castro-Arellano (2018c). Bat activity in the interior of Arabuko-Sokoke Forest and adjacent farmlands in Kenya. *Journal of Bat Research and Conservation*, **11 (1):** 39 - 51. doi: 10.14709/BarbJ.11.1.2018.05.

Mutere, F. A. (1965a). Delayed implantation in an equatorial fruit bat. *Nature*, **207:** 780.

Mutere, F. A. (1965b). Reproduction in the African fruit bat, *Eidolon helvum* Kerr. *Proceedings of the East African Academy*, **3:** 87.

Mutere, F. A. (1966). On the bats of Uganda. *Uganda Journal*, **30 (1):** 75 - 79.

Mutere, F. A. (1967). The breeding biology of equatorial vertebrates; reproduction in the fruit bat *E. helvum*, at latitude 0º20'N. *Journal of Zoology*, **153 (2):** 153 - 161. doi: 10.1111/j.1469-7998.1967.tb04058.x. [Abstract]

Mutere, F. A. (1968). Breeding cycles in tropical bats in Uganda. *Journal of Animal Ecology*, **37:** 8p - 9p.

Mutere, F. A. (1970). Bat studies in Uganda. *Studies in Speleology (London)*, **2 (2):** 61 - 68. [Abstract]

Mutere, F. A. (1973a). A comparative study of reproduction in the populations of the insectivorous bats, *Otomops martiensseni*, at latitudes 1° 5' S and 2° 30' S. *Journal of Zoology*, **171:** 79 - 92. [Abstract]

Mutere, F. A. (1973b). Reproduction in two species of equatorial free-tailed bats (Molossidae). *African Journal of Ecology*, **11 (3-4):** 271 - 280. doi: 10.1111/j.1365-2028.1973.tb00092.x. [Abstract]

Mutere, F. A. (1980). *Eidolon helvum revisited.* In Wilson, D. E. and A. L. Gardner [Eds]: *Proceedings of the Fifth International Bat Research Conference.* Texas Tech Press - Lubbock, Texas: 145 - 150.

Mutumi, G. and D. (S.) Jacobs (2013). Geographic variation in the echolocation calls of a species of horseshoe bat, *Rhinolophus simulator*. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 108. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Mutumi, G. L., D. S. Jacobs and H. Winker (2016). Sensory drive mediated by climatic gradients partially explains divergence in acoustic signals in two horseshoe bat species, *Rhinolophus swinnyi* and *Rhinolophus simulator*. *PLoS ONE*, **11 (1):** e0148053. doi: 10.1371/journal.pone.0148053.
Mutumi, G. L., D. S. Jacobs and H. Winker (2017). The relative contribution of drift and selection to phenotypic divergence: A test case using the horseshoe bats *Rhinolophus simulator* and *Rhinolophus swinnyi*. *Ecology and Evolution*, **7:** 4299 - 4311. doi: 10.1002/ece3.2966.
Muyembe-Tamfum, J. J., S. Mulangu, J. Masumu, J. M. Kayembe, A. Kemp and J. T. Paweska (2012). Ebola virus outbreaks in Africa: Past and present. *Onderstepoort Journal of Veterinary Research*, **79 (2):** #451. doi: 10.4102/ojvr.v79i2.451.
Mwase, E. T. and A. S. Baker (2006). An annotated checklist of mites (Arachnida: Acari) of Zambia. *Zootaxa*, **1106:** 1 - 24.
Myers, P. (1978). Sexual dimorphism in size of vespertilionid bats. *American Naturalist*, **112 (986):** 701 - 711. [Abstract]
Nadachowski, A., J. Smielowski, B. Rzebik-Kowalska and A. Daoud (1990). Mammals from the Near East in Polish collections. *Acta Zoologica cracoviense*, **33 (6):** 91 - 120. [Abstract]
Nader, I. A. (1975). On the bats (Chiroptera) of the kingdom of Saudi Arabia. *Journal of Zoology*, **176:** 331 - 340. [Abstract]
Nader, I. A. (1982). New distributional records of bats from the kingdom of Saudi Arabia (Mammalia: Chiroptera). *Journal of Zoology*, **198:** 69 - 82. [Abstract]
Nader, I. A. (1985). First record of *Eidolon helvum sabaeum* (K. Andersen, 1907) for the kingdom of Saudi Arabia (Chiroptera: Pteropodidae). *Mammalia*, **49 (3):** 429 - 431. [Abstract]
Nader, I. A. and D. Kock (1980). First record of *Tadarida nigeriae* (Thomas 1913) from the Arabian peninsula (Mammalia: Chiroptera: Molossidae). *Senckenbergiana biologica*, **60 (3/4):** 131 - 135. [Abstract]
Nader, I. A. and D. Kock (1983a). A new slit-faced bat from central Saudi Arabia (Mammalia: Chiroptera: Nycteridae). *Senckenbergiana biologica*, **63 (for 1982) (1/2):** 5 - 9. [Abstract]
Nader, I. A. and D. Kock (1983b). *Rhinopoma microphyllum asirensis* n. subsp. from southwestern Saudi Arabia (Mammalia: Chiroptera: Rhinopomatidae). *Senckenbergiana biologica*, **63 (for 1982) (3/4):** 147 - 152. [Abstract]
Nader, I. A. and D. Kock (1983c). Notes on some bats from the Near East (Mammalia: Chiroptera). *Zeitschrift für Säugetierkunde*, **48:** 1-9.
Nader, I. A. and D. Kock (1987). First record of *Miniopterus schreibersi* (Kuhl 1819) (Mammalia: Chiroptera) from North Yemen with zoogeographical relationship evidenced by wing mites (Acarina: Spinturnicidae). *Senckenbergiana biologica*, **67 (4/6):** 225 - 229. [Abstract]
Nader, I. A. and D. Kock (1990). *Eptesicus* (*Eptesicus*) *bottae* (Peters, 1869) in Saudi Arabia with notes on its subspecies and distribution. *Senckenbergiana biologica*, **79 (for 1989) (1/3):** 1 - 13. [Abstract]
Nadin-Davis, S. A., L. Elmgren, M. Sheen, C. Sabeta and A. I. Wandeler (2011). Generation and characterization of a panel of anti-phosphoprotein monoclonal antibodies directed against Mokola virus. *Virus Research*, **160 (1 - 2):** 238 - 245. doi: 10.1016/j.virusres.2011.06.022.
Nagorsen, D, W., J. L. Eger and R. L. Peterson (1976). Somatic chromosomes of three African species of bats (Chiroptera), *Scotoecus hindei*, *Tadarida aegyptiaca*, and *Tadarida bemmeleni*. *Mammalian Chromosomes Newsletter*, **17 (3):** 9 - 12.
Nagy, L. Z. and L. Szántó (2003). The occurrence of hibernating *Pipistrellus pipistrellus* (Schreber, 1774) in caves of the Carpathian Basin. *Acta Chiropterologica*, **5 (1):** 155 - 160.
Nagy, Z. T., Z. C. Kusamba, G.-C. Gembu Tungaluna, A. L. Lokasola, J. Kolby and J. Kielgast (2011). Foraging acrobatics of *Toxicodryas blandingii* in the Democratic Republic of the Congo. *Herpetology Notes*, **4:** 91 - 92. URL: http://www.congobiodiv.org/sites/default/files/nagyetal_herpnotes2011.pdf.
Naidoo, S., R. L. Mackey and M. C. Schoeman (2011). Foraging ecology of insectivorous bats (Chiroptera) at a polluted and an unpolluted river in an urban landscape. *Durban Museum Novitates*, **34:** 21 - 28.
Naidoo, S., C. M. Schoeman, D. Vosloo and R. L. Mackey (2009). Effects of wastewater works on the behaviour and physiology of the insectivorous bat, *Neoromicia nanus* (Family: Vespertilionidae). 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 30. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.
Naidoo, S., D. Vosloo and M. C. Schoeman (2013a). Foraging at wastewater treatment works increases the potential for metal accumulation in an urban adapter, the banana bat (*Neoromicia nana*). *African Zoology*, **48 (1):** 39 - 55. doi: 10.3377/004.048.0111.
Naidoo, S., D. Vosloo and (M.)C. Schoeman (2013b). Foraging at wastewater treatment works increases health risks in an urban adapter, the banana bat. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 108 - 109. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Naidoo, S., D. Vosloo and M. C. Schoeman (2014). Haematological and genotoxic responses in an urban adapter, the banana bat, foraging at wastewater treatment works. *Ecotoxicology and Environmental Safety*, **114:** 304 - 311 (for 2015). doi: 10.1016/j.ecoenv.2014.04.043.
Naidoo, S., D. Vosloo and M. C. Schoeman (2015a). Pollutant exposure at wastewater treatment works affects the detoxification organs of an urban adapter, the Banana Bat. *Environmental Pollution*, **208:** 830 - 839. doi: 10.1016/j.envpol.2015.09.056.
Naidoo, T., S. M. Goodman, M. C. Schoeman, P. J. Taylor and J. M. Lamb (2016). Partial support for the classical ring species hypothesis in the *Chaerephon pumilus* species complex (Chiroptera: Molossidae) from southeastern Africa and western Indian Ocean islands. *Mammalia*, **80 (6):** 627 - 643. doi: 10.1515/mammalia-2015-0062.
Naidoo, T., M. C. Schoeman, S. M. Goodman, P. J. Taylor and J. M. Lamb (2015b). Discordance between mitochondrial and nuclear genetic structure in the bat *Chaerephon pumilus* (Chiroptera: Molossidae) from southern Africa. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **81 (2):** 115 - 122 (for 2016). doi: 10.1016/j.mambio.2015.11.002.
Naidoo, T., M. C. Schoeman, P. J. Taylor, S. M. Goodman and J. M. Lamb (2013c). Stable Pleistocene-era populations of *Chaerephon pumilus* (Chiroptera: Molossidae) in southeastern Africa do not use different echolocation calls. *African Zoology*, **48 (1):** 125 - 142. doi: 10.3377/004.048.0112.
Nakamura, S., S. Settai, H. Hayashidani, T. Urabe, S. Namai and Y. Une (2012). Outbreak of Yersiniosis in Egyptian rousette bats (*Rousettus aegyptiacus*) caused by *Yersinia pseudotuberculosis* Serotype 4b. *Journal of Comparative Pathology*, **148 (4):** 410 - 413 (for 2013). doi: 10.1016/j.jcpa.2012.07.007.
Namah, J., J. J. Midgley and L. M. Kruger (2019). Reproductive biology of the sausage tree (*Kigelia africana*) in Kruger National Park, South Africa. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **61 (1):** a1512. doi: 10.4102/koedoe.v61i1.1512.
Nameer, P. O. (2008). Checklist of bats of India (revised and updated as on June 2008 -114 species in 8 families (Simmons 05). *Bat Net Newsletter*, **9 (1):** 6 - 8.

Napier, M. C. (2013). Genetic variability of *Chaerephon atsinanana* (Chiroptera) within the context of the Afro-Malagasy Molossidae; a mitochondrial and nuclear perspective. MS Thesis - University of KwaZulu-Natal, Durban: i - viii; 1 - 66. URL: http://researchspace.ukzn.ac.za/xmlui/bitstream/handle/10413/10063/Napier_Melanie_Carmel_2013.pdf?sequence=1.

Nash, T. A. M. (1942). Bats as a source of food for *Glossina morsitans* and *G. tachinoides*. *Bulletin of Entomological Research*, **32:** 249.

Nathan, R., A. Tsoar, D. Shohami, Y. Bartan, O. Altstein and N. Ulanovsky (2010). Movement ecology of GPS-tracked *Rousettus aegyptiacus*: Bats as long-distance dispersal vectors of seeds. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 237 -238.

Naumann, R. K., S. Ray, S. Prokop, L. Las, F. L. Heppner and M. Brecht (2015). Conserved size and periodicity of pyramidal patches in layer 2 of medial/caudal entorhinal cortex. *The Journal of Comparative Neurology*, **524 (4):** 783 - 806 (for 2016). doi: 10.1002/cne.23865.

Ndara R. , B. (2014). Contribution à l'inventaire des chauves-souris dans le Rift Albertin. *International Journal of Innovation and Scientific Research*, **12 (1):** 248 - 255.

Neal, E. (1971). *Uganda Quest.* Collins, London: 127 pp.

Neaves, L. E., M. Danks, M. J. Lott, S. Dennison, G. J. Frankham, A. King, M. D. B. Eldridge, R. N. Johnson and A. Divljan (2018). Unmasking the complexity of species identification in Australasian flying-foxes. *PLoS ONE*, **13 (4):** e0194908. doi: 10.1371/journal.pone.0194908.

Negm, M. W., A. A. Mohamed, H. M. K. El-Gepaly and S. M. Abdelaziz (2018). Mesostigmata mites (Acari: Parasitiformes) associated with birds and their nests from Egypt. *Turkish Journal of Zoology*, **42 (6):** 722 - 731. doi: 10.3906/zoo-1801-24.

Negredo, A., G. Palacios, S. Vázquez-Morón, F. González, H. Dopazo, F. Molero, J. Juste, J. Quetglas, N. Savji, M. d. l. C. Martínez, J. E.. Herrera, M. Pizarro, S. K. Hutchison, J. E. Echevarría, W. I. Lipkin and A. Tenorio (2011). Discovery of an Ebolavirus-like filovirus in Europe. *PloS Pathogens*, **7(10) e1002304:** 1 - 8. doi: 10.1371/journal.ppat.1002304.

Nehring, A. (1886). *Zoologische Sammlung der Königlichen Landwirthschaftlichen Hochschule in Berlin. Katalog der Säugethiere.* Paul Parey - Berlin.

Neil, E. (2017). First sighting of a long-tailed hawk attacking a hammer-headed fruit bat. *African Journal of Ecology*, **56 (2):** 131 (for 2018). doi: 10.1111/aje.12419.

Nel, J. A. J. and H. Nolte (1965). Notes on the prey of owls in the Kalahari Gemsbok National Park, with special reference to the small mammals. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **8 (1):** 75 - 81. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/687.

Nel, J. A. J. and J. J. L. Pretorius (1971). Note on the smaller mammals of the Mountain Zebra National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **14 (1):** 99 - 110. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/719. [Abstract]

Nel, L. H. and W. Markotter (2007). Lyssaviruses. *Critical Reviews in Microbiology*, **33 (4):** 301 - 324. doi: 10.1080/10408410701647602.

Nery, M. E., D. J. González, F. G. Hoffmann and J. C. Opazo (2012). Resolution of the laurasiatherian phylogeny: Evidence from genomic data. *Molecular and Phylogenetic Evolution*, **64 (3):** 685 - 689. doi: 10.1016/j.ympev.2012.04.012.

Nesi, N. (2012). Systématique et phylogéographie des chauves-souris africaines de la sous-famille des Epomophorinae (Chiroptera, Pteropodidae). PhD Thesis - Muséum National d'Histoire Naturelle - Paris: 187 pp.

Nesi, N., D. S. Jacobs, K. Feldheim and J. M. Bishop (2015). Development and characterization of 10 microsatellite markers in the Cape horseshoe bat, *Rhinolophus capensis* (Chiroptera, Rhinolophidae) and cross-amplification in southern Africa. *BMC Research Notes*, **8:** 477. doi: 10.1186/s13104-015-1465-5.

Nesi, N., B. Kadjo, X. Pourrut, E. Leroy, C. Pongombo Shongo, C. Cruaud and A. Hassanin (2012). Molecular systematics and phylogeography of the tribe Myonycterini (Mammalia, Pteropodidae) inferred from mitochondrial and nuclear markers. *Molecular phylogenetics and evolution*, **66 (1):** 126 - 137 (for 2013). doi: 10.1016/j.ympev.2012.09.028.

Nesi, N., E. Nakouné, C. Cruaud and A. Hassanin (2011). DNA barcoding of African fruit bats (Mammalia, Pteropodidae). The mitochondrial genome does not provide a reliable discrimination between *Epomophorus gambianus* and *Micropteropus pusillus*. *Comptes Rendus Biologies*, **334 (7):** 544 - 554. doi: 10.1016/j.crvi.2011.05.003.

Neumann, O. (1900). Die von mir in den Jahren 1892-1895 in Ost- und Central-Africa, speciell in den Massai-Ländern und den Ländern am Victoria Nyansa gesammelten und beobachteten Säugethiere. *Zoologische Jahrbücher: Abteilung für Systematik*, **13:** 529 - 562.

Newman, S. H. (2011a). *Chapter 5. Significant zoonotic diseases identified in bats. Introduction.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 63. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Newman, S. H. (2011b). *Chapter 8. The global context of ensuring the health of people, wildlife, livestock and the environment.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 163 - 165. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Newman, S. H., H. Field, J. Epstein and C. de Jong [Eds] (2011). *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 1 - xii; 1 - 169. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Ng, M., E. Ndungo, M. E. Kaczmarek, A. S. Herbert, T. Binger, A. I. Kuehne, R. K. Jangra, J. A. Hawkins, R. J. Gifford, R. Biswas, A. Demogines, R. M. James, M. Yu, T. R. Brummelkamp, C. Drosten, L.-F. Wang, J. H. Kuhn, M. A. Müller, J. M. Dye, S. L. Sawyer and K. Chandran (2015). Filovirus receptor NPC1 contributes to species-specific patterns of ebolavirus susceptibility in bats. *eLife*, **4:** e11785. doi: 10.7554/eLife.11785.

Niamien, C. J. M., B. Kadjo, D. N. Dago, I. Kone and K. E. N'Goran (2017a). Spatiotemporal distribution of *Eidolon helvum* (Kerr, 1792) Near-threatened Species (Côte d'Ivoire, West Africa). *International Journal of Scientific Engineering and Applied Science*, **3 (6):** 70 - 77.

Niamien, C. J. M., B. Kadjo, N. D. Dago, I. Koné and E. K. Kouakou N'Goran (2015a). Initial data on poaching of *Eidolon helvum* (Kerr, 1792) Near-Threatened Species in Côte d'ivoire, West Africa. *European Journal of Scientific Research*, **135 (1):** 219 - 227.

Niamien, C. J. M., B. Kadjo, I. Kone and K. E. N'Goran (2015b). Données préliminaires sur la distribution spatio-temporelle des chauves-souris à tête de marteau, *Hypsignathus monstrosus* H. Allen, 1861 dans la commune du Plateau (Abidjan, Côte d'Ivoire). *Afrique Science*, **11 (1):** 227 - 236.
Niamien, C. J. M., B. Kadjo, K. X. H. Koné and K. E. N'Goran (2017b). Ressources alimentaires de *Eidolon helvum* (Kerr, 1792), espèce proche de la menace (Abidjan, Côte d'Ivoire). *European Scientific Journal*, **13 (3):** 182 - 196.
Niamien, C. J. M., H. K. Yaokokoré-Béibro, I. Koné and K. E. N'Goran (2010). Données préliminaires sur l'écologie des chauves-souris frugivores de la commune du Plateau (Abidjan, Côte d'Ivoire). *Sciences and Nature*, **7 (1):** 21 - 30. URL: http://www.ajol.info/index.php/scinat/article/viewFile/59915/48188.
Niamien, C. J. M., H. K. Yaokokoré-Béibro, I. Koné, S. S. Yao and E. K. N'Goran (2009). Données préliminaires sur les habitudes alimentaires des chauves-souris paillées, *Eidolon helvum* (Kerr, 1792) (Chiroptera: Pteropodidae) de la commune d'Abidjan plateau (Côte d'Ivoire). *Agronomie Africaine*, **21 (3):** 231 - 240.
Nicoll, M. E. and P. A. Racey (1981). The Seychelles fruit bat, *Pteropus seychellensis seychellensis*. *African Journal of Ecology*, **19 (4):** 361 - 364. doi: 10.1111/j.1365-2028.1981.tb01073.x.
Nicoll, M. E. and J. M. Suttie (1982). The sheath-tailed bat, *Coleura seychellensis* (Chiroptera: Emballonuridae) in the Seychelles Islands. *Journal of Zoology*, **197:** 421 - 426.
Nicoll, M. J. (1908). *Three voyages of a naturalist being an account of many little-known islands in three oceans visited by the "Valhalla" R.Y.S.* Witherby & Co. London: i - xxvi; 1 - 246.
Nie, F.-Y., X.-D. Lin, Z.-Y. Hao, X.-N. Chen, Z.-X. Wang, M.-R. Wang, J. Wu, H.-W. Wang, G. Zhao, R. Z. Ma, E. C. Holmes and Y.-Z. Zhang (2017). Extensive diversity and evolution of hepadnaviruses in bats in China. *Virology*, **514:** 88 - 97 (for 2018). doi: 10.1016/j.virol.2017.11.005.
Niethammer, G. (1964). *Alexander Koenigs Reisen am Nil.* Bonn.
Nieto-Rabiela, F., G. Suzán, A. Wiratsudakul and O. Rico-Chávez (2018). Viral metacommunities associated to bats and rodents at different spatial scales. *Community Ecology*, **19 (2):** 168 - 175. doi: 10.1556/168.2018.19.2.9.
Nikaido, M., K. Kawai, Y. Cao, M. Harada, S. Tomita, N. Okada and M. Hasegawa (2001). Maximum likelihood analysis of the complete mitochondrial genomes of Eutherians and a reevaluation of the phylogeny of bats and insectivores. *Journal of Molecular Evolution*, **53:** 508 - 516. doi: 10.1007/s002390010241.
Nina, J. (2014). Ebolavirosis: a 2014 review for clinicians. *Acta Médica Portuguesa*, **27 (5):** 625 - 633.
Niort, P. L. (1970). Contribution à la connaissance des chiroptères du Burundi (Afrique Centrale). *Annalen van de Koninklijke Vereniging voor Dierkunde*, **100:** 247 - 274. [Abstract]
Nkoghe, D., E. M. Leroy, M. Toung-Mve and J. P. Gonzalez (2012). Cutaneous manifestations of filovirus infections. *International Journal of Dermatology*, **51 (9):** 1037 - 1043.
Nkrumah, E. E., E. K. Badu, H. J. Baldwin, P. Anti, S. M. Klose, P. Vallo, C. Drosten, E. K. V. Kalko, S. K. Oppong and M. Tschapka (2017). Flight activity of Noack's round-leaf bat (*Hipposideros* cf. *ruber*) at two caves in central Ghana, West Africa. *Acta Chiropterologica*, **19 (2):** 347 - 355. doi: 10.3161/15081109ACC2017.19.2.011.
Nkrumah, E. E., B. A. Opoku, E. K. Badu, E. Danquah, M. Tschapka and S. K. Oppong (2018). Estimating bat abundance and diversity in a modified tropical environment in central Ghana. *Tropical Ecology*, **58 (4):** 751 - 759 (for 2017).
Nkrumah, E. E., P. Vallo, S. M. Klose, S. Ripperger, E. K. Badu, C. Drosten, E. K. V. Kalko, M. Tschapka and S. K. Oppong (2016a). Home range of Noack's round-leaf bat (*Hipposideros* aff. *ruber*) in an agricultural landscape of central Ghana. *Acta Chiropterologica*, **18 (1):** 239 - 247. doi: 10.3161/15081109ACC2016.18.1.014.
Nkrumah, E. E., P. Vallo, S. M. Klose, S. P. Ripperger, E. K. Badu, F. Gloza-Rausch, C. Drosten, E. K. V. Kalko, M. Tschapka and S. K. Oppong (2016b). Foraging behavior and habitat selection of Noack's Round-Leaf Bat (*Hipposideros* aff. *ruber*) and conservation implications. *Tropical Conservation Science*, **9 (4):** 1 - 11. doi: 10.1177/1940082916680428.
Noack, Th. (1887). Beiträge zur Kenntnis der Säugethier-Fauna von Ost- und Central-Afrika. Nach Sammlungen und Aufzeichnungen des verstorbenen Dr. Richard Böhm. *Zoologische Jahrbücher: Abteilung für Systematik*, **2 (2):** 193 - 302. [Abstract]
Noack, Th. (1889). Beiträge zur Kenntnis der Säugethierfauna von Süd- und Südwest-Afrika. *Zoologische Jahrbücher: Abteilung für Systematik*, **4:** 94 - 261. [Abstract]
Noack, Th. (1891). Beiträge zur Kenntnis der Säugethier-Fauna von Ostafrika. *Jahrbuch des Hamburgischen Wissenschaftlichen Anstalten*, **9:** 1 - 88.
Noack, Th. (1893). ?? Title still needs to be checked. ?? *Zoologische Jahrbücher: Abteilung für Systematik, Oekologie und Geografie der Tiere*7.
Noemec, P., M. Lucova, H. Skalova and I. Horácek (2004). Bearing of neuromorphological traits on reconstruction of chiropteran phylogy. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 8.
Noer, C. L., T. Dabelsteen, K. Bohmann and A. Monadjem (2012). Molossid bats in an African agro-ecosystem select sugarcane fields as foraging habitat. *African Zoology*, **47 (1):** 1 - 11. doi: 10.3377/004.047.0120.
Nogales, M., J. L. Rodríguez-Luengo and P. Marrero (2006). Ecological effects and distribution of invasive non-native mammals in the Canary Islands. *Mammal Review*, **36 (1):** 49 - 65. doi: 10.1111/j.1365-2907.2006.00077.x.
Norberg, U. M. (1972). Functional osteology and myology of the wing of the dog-faced bat *Rousettus aegyptiacus* (É. Geoffroy) (Mammalia Chiroptera). *Zeitschrift für Morphologie de Tiere*, **73 (4):** 1 - 44. [Abstract]
Noroalintseheno Lalarivoniaina, O. S., F. I. Rajemison, A. Andrianarimisa and S. M. Goodman (2018). Variation saisonnière de la structure d'âge et de la sex-ratio de la population de *Rousettus madagascariensis* (Yinpterochiroptera: Pteropodidae) à Ankarana, nord de Madagascar. *Revue d'Ecologie (la Terre et la Vie)*, **73 (1):** 23 - 30.
Norris, R. W., J. Decher and J. Schaer (2015). The past and future of bat research in West Africa. 95th annual meeting of the American Society of Mammalogists - 12 - 16 June 2015 - Jacksonville, Florida: 82 - 83.
Nos, R. (1961). D. Juan Bautista de Aguilar-Amat y Banús. *Miscellánia Zoologia (Barcelona)*, **1:** 147 - 190.
Novacek, M. J. (1987). Auditory features and Affinities of the Eocene Bats *Icaronycteris* and *Palaeochiropteryx* (Microchiroptera, incertae sedis). *American Museum Novitates*, **2877:** 1 - 18, 10 figs. [Abstract]
Novacek, M. J. (1991). Aspects of the morphology of the cochlea in Microchiropteran bats: An investigation of character transformation. In Griffiths, T. A. and D. Klingerer : *Contributions to Mammalogy in honor of Karl F. Koopman. Bulletin of the American Museum of Natural History*, **206:** 84 - 100.
Novick, A. (1958). Notes on an additional example of the fruit bat, *Scotonycteris ophiodon* Pohle. *Postilla*, **34:** 1 - 5. doi: 10.1002/jez.1401380105.
Novick, J. (1960). A small collection of bats from Angola. *Journal of Mammalogy*, **3 (41):** 395.
Novick A. (1958). Orientation in palaeotropical bats. I. Microchiroptera. *Journal of Experimental Zoology*, **138:** 81 - 153, 3 pls.

Nowak, K., J. Fahr, N. Weber, A. Lübke-Becker, T. Semmler, S. Weiss, J.-V. Mombouli, L. H. Wieler, S. Guenther, F. H. Leendertz and C. Ewers (2017). Highly diverse and antimicrobial susceptible *Escherichia coli* display a naïve bacterial population in fruit bats from the Republic of Congo. *PLoS ONE*, **12 (7):** e0178146. doi: 10.1371/journal.pone.0178146.
Nowak, R. M. (1994). *Walker's Bats of the World.* The John Hopkins University Press - Baltimore & London: i - vi; 1 - 288.
Nowak, R. M. (1999). *Walker's Mammals of the World.* The Johns Hopkins University Press, Baltimore, USA and London, UK.
Nowak, R. M. and J. L. Paradiso (1983). *Mammals of the world.* The John Hopkins University Press - Baltimore & London: 1 - 568.
Nwoha, P. U. (2000). Sex differences in the bony pelvis of the fruit-eating bat, *Eidolon helvum*. *Folia Morphologica*, **59 (4):** 291 - 295.
Nwoha, P. U., A. E. Caxton-Martins and D. L. Baxter-Grillo (2000). The os penis of the frugivorous bat, *Eidolon helvum* (Kerr). *Folia Morphologica*, **59 (3):** 153 - 156.
Nyffeler, M. and M. Knörnschild (2013). Bat predation by spiders. *PLoS ONE*, **8 (3):** e58120. doi: 10.1371/journal.pone.0058120.
Nyhagen, D. F. (2004). A study of the bat-fruit syndrome on Mauritius, Indian Ocean. *Phelsuma*, **12:** 118 - 125. URL: http://islandbiodiversity.com/Phelsuma%2012-5.pdf.
Nyhagen, D. F., S. D. Turnbull, J. M. Olesen and C. G. Jones (2005). An investigation into the role of the Mauritian flying fox, *Pteropus niger*, in forest regeneration. *Biodiversity and conservation*, **122 (3):** 491 - 497. doi: 10.1016/j.biocon.2004.08.012.
Oakeley, S.(F.) (1998). *Annotated list of type specimens of Mammalia in NMB.* 8 pp. URL: http://www.nmb.bs.ch/NaturmuseumBasel/LinksNMB/Sammlung/Kataloge/Mammalia.pdf.
Obame-Nkoghe, J., E. M. Leroy and C. Paupy (2017). Diversity and role of cave-dwelling hematophagous insects in pathogen transmission in the Afrotropical region. *Emerging microbes & infections*, **6:** e20. doi: 10.1038/emi.2017.6.
Obame-Nkoghe, J., N. Rahola, M. Bourgarel, P. Yangari, F. Prugnolle, G. D. Maganga, E.-M. Leroy, D. Fontenille, D. Ayala and C. Paupy (2016). Bat flies (Diptera: Nycteribiidae and Streblidae) infesting cave-dwelling bats in Gabon: diversity, dynamics and potential role in *Polychromophilus melanipherus* transmission. *Parasites & Vectors*, **9:** 333. doi: 10.1186/s13071-016-1625-z.
Ober, H. K., E. C. Braun de Torrez, J. A. Gore, A. M. Bailey, J. K. Myers, K. N. Smith and R. A. McCleery (2016). Social organization of an endangered subtropical species, Eumops floridanus, the Florida bonneted bat. *Mammalia*, **81 (4):** 375 - 383 (for 2017). doi: 10.1515/mammalia-2015-0183.
O'Brien, J. (2011). Bats of the Western Indian Ocean Islands. *Animals*, **1 (3):** 259 - 290. doi: 10.3390/ani1030259.
O'Brien, J. and T. J. Hayden (2004). The application of genetic research to the conservation of fruit bats in the western Indian Ocean. *Phelsuma*, **12:** 141 - 146. doi: http://islandbiodiversity.com/Phelsuma%2012-8.pdf.
O'Brien, J., C. Mariani, L. Olson, A. L. Rusell, L. Say, A. D. Yoder and T. J. Hayden (2009). Multiple colonisations of the western Indian Ocean by *Pteropus* fruit bats (Megachiroptera: Pteropodidae): The furthest islands were colonised first. *Phylogeography and Evolution*, **51 (2):** 294 - 303.
O'Brien, J., G. F. McCracken, L. Say and T. J. Hayden (2007). Rodrigues fruit bats (*Pteropus rodricensis*, Megachiroptera: Pteropodidae) retain genetic diversity despite population declines and founder events. *Conservation Genetics*, **8 (5):** 1073 - 1082. doi: 10.1007/s10592-006-9263-1. URL: http://www.springerlink.com/content/27q0817j3224q6u1/.
Odebuyi, J. A., S. O. Bada, A. A. Omoloye, R. O. Awodoyin and P. I. Oni (2004). Vertebrate and insect pests and hemi-parasitic plants of *Parkia biglobosa* and *Vitellaria paradoxa* in Nigeria. *Agroforestry Systems*, **60:** 51 - 59.
Odendaal, L. J. and D. S. Jacobs (2009). Geographic variation in the echolocation calls of the endemic Cape Horseshoe bat, *Rhinolophus capensis* (Chiroptera: Rhinolophidae). 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 62. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.
Odendaal, L. J. and D. S. Jacobs (2010a). Morphological correlates of echolocation frequency in the endemic Cape horseshoe bat, *Rhinolophus capensis* (Chiroptera: Rhinolophidae). *Journal of Comparative Physiology*, **A 197 (5):** 435 - 446 (for 2011). doi: 10.1007/s00359-010-0601-x.
Odendaal, L. J. and D. S. Jacobs (2010b). Geographic variation in echolocation calls of the endemic *Rhinolophus capensis*. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 239 - 240.
Odendaal, L. (J.), D. (S.) Jacobs and J. Bishop (2013). Echolocation divergence in horseshoe bats despite extensive gene flow. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 112. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Odendaal, L. J., D. S. Jacobs and J. M. Bishop (2014). Sensory trait variation in an echolocating bat suggests roles for both selection and plasticity. *BMC Evolutionary Biology*, **14:** 60. doi: 10.1186/1471-2148-14-60.
Odukoya, S. A., O. A. Adeeyo, D. A. Ofusori, O. A. Ayoka, O. P. Oluwayinka, A. J. Akinyeye, G. B. Ojo, A. E. Ashamu and L. S. Babatunde (2009a). Partial septate uterus and tubal implantation: a normal phenomenon in the *Eidolon helvum*. *Scientific Research and Essay*, **4 (1):** 013 - 017.
Odukoya, S. A., O. A. Adeeyo, D. A. Ofusori, A. E. Caxton-Martins, O. A. Ayoka, O. O. Oyewo, L. S. Babatunde, U. A. Yusuf, A. A. Adegoke and Ishola. O. O. (2008). Histological investigation of the pregnant and non pregnant uterine limbs of the frugivorous bat (*Eidolon helvum*). *International Journal of Integrative Biology*, **3 (4):** 169 - 174.
Odukoya, S. A., D. A. Ofusori, O. A. Adeeyo, O. A. Ayoka, T. A. Abayomi, S. A. Ajayi and B. A. Falana (2009b). Comparative biochemical studies of the pregnant and non pregnant uterine limbs of the frugivorous bat, *Eidolon helvum*. *Journal of Cell and Animal Biology*, **3 (10):** 175 - 178.
Oelofsen, M. J. and M. S. Smith (1993). Rabies and bats in a rabies-endemic area of southern Africa: application of two commercial test kits for antigen and antibody detection. *Onderstepoort Journal of Veterinary Research*, **60:** 257 - 260. [Abstract]
Oelofsen, M. J. and E. Van der Ryst (1999). Could bats act as reservoir hosts for Rift valley fever virus?. *Onderstepoort Journal of Veterinary Research*, **66:** 51 - 54.
Ofusori, D. A., E. A. Caxton-Martins, O. O. Komolafe, K. A. Oluyemi, O. A. Adeeyo, S. A. Ajayi, P. O. Oluwayinka, E. A. Adelakun, S. T. Keji and O. A. Adesanya (2008). A comparative study of the ileum in Rat (*Rattus norvegicus*), bat (*Eidolon helvum*) and Pangolin (*Manis tricuspis*) as investigated using histological methods. *International Journal of Morphology*, **26 (1):** 137 - 141.
Ogawa, H., M. Kajihara, N. Nao, A. Shigeno, D. Fujikura, B. M. Hang'ombe, A. S. Mweene, A. Mutemwa, D. Squarre, M. Yamada, H. Higashi, H. Sawa and A. Takada (2017). Characterization of a novel bat adenovirus isolated from straw-colored fruit bat (*Eidolon helvum*). *Viruses*, **9 (12):** 371. doi: 10.3390/v9120371.

Ogawa, H., N. Koizumi, A. Ohnuma, A. Mutemwa, B. M. Hang'ombe, A. S. Mweene, A. Takada, C. Sugimoto, Y. Suzuki, H. Kida and H. Sawa (2015a). Molecular epidemiology of pathogenic *Leptospira* spp. in the straw-colored fruit bat (*Eidolon helvum*) migrating to Zambia from the Democratic Republic of Congo. *Infection, Genetics and Evolution*, **32:** 143 - 147. doi: 10.1016/j.meegid.2015.03.013.

Ogawa, H., H. Miyamoto, E. Nakayama, R. Yoshida, I. Nakamura, H. Sawa, A. Ishii, Y. Thomas, E. Nakagawa, K. Matsuno, M. Kajihara, J. Maruyama, N. Nao, M. Muramatsu, M. Kuroda, E. Simulundu, K. Changula, B. Hang'ombe, B. Namangala, A. Nambota, J. Katampi, M. Igarashi, K. Ito, H. Feldmann, C. Sugimoto, L. Moonga, A. Mweene and A. Takada (2015b). Seroepidemiological prevalence of multiple species of filoviruses in fruit bats (*Eidolon helvum*) migrating in Africa. *The Journal of Infectious Diseases*, **Xxx (x):** xxx - xxx. doi: 10.1093/infdis/jiv063.

Ogen-Odoi, A. A. (1981). *The influence of seasonality of food and rainfall on some aspects of the ecology of bats on Entebbe Penninsular, Uganda. African Small Mammal Newsletter*13. [Abstract]

Ogen-Odoi, A. A. (1983). The influence of seaonality of food and rainfall on some aspects of ecology of bats in Entebbe Peninsula, Uganda. In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 35 - 41. [Abstract]

Ogilby, W. (1835). Descriptions of mammalia and birds from Gambia. *Proceedings of the Zoological Society of London*, **1835, III (xxxi):** 97 - 107.

Ogilvie, P. W. and M. B. Ogilvie (1964). Observations of a roost of yellow or giant fruit-eating bats, *Eidolon helvum*. *Journal of Mammalogy*, **45:** 309 - 311.

Ognev, S. I. (1927). A synopsis of the Russian bats. *Journal of Mammalogy*, **8:** 140 - 157. [Abstract]

Ognev, S. I. (1928). *Mammals of eastern Europe and Northern Asia [Zveri vostochnoi Evropy i severnoi Azii]. Vol I. Insectivora and Chiroptera.* Israel Program for Scientific Translations - Jerusalem 1962.

Ognev, S. I. (1937). ?? Title still needs to be checked. ?? .

Ohemeng, F., J. S. Ayivor, E. T. Lawson and Y. Ntiamoa-Baidu (2018). Local classifications of fever and treatment sought among populations at risk of zoonotic diseases in Ghana. *PLoS ONE*, **13 (8):** e0201526. doi: 10.1371/journal.pone.0201526.

Ohemeng, F., E. T. Lawson, J. (S.) Ayivor, M. Leach, L. Waldman and Y. Ntiamoa-Baidu (2017). Socio-cultural Determinants of Human–Bat Interactions in Rural Ghana. *Anthrozoös*, **30 (2):** 181 - 194. doi: 10.1080/08927936.2017.1310984.

Ohlendorf, B. (1997). *Arbeitskreis Fledermäuse Sachsen-Anhalts e. v.: Tagungsband "Zur Situation der Hufeisennasen in Europa". Nebra 1995.* IFA Verlag, Berlin, Germany.

Ohlendorf, B. (1999). Zur korrekten Schreibweise der naturwissenschaftlichen Namen europäischer Fledermausarten. *Nyctalus (Neue Form), Berlin*, **7 (2):** 193 - 195.

Okafor, F. C. (1988). *Oochoristica agamae* Baylis, 1919 (Eucestoda, Linstowiidae) in one reptile and two bat species from Nsukka (Anambra State, Nigeria). *Miscellánia Zoologia (Barcelona)*, **12:** 11 - 15. [Abstract]

Okafor, F. C., I. B. Igbinosa and H. M. G. Ezenwaji (2004). Helminth fauna of *Tadarida (Chaeraphon) nigeriae* (Thomas, 1913) (Microchiroptera: Molossidae). *Animal Research International*, **1 (1):** 64 - 69.

Oken (1816). Lehrbuch der Naturgeschichte. 3. Teil. Zoologie. 2. Abteilung. Fleischthiere. .

Okia, N. O. (1974a). The breeding pattern of the Eastern Epauletted bat, *Epomophorus anurus* Heuglin, in Uganda. *Journal of Reproduction and Fertility*, **37 (1):** 27 - 31. [Abstract]

Okia, N. O. (1974b). Breeding in Franquet's bat, *Epomops franqueti* (Tomes), in Uganda. *Journal of Mammalogy*, **55 (2):** 462 - 465.

Okia, N. O. (1987). Reproductive cycles of East African bats. *Journal of Mammalogy*, **68 (1):** 138 - 141.

Okon, E. E. (1974). Fruit bats at Ife: Their roosting and food preferences. *The Nigerian Field*, **39:** 33 - 40.

Olatimehin, A., A. O. Shittu, F. C. Onwugamba, A. Mellmann, K. Becker and F. Schaumburg (2018). *Staphylococcus aureus* complex in the straw-colored fruit bat (*Eidolon helvum*) in Nigeria. *Frontiers in Microbiology*, **9:** 162. doi: 10.3389/fmicb.2018.00162.

Olayemi, F. O., O. A. Fagbohun, C. O. Aiki-Raji, D. O. Oluwayelu, O. O. Roberts and B. O. Emikpe (2006). Haematology of the African fruit bat (*Eidolon helvum*). *Tropical Veterinarian*, **24 (4):** 81 - 84.

Olds, J. E., E. R. Burrough, A. J. Fales-Williams, A. Lehmkuhl, D. Madson, A. J. Patterson and M. J. Yaeger (2015). Retrospective evaluation of cases of neoplasia in a captive population of Egyptian fruit bats (*Rousettus aegyptiacus*). *Journal of Zoo and Wildlife Medicine*, **46 (2):** 325 - 332. doi: 10.1638/2014-0069R2.1.

Oleksy, R. Z., C. L. Ayady, V. Tatayah, C. Jones, J. S. P. Froidevaux, P. A. Racey and G. Jones (2018). The impact of the Endangered Mauritian flying fox *Pteropus niger* on commercial fruit farms and the efficacy of mitigation. *Oryx*, **Xxx:** xxx - xxx (8 pp) (for 2019). doi: 10.1017/S0030605318001138.

Oleksy, R. Z., C. L. Ayady, V. Tatayah, C. Jones, P. W. Howey, J. S. P. Froidevaux, P. A. Racey and G. Jones (2019). The movement ecology of the Mauritian flying fox (*Pteropus niger*): a long-term study using solar-powered GSM/GPS tags. *Movement Ecology*, **7:** 12. doi: 10.1186/s40462-019-0156-6.

Oleksy, R. (Z.), L. Giuggioli, T. J. McKetterick, P. A. Racey and G. Jones (2017). Flying foxes create extensive seed shadows and enhance germination success of pioneer plant species in deforested Madagascan landscapes. *PLoS ONE*, **12 (9):** e0184023. doi: 10.1371/journal.pone.0184023.

Oleksy, R. (Z.) and G. Jones (2013). The role of *Pteropus rufus* in forest regeneration in Madagascar. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 113. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Oleksy, R. (Z.), P. A. Racey and G. Jones (2015a). High-resolution GPS tracking reveals habitat selection and the potential for long-distance seed dispersal by Madagascan flying foxes *Pteropus rufus*. *Global Ecology and Conservation*, **3:** 678 - 692. doi: 10.1016/j.gecco.2015.02.012.

Oleksy, R. (Z.), F. Randrianandrianina and R. K. B. Jenkins (2015b). Commercial hunting of foraging bats in western Madagascar. *African Bat Conservation News*, **37:** 3 - 5.

Olival, K. J. (2015). To cull, or not to cull, bat is the question. *EcoHealth*, **13 (1):** 6 - 8 (for 2016). doi: 10.1007/s10393-015-1075-7.

Olival, K. J. and D. T. S. Hayman (2014). Filoviruses in bats: current knowledge and future directions. *Viruses*, **6 (4):** 1759 - 1788. doi: 10.3390/v6041759.

Olive, M.-M., S. M. Goodman and J.-M. Reynes (2012). The role of wild mammals in the maintenance of Rift Valley fever virus. *Journal of wildlife diseases*, **48 (2):** 241 - 266.

Oliveira, R. C. d., A. Guterres, J. Fernandes, P. S. D'Andrea, C. R. Bonvicino and E. R. S. d. Lemos (2014). Hantavirus Reservoirs: current status with an emphasis on data from Brazil. *Viruses*, **6 (5):** 1929 - 1973. doi: 10.3390/v6051929.

Oliver, J. H. Jr. and J. E. Keirans (2000). Dedication to Harry Hoogstraal 1917 - 1986. *Journal of parasitology*, **86 (5):** 897 - 898. doi: 10.1645/0022-3395(2000)086[0897:DTHH]2.0.CO;2.
Olivero, J., J. E. Fa, R. Real, A. L. Márquez, M. A. Farfán, J. M. Vargas, D. Gaveau, M. A. Salim, D. Park, J. Suter, S. King, S. A. Leendertz, D. Sheil and R. Nasi (2017). Recent loss of closed forests is associated with Ebola virus disease outbreaks. *Scientific Reports*, **7:** 14291. doi: 10.1038/s41598-017-14727-9.
Olivier, E. (1909). *Rhinopoma microphyllum* en Tunisie. *Bulletin de la Société zoologique de France*, **34:** 148.
Ollivier, F. J., D. A. Samuelson, D. E. Brooks, P. A. Lewis, M. E. Kallberg and A. M. Komaromy (2004). Comparative morphology of the tapetum lucidum (among selected species). *Veterinary Ophthalmology*, **7:** 11 - 22.
Olson, D. M., E. Dinerstein, E. D. Wikrmanayake, N. D. Burgess, G. V. N. Powell, E. C. Underwood, J. A. D'amico, I. Itoua, H. E. Strand, J. C. Morrison, C. J. Loucks, T. F. Allnutt, T. H. Ricketts, Y. Kura, J. F. Lamoreux, W. W. Wettengel, P. Hedao and K. R. Kassem (2001). Terrestrial ecoregions of the world: a new map of life on earth. *BioScience*, **51 (11):** 933 - 938.
Olsson, A., D. Emmett, D. Henson and E. Fanning (2006). Activity patterns and abundance of microchiropteran bats at a cave roost in south-west Madagascar. *African Journal of Ecology*, **44 (3):** 401 - 403. doi: 10.1111/j.1365-2028.2006.00661.x.
Oluduro, A. O. (2012). Antibiotic-resistant commensal *Escherichia coli* in faecal droplets from bats and poultry in Nigeria. *Veterinaria Italiana*, **48 (3):** 297 - 308.
Olufemi, O. T., J. U. Umoh, A. Dzikwi, Y. O. Olufemi, T. M. Hamisu, T. A. Delia and A. O. Shaibu (2018). Screening for viral proteins to some emerging viruses in African straw-coloured fruit bats (*Eidolon Helvum*) captured in Zaria, Nigeria. *International Journal of Infectious Diseases*, **73 (Suppl.):** 192. doi: 10.1016/j.ijid.2018.04.3849.
O'Mara, M. T., K. Bauer, D. Blank, J. W. Baldwin and D. K. N. Dechmann (2016). Common noctule bats are sexually dimorphic in migratory behaviour and body size but not wing shape. *PLoS ONE*, **11 (11):** e0167027. doi: 10.1371/journal.pone.0167027.
O'Mara, M. T., A. K. Scharf, J. Fahr, M. Abedi-Lartey, M. Wikelski, D. K. N. Dechmann and K. Safi (2019a). Overall dynamic body acceleration in straw-colored fruit bats increases in headwinds but not with airspeed. *Frontiers in Ecology and Evolution*, **7:** 200. doi: 10.3389/fevo.2019.00200.
O'Mara, M. T., M. Wikelski, B. Kranstauber and D. K. N. Dechmann (2019b). Common noctules exploit low levels of the aerosphere. *Royal Society Open Science*, **6 (2):** 181942. doi: 10.1098/rsos.181942.
Omatsu, T., E.-J. Bak, Y. Ishii, S. Kyuwa, Y. Tohya, H. Akashi and Y. Yoshikawa (2008). Induction and sequencing of Rousette bat interferon a and ß genes. *Veterinary Immunology and Immunopathology*, **124 (1-2):** 169 - 176. doi: 10.1016/j.vetimm.2008.03.004.
Omoleke, S. A., I. Mohammed and Y. Saidu (2016). Ebola viral disease in West Africa: A threat to global health, economy and political stability. *Journal of Public Health in Africa*, **7 (1) 534:** 27 - 40. doi: 10.4081/jphia.2016.534.
Orozco, J. , Philips, T. K. (2012). *Pachnoda marginata* (Drury) (Coleoptera: Scarabaeidae: Cetoniinae) Developing in Bat Guano in a West African Cave. *The Coleopterists Bulletin*, **66 (4):** 378 - 379. doi: 10.1649/072.066.0417.
Orr, T. J. and M. Zuk (2013). Does delayed fertilization facilitate sperm competition in bats? *Behavioral ecology and sociobiology*, **67 (12):** 1903 - 1913. doi: 10.1007/s00265-013-1598-2.
Orr, T. J. and M. Zuk (2014). Reproductive delays in mammals: an unexplored avenue for post-copulatory sexual selection. *Biological Reviews*, **89 (4):** 889 - 912. doi: 10.1111/brv.12085.
Ortlepp, R. J. (1932). Some helminths from South Africa chiroptera. 18th Report of the Director of Veterinary Sciences and Animal Industry, Union of South Africa.
Osborn, D. J. (1988). New bat records from the Red Sea Mountains of Egypt. *Mammalia*, **52 (4):** 596 - 598.
Osborn, D. J. and I. Helmy (1980). The contemporary land mammals of Egypt (including Sinai). *Fieldiana: zoology*N.S., 5 (1309).
Osborn, H. F. (1919). The Congo expedition of the American Museum of Natural History. *Bulletin of the American Museum of Natural History*, **39:** xv - xxviii. doi: 10.5962/bhl.title.53716.
Osborne, C., P. M. Cryan, T. J. O'Shea, . L. M. Oko, C. Ndaluka, C. H. Calisher, A. D. Berglund, M. L. Klavetter, R. A. Bowen, K. V. Holmes and S. R. Dominguez (2011). Alphacoronaviruses in New World bats: Prevalence, persistence, phylogeny, and potential for interaction with humans. *PLoS ONE*, **6 (5) e19156:** 1 - 11. doi: 10.1371/journal.pone.0019156.
O'Shea, T. J. (1980). Roosting, Social organization and the annual cycle in a Kenya population of the bat *Pipistrellus nanus*. *Zeitschrift für Tierpsychologie - Journal of Comparative Ethology*, **53 (2):** 171 - 195. [Abstract]
O'Shea, T. J., P. M. Cryan, A. A. Cunningham, A. R. Fooks, D. T. S. Hayman, A. D. Luis, A. J. Peel, R. K. Plowright and J. L. N. Wood (2014). Bat flight and zoonotic viruses. *Emerging Infectious Diseases*, **20 (5):** 741 - 745. doi: 10.3201/eid2005.130539.
O'Shea, T. J., P. M. Cryan, D. T. S. Hayman, R. K. Plowright and D. G. Streicker (2016). Multiple mortality events in bats: a global review. *Mammal Review*, **xxx (x):** xxx - xxx. doi: 10.1111/mam.12064.
O'Shea, T. J. and T. A. Vaughan (1980). Ecological observations on an East African bat community. *Mammalia*, **44 (4):** 485 - 496. [Abstract]
Ospina-Garcés, S. M. and E. De Luna (2017). Phylogenetic analysis of landmark data and the morphological evolution of cranial shape and diets in species of *Myotis* (Chiroptera: Vespertilionidae). *Zoomorphology: evolutionary, comparative and functional morphology*, **136 (2):** 251 - 265. doi: 10.1007/s00435-017-0345-z.
Ossa, G., S. Kramer-Schadt, A. J. Peel, A. K. Scharf and C. C. Voigt (2012). The movement ecology of the straw-colored fruit bat, *Eidolon helvum*, in Sub-Saharan Africa assessed by stable isotope ratios. *PLoS ONE*, **7 (9) e45729:** 1 - 9. doi: 10.1371/journal.pone.0045729.
Ossa Gómez, G. (2012). Establishing an isotopic basemap for flying foxes in Central Africa to assess the movement ecology of the straw-coloured fruit bat *Eidolon helvum* (Kerr, 1792). Master's thesis - Natural Heritage and Society (MNHN Paris) / Leibniz Institute for Zoo and Wildlife Research, Berlin, Germany: 51 pp. URL: http://https://www.researchgate.net/publication/236111456_Establishing_an_isotopic_basemap_for_flying_foxes_in_Central_Africa_to_assess_the_movement_ecology_of_the_straw-coloured_fruit_bat_Eidolon_helvum_%28Kerr_1792%29.
Ouahbi, Y., M. Aberkan and F. Serre (2003). Recent Quaternary fossil mammals of Chrafate and Ez Zarka. The origin of modern fauna in the Northern Rif (NW Morocco, Northern Africa). *Geologica Acta*, **1 (3):** 277 - 288.
Oubaziz, B. (2012). Recherches écologiques sur les Chiroptères de l'extême Ouest algérien: habitat, répartition et statut. Master's thesis - Abou Bekr Belkaid University, Tlemcen, Algeria: 223 pp. URL: dspace.univ-tlemcen.dz/handle/112/2280?.
Oustalet, E. (1894). Les mammifères et les oiseaux d'Obock et du pays des çomalis, (Première partie). *Mémoire de la Société zoologique de France*, **7 (1):** 73 - 78. [Abstract]

Overal, W. L. and L. R. Wingate (1976). The biology of the batbug *Stricticimex antennatus* (Hemiptera: Cimicidae) in South Africa. *Annals of the Natal Museum / Annale van die Natal museum*, **22 (3):** 821 - 828. [Abstract]
Owen, R. D., R. K. Chesser and D. C. Carter (1990). The systematic status of *Tadarida brasiliensis cynocephala* and Antillean members of the *Tadarida brasiliensis* group, with comments on the generic name *Rhizomops* Legendre. *Occasional Papers of the Museum, Texas Tech University*, **133:** 1 - 18.
Owen, R. D. and M. B. Qumsiyeh (1987). The subspecies in the Trident leaf-nosed bat, *Asellia tridens*: homomorphism in widely separated populations. *Zeitschrift für Säugetierkunde*, **52:** 329 - 337. [Abstract]
Owen, R. D. and W. D. Webster (1983). Morphological variation in the Ipanema bat, *Pygoderma bilabiatum*, with description of a new subspecies. *Journal of Mammalogy*, **64 (1):** 146 - 149.
Owen-Ashley, N. T. and D. E. Wilson (1998). *Micropteropus pusillus*. *Mammalian Species*, **577:** 1 - 5, 3 figs.
Padial, J. M. and C. Ibáñez (2005). New records and comments for the Mauritanian mammal fauna. *Mammalia*, **69 (2):** 239 - 243.
Pagel, Th. (2005). Eine Reise in das Land der Berggorillas: Uganda. *Zeitschrift Kölner Zoo*, **48 (3):** 107 - 130.
Pagenstecher, H. A. (1885a). 7. *Megaloglossus Woermanni* nov. gen. et spec. *Zoologischer Anzeiger*, **8 (193):** 245.
Pagenstecher, H. A. (1885b). Die von Dr. G.A. Fischer auf der in Auftrage des geographischen Gesellschaft in Hamburg unternommenen Reise in das Massai-Land gesammelten Säugethiere. *Jahrbuch des Hamburgischen Wissenschaftlichen Anstalten*, **2:** 31 - 46. [Abstract]
Pagenstecher, H. A. (1885c). *Megaloglossus Woermanni*, eine neue Form makroglosser Fledermäuse. *Jahrbuch des Hamburgischen Wissenschaftlichen Anstalten*, **2:** 125 - 130.
Pakenham, R. H. W. (1984). *The mammals of Zanzibar and Pemba Islands.* Printed privately, Harpenden. URL: http://www.scribd.com/doc/14538645/The-Mammals-of-Zanzibar-and-Pemba.
Pakula, M., M. Pielaszkiewicz and J. Furmankiewicz (2017). Offshore observation of the African Straw-coloured fruit bat *Eidolon helvum* (Kerr, 1792) in the Gulf of Guinea. *African Bat Conservation News*, **46:** 2 - 4.
Pallas, P. S. (1811). *Zoographia Rosso-Asiatica, sistens omnium Animalium in extenso Imperis Rossico et adjacentibu maribu, &c.* 1.
Palmeirim, J. M. (1982). On the presence of *Nyctalus lasiopterus* in North Africa (Mammalia: Chiroptera). *Mammalia*, **46 (3):** 401 - 403. doi: 10.1515/mamm.1982.46.3.395.
Palmeirim, J. M. (1991). A morphometric assessment of the systematic position of the *Nyctalus* from Azores and Madeira. *Mammalia*, **55 (3):** 381 - 388. [Abstract]
Palmeirim, J. M., D. L. Gorchov and S. Stoleson (1989). Trophic structure of a neotropical frugivore community: is there competition between birds and bats?. *Oecologia*, **79:** 403 - 411.
Palmer, T. S. (1904). Index generum mammalium; a list of the genera and families of mammals. *North American Fauna*, **23:** 1 - 984.
Palomo, L. J. and J. Gisbert (2002). *Atlas de los mamíferos terrestres de España.* Dirección General de Conservación de la Naturaleza. SECEM-SECEMU, Madrid, Spain.
Pancer, K., W. Gut and B. Litwinska (2016). Filowirusy - wirusy obecne od milionów lat - dlaczego teraz wybuchla tak wielka epidemia? (In Polish with English summary). *Postwpy Mikrobiologii*, **55 (2):** 205 - 214.
Paniutina, A. A. (2002). Wing shape in the context of foraging strategies in Rhinolophoidea. *Plecotus et al.*, **pars spec:** 35 - 40.
Pankakoski, E., R. A. Vaisanen and K. Nurmi (1987). Variability of muskrat skulls: measurement error, environmental modification and size allometry. *Systematic zoology*, **36 (1):** 35 - 51.
Panouse, J. B. (1951). Les Chauves-souris du Maroc. *Travaux de l'Institut de Sciences Cherifien*, **1:** 1 - 120. [Abstract]
Panouse, J. B. (1953). Observations sur les chauves-souris du Maroc et addition d'une nouvelle espèce *Myotis mystacinus* (Kuhl 1819) à la faune marocaine. *Bulletin de la Société des sciences naturelles et physiques du Maroc*, **33:** 89 - 107. [Abstract]
Panouse, J. B. (1958). Présence au Maroc de *Nycteris thebaica*. *Bulletin de la Société des sciences naturelles et physiques du Maroc*, **38:** 91 - 98. [Abstract]
Panyutina, A. A., A. N. Kuznetsov and L. P. Korzun (2013). Kinematics of chiropteran shoulder girdle in flight. *The Anatomical Record*, **296 (3):** 382 - 394. doi: 10.1002/ar.22650.
Papadatou, E., R. K. Butlin and J. D. Altringham (2008a). Seasonal roosting habits and population structure of the Long-fingered Bat *Myotis capaccinii* in Greece. *Journal of Mammalogy*, **89 (2):** 503 - 512. doi: 10.1644/07-MAMM-A-163R1.1.
Papadatou, E., R. K. Butlin and J. D. Altringham (2008b). Identification of bat species in Greece from their echolocation calls. *Acta Chiropterologica*, **10 (1):** 127 - 143. doi: 10.3161/150811008X331153.
Papadatou, E., X. Grémillet, F. Beog, S. Petkovski, E. Stojkoska, O. Avramoski and Y. Kazoglou (2011). Status survey and conservation action plan fort he bats of Prespa. Society for the protection of Prespa, Agios Germanos: 170 pp.
Papadatou, E., C. Ibáñez, R. Pradel, J. Juste and O. Gimenez (2010). Assessing survival in a multi-population system: a case study on bat populations. *Oecologia*, **165 (4):** 925 - 933 (for 2011). doi: 10.1007/s00442-010-1771-5.
Park, J. and J. H. Lee (2009). Comparative morphology of the tongue of *Miniopterus schreibersi fuliginosus* and *Pipistrellus savii*. *Korean Joural of Microscopy*, **39 (3):** 267 - 276.
Park, K. J., J. D. Altringham and G. Jones (1996). Assortative roosting in the two phonic types of *Pipistrellus pipistrellus* during the mating season. *Proceedings of the Royal Society of London*, **B 263:** 1495 - 1499. [Abstract]
Park, K. J., G. Jones and R. D. Ransome (2000). Torpor, arousal and activity of hibernating Greater Horseshoe Bats (*Rhinolophus ferrumequinum*). *Functional Ecology*, **14 (5):** 580 - 588. doi: 10.1046/j.1365-2435.2000.t01-1-00460.x.
Parker, D. M. and R. T. F. Bernard (2018). The use of acoustic detectors for assessing bat species richness and functional activity in a South African National Park. *Mammalia*, **83 (1):** 53 - 63 (for 2019). doi: 10.1515/mammalia-2017-0055.
Parker, J., G. Tsagkogeorga, J. A. Cotton, Y. Liu, P. Provero, E. Stupka and S. J. Rossiter (2013). Genome-wide signatures of convergent evolution in echolocating mammals. *Nature*, **502 (474):** 228 - 236. doi: 10.1038/nature12511.
Parsons, S., A. M. Boonman and M. K. Obrist (2000). Advantages and disadvantages of techniques for transforming and analyzing Chiropteran echolocation calls. *Journal of Mammalogy*, **81 (4):** 927 - 938.
Parsons, S. and D. Jacobs (2012). The role of habitat reflectivity in the detectability of bat echolocation calls by moths. Refuting the allotonic frequency hypothesis? *The Australasian Bat Society Newsletter*, **38:** 36.
Parsons, S., C. W. Thorpe and S. M. Dawson (1997). Echolocation calls of the Long-tailed bat: A quantitative analysis of types of calls. *Journal of Mammalogy*, **78 (3):** 964 - 976. [Abstract]
Participants of CBSG CAMP Madagascar Mammal Workshop, the (2004). *Pteropus rufus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Patterson, B. D. and P. W. Webala (2012). Keys to the bats (Mammalia: Chiroptera) of East Africa. *Fieldiana Life and Earth Sciences,*, **6:** 1 - 60. doi: 10.3158/2158-5520-12.6.1.

Patterson, B. D., P. W. Webala, M. Bartonjo, J. Nziza, C. W. Dick and T. C. Demos (2018). On the taxonomic status and distribution of African species of *Otomops* (Chiroptera: Molossidae). *PeerJ*, **6:** e4864. doi: 10.7717/peerj.4864.

Patterson, B. (D.), P. (W.) Webala, R. Keeru, C. Dick and A. Weber (2013). Delimiting cryptic species for 'The Bats of Kenya' - the genus *Miniopterus* (Miniopteridae). 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 118. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Patterson, B. D., P. W. Webala, J. C. Kerbis Peterhans, S. M. Goodman, M. Bartonjo and T. C. Demos (2019). Genetic variation and relationships among Afrotropical species of *Myotis* (Chiroptera: Vespertilionidae). *Journal of Mammalogy*, **100 (4):** 1130 - 1143. doi: 10.1093/jmammal/gyz087.

Paulian, R. (1961). *Faune de Madagascar. XIII. La zoogéographie de Madagascar et les îles voisines.* Publication de l'Institut de Recherche Scientifique de Tananarive, Tsimbazaza.

Paunovic, M., B. Karapandža, C. Ivanovic, M. Ždralevic, M. Đurovic and P. Presetnik (2010). Paunovic, M.; Karapandža, B.; Ivanovic, C.; Ždralevic, M.; Đurovic, M.; Presetnik, P.

Materials for Atlas of bats of Montenegro. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 243 - 244.

Pavlinic, I. and M. Đakovic (2010). Roosting and reproductive ecology of *Plecotus macrobullaris* and *P. kolombatovici*. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 244.

Pavlinov, I. J., A. V. Borissenko, S. V. Kruskop and E. L. Jahoton (1995). Mammals of Eurasia. II. Non-Rodentia, Systematic-geographical review (in Russian). *Archives of the Zoological Museum; Moscow State University*, **133:** 1 - 336.

Paweska, J. T., L. H. Blumberg, C. Liebenberg, R. H. Hewlett, A. A. Grobbelaar, P. A. Leman, J. E. Croft, L. H. Nel, L. Nutt and R. Swanepoel (2006). Fatal Human Infection with Rabies-related Duvenhage Virus, South Africa. *Emerging Infectious Diseases*, **12 (12):** 1965 - 1967.

Paweska, J. T., P. Jansen van Vuren, K. A. Fenton, K. Graves, A. A. Grobbelaar, N. Moolla, P. Leman, J. Weyer, N. Storm, S. D. McCulloch, T. P. Scott, W. Markotter, L. Odendaal, S. J. Clift, T. W. Geisbert, M. J. Hale and A. Kemp (2015). Lack of Marburg virus transmission from experimentally infected to susceptible in-contact Egyptian fruit bats. *The Journal of Infectious Diseases*, **Xxx (x):** xxx - xxx (10 pp). doi: 10.1093/infdis/jiv132.

Paweska, J. T., P. Jansen van Vuren, A. Kemp, N. Storm, A. A. Grobbelaar, M. R. Wiley, G. Palacios and W. Markotter (2018). Marburg virus infection in Egyptian Rousette Bats, South Africa, 2013 - 2014. *Emerging Infectious Diseases*, **24 (6):** 1134 - 1137. doi: 10.3201/eid2406.172165.

Paweska, J. T., P. Jansen van Vuren, J. Masumu, P. A. Leman, A.. A. Grobbelaar, M. Birkhead, S. Clift, R. Swanepoel and A. Kemp (2012). Virological and serological findings in *Rousettus aegyptiacus* experimentally inoculated with vero cells-adapted Hogan strain of Marburg virus. *PLoS ONE*, **7 (9) e45479:** 1 - 11. doi: 10.1371/journal.pone.0045479.

Paweska, J. T., N. Storm, A. A. Grobbelaar, W. Markotter, A. Kemp and P. Jansen van Vuren (2016). Experimental inoculation of Egyptian fruit bats (*Rousettus aegyptiacus*) with Ebola virus. *Viruses*, **8:** 29. doi: 10.3390/v8020029.

Pearch, M. J., P. J. J. Bates and C. Magin (2001). A review of the small mammal fauna of Djibouti and the results of a recent survey. *Mammalia*, **65 (3):** 387 - 409.

Pearl, D. L. (1994). *Rhinolophus hildebrandti*. *Mammalian Species*, **486:** 1 - 3, 3 figs.

Peat, A. and T. M. Bell (1970). Entebbe Bat Salivary Gland Virus?: Electron Microscopic Study of Morphology and Development in New Born Mice. *Arch. Gesamte Virusforsch.*, **31:** 230 – 236.

Peckham, R. and R. Sinha (2017). Satellites and the new war on infection: tracking Ebola in West Africa. *Geoforum*, **80:** 24 - 38. doi: 10.1016/j.geoforum.2017.01.001.

Pedersen, S. C. (1998). Morphometric analysis of the chiropteran skull with regard to mode of echolocation. *Journal of Mammalogy*, **79 (1):** 91 - 103. [Abstract]

Peel, A. J. , Baker, K. S. , Hayman, D. T. S. , Broder, C. C. , Cunningham, A. A. , Fooks, A. R. , Garnier, R. , Wood, J. L. N. , Restif, O. (2018). Support for viral persistence in bats from age-specific serology and models of maternal immunity. *Scientific Reports*, **8:** 3859. doi: 10.1038/s41598-018-22236-6.

Peel, A. J., K. S. Baker, G. Crameri, J. A. Barr, D. T. S. Hayman, E. Wright, C. C. Broder, A. Fernández-Loras, A. R. Fooks, L.-F. Wang, A. A. Cunningham and J. L. N. Wood (2012). Henipavirus neutralising antibodies in an isolated island population of African fruit bats. *PLoS ONE*, **7 (1) e30346:** 1 - 9. doi: 10.1371/journal.pone.0030346.

Peel, A. J., K. S. Baker, D. T. S. Hayman, R. Suu-Ire, A. C. Breed, G.-C. Gembu, T. Lembo, A. Fernández-Loras, D. R. Sargan, A. R. Fooks, A. A. Cunningham and J. L. N. Wood (2016). Data Descriptor: Bat trait, genetic and pathogen data from large-scale investigations of African fruit bats, *Eidolon helvum*. *Scientific Data*, **3:** 160049. doi: 10.1038/sdata.2016.49.

Peel, A. J., A. L. Fernández, K. S. Baker, D. T. S. Hayman, A. Kamins, S. J. Rossiter, D. R. Sargan, A. A. Cunningham and J. L. N. Wood (2010b). Disease investigations in *Eidolon helvum* in the Gulf of Guinea islands. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 244 - 245.

Peel, A. J., A. Fernández Loras, K. S. Baker, D. T. S. Hayman, A. Kamins, S. J. Rossiter, D. R. Sargan, J. L. N. Wood and A. A. Cunningham (2011). Evidence of Henipaviruses and Lyssaviruses in isolated island populations of African fruit bats. In Anonymus : *1st International One Health Congress. EcoHealth*, **7 (Suppl. 1):** S40. doi: 10.1007/s10393-010-0376-0. URL: http://www.springerlink.com/content/0976673444566520/fulltext.pdf.

Peel, A. J., T. J. McKinley, K. S. Baker, J. A. Barr, G. Crameri, D. T. S. Hayman, Y.-R. Feng, C. C. Broder, L.-F. Wang, A. A. Cunningham and J. L. N. Wood (2013a). Use of cross-reactive serological assays for detecting novel pathogens in wildlife: Assessing an appropriate cutoff for henipavirus assays in African bats. *Journal of Virological Methods*, **193 (2):** 295 - 303. doi: 10.1016/j.jviromet.2013.06.030.

Peel, A. J., S. J. Rossiter, J. L. N. Wood, A. A. Cunningham and D. R. Sargan (2010a). Characterization of microsatellite loci in the straw-colored fruit bat, *Eidolon helvum* (Pteropodidae). *Conservation Genetics Resources*, **2:** 279 - 282. doi: 10.1007/s12686-010-9190-9. URL: http://www.springerlink.com/content/908721103384r556/fulltext.pdf.

Peel, A. J., D. R. Sargan, K. S. Baker, D. T. S. Hayman, J. A. Barr, G. Crameri, R. Suu-Ire, C. C. Broder, T. Lembo, L.-F. Wang, A. R. Fooks, S. J. Rossiter, J. L. N. Wood and A. A. Cunningham (2013b). Continent-wide panmixia of an African fruit bat facilitates transmission of potentially zoonotic viruses. *Nature Communications*, **4:** 2770. doi: 10.1038/ncomms3770.

Peel, A. J., J. L. N. Wood, K. S. Baker, A. C. Breed, A. De Carvalho, A. Fernández-Loras, H. S. Gabrieli, G.-C. Crispin GEMBU, V. A. Kakengi, P. M. Kaliba, R. M. Kityo, T. Lembo, F. E. Mba, D. Ramos, I. Rodriguez-Prieto, R. Suu-Ire, A. A. Cunningham and D. T. S. Hayman (2017). How does Africa's most hunted bat vary across the continent? Population

traits of the straw-coloured fruit bat (*Eidolon helvum*) and its interactions with humans. *Acta Chiropterologica*, **19 (1):** 77 - 92. doi: 10.3161/15081109ACC2017.19.1.006.
Peereboom, D. and S. van Lieshout (2015). Possible first record and echolocation call of *Scotophilus* cf. *nux* Thomas, 1904 from Gabon. *African Bat Conservation News*, **37:** 5 - 8.
Peereboom, D., S. Van Lieshout, K. J. Jeffery and W. Bergmans (2012). First record and echolocation call of *Glauconycteris argentata* (Dobson, 1875) from Gabon. *African Bat Conservation News*, **27:** 3 - 5.
Peirce, M. A. (1984). Parasites of chiroptera in Zambia. *Journal of wildlife diseases*, **20 (2):** 153 - 154.
Peixoto, F. P., P. H. P. Braga, M. V. Cianciaruso, J. A. F. Diniz-Filho and D. Brito (2013). Global patterns of phylogenetic beta diversity components in bats. *Journal of Biogeography*, **41 (4):** 762 - 772 (for 2014). doi: 10.1111/jbi.12241.
Peixoto, F. P., F. Villalobos, A. S. Melo, J. A. F. Diniz-Filho, R. Loyola, T. F. Rangel and M. V. Cianciaruso (2017). Geographical patterns of phylogenetic beta-diversity components in terrestrial mammals. *Global Ecology and Biogeography*, **26 (5):** 573 - 583. doi: 10.1111/geb.12561.
Penzhorn, B. L. and I. L. Rautenbach (1988). Reproduction of the Egyptian fruit bat *Rousettus aegyptiacus* in the southern tropics. *South African Journal of Wildlife Research*, **18 (3):** 88 - 92.
Peralta-Rodríguez, J. L., J. M. Caspeta-Mandujano and J. A. Guerrero (2012). A new Spirurid (Nematoda) parasite from Mormoopid Bats in Mexico. *Journal of parasitology*, **98 (5):** 1006 - 1009. doi: 10.1645/GE-2933.1.
Pérez-Suárez, G., J. M. Reina, J. Navlet, O. de Paz and E. J. López-Caballero (1991). *Citogenetica de Quirópteros de la Pen¡nsula Ibérica.* In Benzal, J. and O. de Paz : *Los Murci,lagos de Espa¤a y Portugal.* Colección Técnica, Icona - Madrid: 305 - 330.
Perkins, S. L. and J. Schaer (2016). A modern menagerie of mammalian malaria. *Trends in Parasitology*, **32 (10):** 772 - 782. doi: 10.1016/j.pt.2016.06.001.
Pernet, O., B. S. Schneider, S. M. Beaty, M. LeBreton, T. E. Yun, A. Park, T. T. Zachariah, T. A. Bowden, P. Hitchens, C. M. Ramirez, P. Daszak, J. Mazet, A. N. Freiberg, N. D. Wolfe and B. Lee (2014). Evidence for henipavirus spillover into human populations in Africa. *Nature Communications*, **5:** 5342. doi: 10.1038/ncomms6342.
Perret, J. L. and V. Aellen (1956). Mammifères du Cameroun de la collection J.L. Perret. *Revue suisse de zoologie*, **63 (26):** 395 - 450. [Abstract]
Perrin, M. R. (1982). Prey specificity of the barn owl, *Tyto alba*, in the Great Fish River valley of the Eastern Cape Province. *South African Journal of Wildlife Research*, **12:** 14 - 25. [Abstract]
Pervushina, E. M., A. A. Pervushin and K. I. Berdyugin (2012). Social behavior of Water Bats (*Myotis daubentonii*, Chiroptera) in an open-air cage. *Biology Bulletin*, **39 (9):** 741 - 751. doi: 10.1134/S1062359012090051.
Pestano, J., R. P. Brown, N. M. Suárez, J. Benzal and S. Fajardo (2003a). Intraspecific evolution of Canary Island Plecotine bats, based on mtDNA sequences. *Heredity*, **90 (4):** 302 - 307.
Pestano, J., R. P. Brown, N. M. Suárez and S. Fajardo (2003b). Phylogeography of pipistrelle-like bats within the Canary Islands, based on mtDNA sequences. *Molecular phylogenetics and evolution*, **26 (1):** 56 - 63.
Peters, C., R. Isaza, D. J. Heard, R. D. Davis, S. M. Moore and D. J. Briggs (2004). Vaccination of Egyptian fruit bats (*Rousettus aegyptiacus*) with monovalent inactivated rabies vaccine. *Journal of Zoo and Wildlife Medicine*, **35 (1):** 55 - 59. doi: 10.1638/03-027.
Peters, J. L. and A. Loveridge (1936). Scientific results of an expedition to rain forest regions in eastern Africa. IV. Birds. *Bulletin of the Museum of Comparative Zoology*Bull. Mus. comp. Zool.
Peters, W. C. H. (1852). *Naturwissenschaftliche Reise nach Mossambique auf Befehl seiner majestät des des Königs Friedrich Wilhelm IV in den Jahren 1842 bis 1848 ausgeführt. Zoologie. I. Säugethiere.* G. Reimer - Berlin.
Peters, W. C. H. (1859). Neue Beiträge zur Kenntniss der Chiropteren. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*223 - 226.
Peters, W. C. H. (1861). Eine neue von Hrn. Dr. Gundlach beschriebene Gattung von Flederthieren aus Cuba, *Phyllonycteris*. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*, **(for 1860):** 817 - 819.
Peters, W. C. H. (1865a). Ueber Flederthiere (*Vespertilio soricinus* Pallas, *Choeronycteris* Lichtenst., *Rhinophylla pumilo* nov. gen., *Artibeus fallax* nov. sp., *A. concolor* nov. sp., *Dermanura quadrivittatum* nov. sp., *Nycteris grandis* n. sp.). *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*351 - 359.
Peters, W. [C. H.] (1865b). 2. Note on the mammalian observed by Dr. Welwitsch in Angola. *Proceedings of the Zoological Society of London*, **1865, II:** 400 - 401.
Peters, W. C. H. (1867a). Vorläufige Uebersicht der aus dem Nachlass des Baron Carl Von der Decken stammenden und auf seiner ostafrikanischen Reise gesammelten Säugethiere und Amphibien. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*, **(for 1866):** 884 - 887.
Peters, W. C. H. (1867b). 1. Note on a bat from the Azores. *Proceedings of the Zoological Society of London*, **1866, III:** 558.
Peters, W. C. H. (1867c). Über die Flederhunde, Pteropi, und insbesondere uber die Arten der Gattung Pteropus s.s. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*319 - 333.
Peters, W. C. H. (1868). Über Flederthiere (*Pteropus Gouldii, Rhinolophus Deckenii, Vespertilio lobipes, Vesperugo Temminckii*) und Amphibien (*Hypsilurus Godeffroyi, Lygosoma scutatum, Stenostoma narirostre, Onychocephalus unguirostris, Ahaetulla polylepis,Pseudechis scutella*. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*, **(for 1867):** 703 - 712.
Peters, W. C. H. (1869a). Ueber neue oder weniger bekannte Flederthiere, besonders des Pariser Museums. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*391 - 406. [Abstract]
Peters, W. C. H. (1869b). *Säugethiere.* In Von der Decken, Baron C. C. : *Reisen in Ost-Afrika. III. Band. Wissenschaftliche Ergebnisse. 1. Abtheilung: Säugethiere, Vögel, Amphibien, Crustaceen, Mollusken und Echinodermen.* Winter'sche Verlagshandlung - Leipzig & Heidelberg.
Peters, W. (C. H.) (1870). 1. Lista de mammiferos das possessões portuguezas da Africa occidental e diagnoses de algumas espécies novas. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **(10):** 123-127.
Peters, W. C. H. (1871). Eine monographische Uebersicht der Chiropterengattungen *Nycteris* und *Atalapha*. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*, **(for 1870):** 900 - 914.
Peters, W. C. H. (1872a). Mittheilung über neue Flederthiere (*Phyllorhina micropus*, *Harpyiocephalus Huttonii*, *Murina grisea*, *Vesperugo micropus*, *Vesperus (Marsipolaemus) albigularis*, *Vesperus propinquus, tenuipinnis*). *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*256 - 264.
Peters, W. (C. H.) (1872b). 3. Note on a collection of small Mammalia made by Mr. Monteiro in Angola. *Proceedings of the Zoological Society of London*, **1872, I or II:** 363 - 364.
Peters, W. C. H. (1873). ?? Title still needs to be checked. ?? *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*.

Peters, W. C. H. (1874). Eine Mittheilung über die von Herrn Rohlfs und Prof. Dr. Ascherson ihm zugesandten Wirbelthiere aus der Libyschen Wüste. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*, **1874:** 66 - 67.
Peters, W. C. H. (1876). Ueber die von dem verstorbenen Professor Dr. Reinhold Buchholz in Westafrika gesammelten Säugethiere. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*469 - 485. [Abstract]
Peters, W. C. H. (1877). Über eine kleine Sammlung von Saugethieren welche der Reisende Hr. J. M. Hildebrandt aus Mombaca in Ostafrica eingesandt hat. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*.
Peters, W. C. H. (1879). Ueber die von Hrn J.M. Hildebrandt während seiner letzten ostafrikanischen Reise gesammelten Säugethiere und Amphibien. *Monatsberichte der königlichen preussische Akademie für Wissenschaften, Berlin*, **(for 1878):** 194 - 203. [Abstract]
Petersen, H., N. Finger, A. Bastian and D. Jacobs (2019). The behaviour and vocalisations of captive Geoffroy's horseshoe bats, *Rhinolophus clivosus* (Chiroptera: Rhinolophidae). *Acta Chiropterologica*, **20 (2):** 439 - 453 (for 2018). doi: 10.3161/15081109ACC2018.20.2.014.
Peterson, A. T., J. T. Bauer and J. N. Mills (2004a). Ecologic and geographic distribution of filovirus disease. *Emerging Infectious Diseases*, **10 (1):** 40 - 47.
Peterson, A. T., D. S. Carroll, J. N. Mills and K. M. Johnson (2004b). Potential mammalian filovirus reservoirs. *Emerging Infectious Diseases*, **10 (12):** 2073 - 2081.
Peterson, A. T. and M. T. Holder (2012). Phylogenetic assessment of filoviruses: how many lineages of Marburg virus? *Ecology and Evolution*, **2 (8):** 1826 - 1833. doi: 10.1002/ece3.297.
Peterson, A. T., M. Pape?, D. S. Carroll, H. Leirs and K. M. Johnson (2007). Mammal taxa constituting potential coevolved reservoirs of filoviruses. *Journal of Mammalogy*, **88 (6):** 1544 - 1554. doi: 10.1644/06-MAMM-A-280R1.1.
Peterson, R. L. (1965). A review of the flat-headed bats of the family Molossidae from South America and Africa. *Life science contributions - Royal Ontario Museum*, **64:** 1 - 32. [Abstract]
Peterson, R. L. (1967). A new record for the African molossid bat *Tadarida aloysiisabaudiae*. *Canadian journal of zoology*, **45:** 449 - 452. [Abstract]
Peterson, R. L. (1969). Further notes on the African molossid bat *Tadarida aloysiisabaudiae*. *Life science contributions - Royal Ontario Museum*, **161:** 1 - 6. [Abstract]
Peterson, R. L. (1971a). The African molossid bat *Tadarida russata*. *Canadian journal of zoology*, **49 (3):** 297 - 301. [Abstract]
Peterson, R. L. (1971b). Notes on the African long-eared bats of the genus *Laephotis* (family Vespertilionidae). *Canadian journal of zoology*, **49 (6):** 885 - 888. doi: 10.1139/z71-133. [Abstract]
Peterson, R. L. (1971c). The systematic status of the African molossid bats *Tadarida bemmeleni* and *Tadarida cistura*. *Canadian journal of zoology*, **49 (10):** 1347 - 1354. doi: 10.1139/z71-201. [Abstract]
Peterson, R. L. (1972). Systematic status of the African molossid bats *Tadarida congica*, *T. niangarae* and *T. trevori*. *Life science contributions - Royal Ontario Museum*, **85:** 1 - 32. doi: 10.5962/bhl.title.52087. [Abstract]
Peterson, R. L. (1973). The first known female of the African long-eared bat *Laephotis wintoni* (Vespertilionidae: Chiroptera). *Canadian journal of zoology*, **51 (6):** 601 - 603. [Abstract]
Peterson, R. L. (1974). Variation in the African bat, *Tadarida lobata*, with notes on habitat and habits (Chiroptera: Molossidae). *Life Science Occasional Papers - Royal Ontario Museum*, **24:** 1 - 8. [Abstract]
Peterson, R. L. (1981). Systematic variation in the *tristis* group of the bent-winged bats of the genus *Miniopterus* (Chiroptera: Vespertilionidae). *Canadian journal of zoology*, **59 (5):** 828 - 843.
Peterson, R. L. (1982). A new species of *Glauconycteris* from the east coast of Kenya (Chiroptera: Vespertilionidae). *Canadian journal of zoology*, **60:** 2521 - 2525. [Abstract]
Peterson, R. L. (1985). A systematic review of the molossid bats allied with the genus *Mormopterus* (Chiroptera: Molossidae). *Acta zoologica Fennica*, **170:** 205 - 208.
Peterson, R. L. (1987). Notes on systematic variation in the *nanus* group of African *Pipistrellus*. *Bat Research News*, **28:** 37. [Abstract]
Peterson, R. L., J. L. Eger and L. Mitchell (1995). *Faune de Madagascar: Chiroptères.* Faune de Madagascar, 84: 1 - 204. [Abstract]
Peterson, R. L. and D. L. Harrison (1970). The second and third known specimens of the African molossid bat, *Tadarida lobata*. *Life Science Occasional Papers - Royal Ontario Museum*, **16:** 1 - 6. [Abstract]
Peterson, R. L. and D. W. Nagorsen (1975). Chromosomes of fifteen species of bats (Chiroptera) from Kenya and Rhodesia. *Life Science Occasional Papers - Royal Ontario Museum*, **27:** 1 - 14. [Abstract]
Peterson, R. L. and D. A. Smith (1973). A new species of *Glauconycteris* (Vesptertilionidae, Chiroptera). *Life Science Occasional Papers - Royal Ontario Museum*, **22:** 1 - 9. [Abstract]
Petit, E., F. Balloux and J. Goudet (2001). Sex-biased dispersal in a migratory bat: a characterization using sex-specific demographic parameters. *Evolution*, **55 (3):** 635 - 640. doi: 10.1554/0014-3820(2001)055[0635:SBDIAM]2.0.CO;2.
Petit, E. and F. Mayer (1999). Male dispersal in the noctule bat (*Nyctalus noctula*): where are the limits?. *Proceedings of the Royal Society of London*, **B 266:** 1717 - 1722. doi: 10.1098/rspb.1999.0837.
Pettersson, S. (2004). Bat pollination in a West African rain forest community. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 17.
Pettersson, S., F. Ervik and J. T. Knudsen (2004). Floral scent of bat-pollinated species: West Africa vs. the New World. *Biological Journal of the Linnean Society*, **82 (2):** 161 - 168.
Pettigrew, J. D. (1986). Flying primates? Megabats have the advanced pathway from eye to midbrain. *Science*, **231:** 1304 - 1306. doi: 10.1126/science.3945827.
Pettigrew, J. D. (1991a). Wings or Brains? Convergent Evolution in the Origins of bats. *Systematic zoology*, **40 (2):** 199 - 216. [Abstract]
Pettigrew, J. D. (1991b). A Fruitful, Wrong Hypothesis? Response to Baker, Novacek, and Simmons. *Systematic zoology*, **40 (2):** 231 - 239.
Pettigrew, J. D. and J. A. W. Kirsch (1998). Base-compositional biases and the bat problem. I. DNA-hybridization melting curves based on AT- and GC-enriched tracers. *Philosophical transactions of the Royal Society of London*, **B 353 (1367):** 369 - 379. doi: 10.1098/rstb.1998.0215. [Abstract]
Pfefferle, S., S. Oppong, J. F. Drexler, F. Gloza-Rausch, A. Ipsen, A. Seebens, M. A. Müller, A. Annan, P. Vallo, Y. Adu-Sarkodie, T. F. Kruppa and C. Drosten (2009). Distant relatives of Severe Acute Respiratory Syndrome Coronavirus and close relatives of Human Coronavirus 229E in bats, Ghana. *Emerging Infectious Diseases*, **15 (9):** 1377 - 1384. doi: 10.3201/eid1509.090224.
Philby, H. StJ. B. (1933). *The Empty Quarter being a description of the Great South Desert of Arabia known as Rub'al Khali. Appendix E. Mammals of the Rub'al Khali.* Constable & Company Ltd - London: 394 pp.

Philips, T. K., C. S. DeWildt, H. Davis and R. S. Anderson (2016). Survey of the terrestrial arthropods found in the caves of Ghana. *Journal of Cave and Karst Studies*, **78 (2):** 128 - 137. doi: 10.4311/2015LSC0120.

Phillips, M. J. (2015). Four mammal fossil calibrations: balancing competing palaeontological and molecular considerations. *Palaeontologia Electronica*, **18.1.5FC:** 1 - 16.

Picard-Meyer, E., J. Barrat, M. Wasniewski, A. Wandeler, S. Nadin-Davis, J. P. Lowing, A. R. Fooks, L. McElhinney, V. Bruyere and F. Cliquet (2004). Epidemiology of rabid bats in France. *Veterinary Record*, **155:** 774 - 777.

Pickford, M. (1990). Some fossiliferous Plio-Pleistocene cave systems of Ngamiland, Botswana. *Botswana Notes & Records*, **22:** 1 - 15.

Picot, M., R. K. B. Jenkins, O. Ramilijaona, P. A. Racey and S. M. Carriere (2007). The feeding ecology of *Eidolon dupreanum* (Pteropodidae) in eastern Madagascar. *African Journal of Ecology*, **45 (4):** 645 - 650. doi: 10.1111/j.1365-2028.2007.00788.x.

Picot, M. M. (2005). Etude de l'ecologie du Megachiroptère *Eidolon dupreanum* (Pollen, 1866) et son rôle dans la dispersion des graines en lisière du corridor forestier reliant les Parcs Nationaux de Ranomafana et d'Andringitra. Unpublished. Départment de Biologie Animale, Faculté des Sciences. Université d'Antanarivo, Antanarivo. 77 pp.

Pienaar, U. de V. (1961). A supplementary check-list of decapoda, fresh-water fish, amphibia, reptiles and small mammals recorded in the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **4 (1):** 167 - 177. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/836.

Pienaar, U. de V. (1964). The small mammals of the Kruger National Park - A systematic list and zoogeography. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **7 (1):** 1 - 25. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/795. [Abstract]

Pienaar, U. de V. (1972). A new bat record for the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **15 (1):** 91 - 93. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/673. [Abstract]

Pienaar, U. de V., I. L. Rautenbach and G. de Graaff (1980). *The small mammals of the Kruger National Park (A check list and atlas).* National Parks Board of South Africa - Johannesburg: 1 - 149.

Pierce, M. W., T. Kearney, E. C. J. Seamark, M. Curran, M. Kopp and M. Keith (2012). New records and echolocation information of *Laephotis botswanae* (Chiroptera, Vespertilionidae) from southern Africa. *Durban Natural Science Museum Novitates*, **34:** 39 - 44.

Pierquin, L. (1960). Note complémentaire sur les tiques du Congo belge et du Ruanda Urundi. *Bulletin d'Agronomie de la Congo belge*, **60:** 125 - 138. [Abstract]

Pierquin, L. and K. Niemegeers (1957). Répertoire et distribution géographique des tiques au Congo belge et au Ruanda-Urundi. *Bulletin d'Agronomie de la Congo belge*, **48 (5):** 1177 - 1224. [Abstract]

Pierson, E. D. (1986). Molecular systematics of the Microchirptera: higher taxon relationships and biogeography. Ph.D. dissertation, University of California, Berkeley, California.

Pigott, D. M., N. Golding, A. Mylne, Z. Huang, A. J. Henry, D. J. Weiss, O. J. Brady, M. U. G. Kraemer, D. L. Smith, C. L. Moyes, S. Bhatt, P. W. Gething, P. W. Horby, I. I. Bogoch, J. S. Brownstein, S. R. Mekaru, A. J. Tatem, K. Khan and S. I. Hay (2014). Mapping the zoonotic niche of Ebola virus disease in Africa. *eLife*, **3:** e04395. doi: 10.7554/eLife.04395.

Pigott, D. M., A. I. Millear, L. Earl, C. Morozoff, B. A. Han, F. M. Shearer, D. J. Weiss, O. J. Brady, M. U. G. Kraemer, C. L. Moyes, S. Bhatt, P. W. Gething, N. Golding and S. I. Hay (2016). Updates to the zoonotic niche map of Ebola virus disease in Africa. *eLife*, **5:** e16412. doi: 10.7554/eLife.16412.001.

Pine, R. H. (1993). A new species of *Thyroptera* Spix (Mammalia: Chiroptera: Thyropteridae) from the Amazon basin of northeastern Perú. *Mammalia*, **57 (2):** 213 - 225. [Abstract]

Pine, R. H., D. C. Carter and R. K. LaVal (1971). Status of *Bauerus* Van Gelder and its relationships to other nyctophiline bats. *Journal of Mammalogy*, **52:** 663-669.

Pinus, M and H. E. Müller (1980). Enterobakterien bei Fledertieren (Chiroptera). *Zentralblatt für Bakteriologie. 1. Abt. Originale*, **A 247:** 315 - 322.

Pio, D. V., R. Engler, H. P. Linder, A. Monadjem, F. P. D. Cotterill, P. J. Taylor, M. C. Schoeman, B. W. Price, M. H. Villet, G. Eick, N. Salamin and A. Guisan (2014). Climate change effects on animal and plant phylogenetic diversity in southern Africa. *Global Change Biology*, **20 (5):** 1538 - 1549. doi: 10.1111/gcb.12524.

Platt, R. N. II, S. F. Mangum and D. A. Ray (2016). Pinpointing the vesper bat transposon revolution using the *Miniopterus natalensis* genome. *Mobile DNA*, **7:** 12. doi: 10.1186/s13100-016-0071-y.

Plourde, B. T., T. L. Burgess, E. A. Eskew, T. M. Roth, N. Stephenson and J. E. Foley (2017). Are disease reservoirs special? Taxonomic and life history characteristics. *PLoS ONE*, **12 (7):** e0180716. doi: 10.1371/journal.pone.0180716.

Plowright, R. K., A. J. Peel, D. G. Streicker, A. T. Gilbert, H. McCallum, J. Wood, M. L. Baker and O. Restif (2016). Transmission or within-host dynamics driving pulses of zoonotic viruses in reservoir-host populations. *PLoS Neglected Tropical Diseases*, **10 (8):** e0004796. doi: 10.1371/journal.pntd.0004796.

Plumptre, A. J., D. Kujirakwinja, J. Matunguru, C. Kahindo, P. Kaleme, B. Marks and M. Huhndorf (2008). Biodiversity surveys in the Misotshi-Kabogo and Marungu regions of eastern Democratic Republic of Congo with a focus on chimpanzees. Albertine Rift Technical Reports No. 5: 1 - 80.

Poché, R. M. (1975). The bats of the National Park W, Niger, Africa. *Mammalia*, **39 (1):** 39 - 50. [Abstract]

Pocock, R. I. (1935). The mammals collected in S.E. Arabia by Mr. Bertram Thomas and Mr. H. St. J. Philby. *Annals and Magazine of Natural History*, **ser. 10, 15 (88):** 441 - 467. [Abstract]

Podturkin, A. A. (2012). Effect of group size on the intensity of exploratory behaviour in Egyptian rousettes (*Rousettus aegyptiacus*) (in Russian with English summary). *Plecotus et al.*, **14:** 60 - 74 (for 2011).

Pohle, H. (1943). *Scotonycteris ophiodon* sp. n., eine neue Art epomophorider Flughunde. *Sitzungsberichte Gesellschaft naturforschenden Freunde Berlin*78 - 87.

Polak, T., C. Korine, S. Yair and M. W. Holderied (2011). Differential effects of artificial lighting on flight and foraging behaviour of two sympatric bat species in a desert. *Journal of Zoology*, **285 (1):** 21 - 27. doi: 10.1111/j.1469-7998.2011.00808.x.

Poll, M. (1939). Mammifères de la région de Rutshuru recoltés par M.J. Ghesquière. *Revue de zoologie et de botanique africaines*, **32 (1):** 33 - 41. [Abstract]

Ponce, L., R. Kinoshita and H. Nishiura (2019). Exploring the human-animal interface of Ebola virus disease outbreaks. *Mathematical Biosciences and Engineering*, **16 (4):** 3130 - 3143. doi: 10.3934/mbe.2019155.

Pont, S. M. and J. D. Armstrong (1990). *A study of the bat fauna of R,serve Naturelle Int,gral de Marojejy in north east Madagascar.* University of Aberdeen - Aberdeen.

Poole, A. J. and V. S. Schantz (1942). Catalog of the type specimens of mammals in the United States National Museum, including the Biological Surveys Collection. *Bulletin of the United States National Museums*, **178:** i - xiii; 1 - 705.

Popa, E. M., N. Anthwal and A. S. Tucker (2016). Complex patterns of tooth replacement revealed in the fruit bat (*Eidolon helvum*). *Journal of Anatomy*, **229 (6):** 847–856. doi: 10.1111/joa.12522.
Popa-Lisseanu, A. G., A. Delgado-Huertas, M. G. Forero, A. Rodríguez, R. Arlettaz and C. Ibáñez (2007). Bats' conquest of a formidable foraging niche: the myriads of nocturnally migrating songbirds. *PLoS ONE*, **2 (2):** e205. doi: 10.1371/journal.pone.0000205.
Popa-Lisseanu, A. G. and C. C. Voigt (2009). Bats on the move. *Journal of Mammalogy*, **90 (6):** 1283 - 1289. doi: 10.1644/09-MAMM-S-130R2.1.
Porter, C. A., A. W. Primus, F. G. Hoffmann and R. J. Baker (2010). Karyology of five species of bats (Vespertilionidae, Hipposideridae, and Nycteridae) from Gabon with comments on the taxonomy of *Glauconycteris*. *Occasional Papers of the Museum, Texas Tech University*, **295:** 1 - 7.
Post, K. (2018). Sending the right message: wild game and the West Africa Ebola outbreak. *Health Security*, **16 (1):** 48 - 57. doi: 10.1089/hs.2017.0086.
Postawa, T. and A. Furman (2014). Abundance patterns of ectoparasites infesting different populations of *Miniopterus* species in their contact zone in Asia Minor. *Acta Chiropterologica*, **16 (2):** 387 - 395. doi: 10.3161/150811014X687341.
Potgieter, K. , Diamond, M. (2012). Bat (Chiroptera) sensitivity assessment. Proposed Denhami Wind Energy Farm near Struis Bay, Western Cape Province, South Africa. Savannah Environmental (PTY) Ltd.: 42 pp. URL: http://www.savannahsa.com/documents/4199/Appendix%20D3%20Struisbaai%20(Bat%20Specialist%20Study).pdf.
Poulet, A. R. (1970). Les Rhinopomatidae de Mauritanie. *Mammalia*, **34 (2):** 237 - 243. [Abstract]
Poulet, A. R. (1972). Recherches écologiques sur une savane sahelienne du Ferlo Septentrional, Senegal: Les mammifères. *La terre at la vie: revue d'écologie appliquée*, **26 (3):** 440 - 472. [Abstract]
Pourrut, X., A. Délicat, P. E. Rollin, T. G. Ksiazek, J-P. Gonzalez and E. M. Leroy (2007). Spatial and temporal patterns of Zaire ebolavirus antibody prevalence in the possible reservoir bat species. *The Journal of Infectious Diseases*, **196 (Suppl. 2):** S176 - S183. doi: 10.1086/520541.
Pourrut, X., B. Kumulungui, T. Wittmann, G. Moussavou, A. D,licat, P. Yaba, D. Nkoghe, J.-P. Gonzalez and E. M. Leroy (2005). The natural history of Ebola virus in Africa. *Microbes and Infection*, **7 (7-8):** 1005 - 1014. doi: 10.1016/j.micinf.2005.04.006.
Pourrut, X., M. Souris, J. S. Towner, P. E. Rollin, S. T. Nichol, J.-P. Gonzalez and E. Leroy (2009). Large serological survey showing cocirculation of Ebola and Marburg viruses in Gabonese bat populations, and a high seroprevalence of both viruses in *Rousettus aegyptiacus*. *BMC Infectious Diseases*, **9 (1):** 159.
Pousargues, E. de. (1896). Etude sur les mammifères du Congo Français. *Annales des Sciences Naturelles*, **(8) 3:** 128 - 416.
Pousargues, E. de (1898). Déscription d'un Rhinolophe d'espèce nouvelle, *R. Maclaudi*, recueilli par M. le Dr. Maclaud sur l'île de Conakry (Guinée française). *Bulletin du Muséum national d'histoire naturelle de Paris*, **sér 1, 3 (8):** 358, f. 1, 2 (for 1897).
Powell, V. J. and S. C. Wehnelt (2003). A new estimate of the population size of the Critically Endangered Rodrigues fruit bat *Pteropus rodricensis*. *Oryx*, **37 (3):** 353 - 357. doi: 10.1017/S0030605303000619.
Prat, Y., M. Taub, E. Pratt and Y. Yovel (2017). Data Descriptor: An annotated dataset of Egyptian fruit bat vocalizations across varying contexts and during vocal ontogeny. *Scientific Data*, **4:** 170143. doi: 10.1038/sdata.2017.143.
Prat, Y., M. Taub and Y. Yovel (2013). Ontogeny of vocal communication of the Egyptian fruit bat and the role of learning in its acquisition. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 123. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Prat, Y., M. Taub and Y. Yovel (2015). Vocal learning in a social mammal: Demonstrated by isolation and playback experiments in bats. *Science Advances*, **1:** e1500019. doi: 10.1126/sciadv.1500019.
Prat, Y., M. Taub and Y. Yovel (2016). Everyday bat vocalizations contain information about emitter, addressee, context, and behavior. *Scientific Reports*, **6:** 39419. doi: 10.1038/srep39419.
Presetnik, P. and S. Aulagnier (2013). The diet of Schreiber's bent-winged bat, *Miniopterus schreibersii* (Chiroptera: Miniopteridae), in northeastern Slovenia (Central Europe). *Mammalia*, **77 (3):** 297 - 305. doi: 10.1515/mammalia-2012-0033.
Pretorius, M., T. Kearney, M. Keith, W. Markotter, E. Seamark and H. Broders (2019). Increased body mass supports energy compensation hypothesis in the breeding female Natal long-fingered bat *Miniopterus natalensis*. *Acta Chiropterologica*, **20 (2):** 319 - 328 (for 2018). doi: 10.3161/15081109ACC2018.20.2.004.
Price, V. (2013). Trouble in paradise: mapping human-wildlife conflict in the western Indian Ocean. MS thesis - Imperial College London: 69 pp. URL: https://www.iccs.org.uk/wp-content/thesis/consci/2013/Price.pdf.
Prié, V. (2011). Les chauves-souris du massif du Makay (Madagascar). Premier inventaire chiroptérologique dans le cadre du projet Makay Nature. *Le Vespère*, **2:** 107 - 123.
Prié, V., S. Augros, G. Amirault, Y. Bas, J.-F. Desmet, P. Favre, S. Giosa, C. Hoarau, M. Souquet, O. Vinet and M. Barataud (2016). Actualisation des critères acoustiques et synthèse des données concernant le présumé *Scotophilus* sp. à La Réunion (Mascareignes, France). *Le Vespère*, **6:** 385 - 396.
Primus, A., J. Harvey, S. Guimondou, S. Mboumba, R. Ngangui, F. Hoffmann, R. Baker and C. A. Porter (2006). *Karyology and chromosomal evolution of some small mammals inhabiting the rainforest of the Rabi Oil Field, Gabon*. In Alonso, A., M. E. Lee, P. Campbell, O. S. G. Pauwels and F. Dallmeier : *Biodiversity of an Equatorial African Rainforest. Bulletin of the Biological Society of Washington*, **12:** 371 - 382.
Pritchard, P. C. H. (1994). Comment on gender and declension of generic names. *Journal of Mammalogy*, **75:** 549 - 550.
Probst, J.-M. (2003). Fiche patrimoine naturel à protéger le petit molosse *Mormopterus acetabulosus*. *Bulletin Phaethon*, **17:** 19-21.
Proches, S. (2005). The world's biogeographical regions: cluster analyses based on bat distributions. *Journal of Biogeography*, **32 (4):** 607 - 614. doi: 10.1111/j.1365-2699.2004.01186.x.
Proches, S. (2006). Latitudinal and longitudinal barriers in global biogeography. *Biology Letters*, **2 (1):** 69 - 72. doi: 10.1098/rsbl.2005.0396.
Proches, S., Ramdhani and S. (2012). Analyses towards determining Madagascar's place in global biogeography. *Current Zoology*, **58 (3):** 363 - 374.
Puechmaille, S. J., B. Allegrini, P. Benda, K. Gürün, J. Šrámek, C. Ibáñez, J. Juste and R. Bilgin (2014a). A new species of the *Miniopterus schreibersii* species complex (Chiroptera: Miniopteridae) from the Maghreb Region, North Africa. *Zootaxa*, **3794 (1):** 108 - 124. doi: 10.11646/zootaxa.3794.1.4.
Puechmaille, S. J., B. Allegrini, E. S. M. Boston, M.-J. Dubourg-Savage, A. Evin, A. Knochel, Y. Le Bris, V. Lecoq, M. Lemaire, D. Rist and E. C. Teeling (2011a). Genetic analyses reveal further cryptic lineages within the *Myotis nattereri* species complex. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **77 (3):** 224 - 228. doi: 10.1016/j.mambio.2011.11.004.

Puechmaille, S. J., I. M. Borissov, S. Zsebok, S. Allegrini, M. Hizem, S. Kuenzel, M. Schuchmann, E. C. Teeling and B. M. Siemers (2014b). Female mate choice can drive the evolution of high frequency echolocation in bats: a case study with *Rhinolophus mehelyi*. *PLoS ONE*, **9 (7):** e103452. doi: 10.1371/journal.pone.0103452.

Puechmaille, S. J., W. M. Hizem, B. Allegrini and A. Abiadh (2012). Bat fauna of Tunisia: Review of records and new records, morphometrics and echolocation data. *Vespertilio*, **16:** 211 - 239. URL: http://www.ceson.org/vespertilio/16/211_239_Puechmaille.pdf.

Puechmaille, S. (J.), M. Schuchman, S. Zsebok, I. Borissov, E. Teeling and B. Siemers (2011b). Female *Rhinolophus mehelyi* prefer males with high frequency echolocation calls. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 40 - 41. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.

Puechmaille, S. J. and E. C. Teeling (2013). Non-invasive genetics can help find rare species: a case study with *Rhinolophus mehelyi* and *R. euryale* (Rhinolophidae: Chiroptera) in Western Europe. *Mammalia*, **78 (2):** 251 - 255 (for 2014). doi: 10.1515/mammalia-2013-0040.

Puerma, E., M. J. Acosta, M. J. L. Barragán, S. Martínez, J. A. Marchal, M. Bullejos and A. Sánchez (2007). The karyotype and 5S rRNA genes from Spanish individuals of the bat species *Rhinolophus hipposideros* (Rhinolophidae; Chiroptera). *Genetica*. doi: 10.1007/s10709-007-9236-4.

Puscher, H. (1972). Uber die Schultertaschen von *Epomophorus* (Epomophorini, Pteropodidae, Megachiroptera, Mammalia). *Zeitschrift für Säugetierkunde*, **37 (3):** 154 - 161.

Püscher, H. (1972). Über die Schultertaschen von *Epomophorus* (Epomophorini, Pteropodidae, Megachiroptera, Mammalia). *Zeitschrift für Säugetierkunde*, **37 (3):** 154 - 161. [Abstract]

Pye, J. D. (1972). Bimodal distribution of constant frequencies in some hipposiderid bats (Mammalia: Hipposideridae). *Journal of Zoology*, **166 (3):** 323 - 335. doi: 10.1111/j.1469-7998.1972.tb03102.x. [Abstract]

Pye, J. D. (1980). *Echolocation signals and echoes in air.* In Busnel, R. G. and J. F. Fish : *Animal sonar systems.* Plenum Publishing Corporation: New York: 309 - 351.

Qiu, Y., M. Kajihara, H. Harima, B. M. Hang'ombe, R. Nakao, K. Hayashida, A. Mori-Kajihara, K. Changula, Y. Eto, J. Ndebe, R. Yoshida, Y. Takadate, D. Mwizabi, H. Kawabata, M. Simuunza, A. Mweene, H. Sawa, A. Takada and C. Chihiro Sugimoto (2019). Molecular characterization and phylogenetic analysis of *Trypanosoma* spp. detected from striped leaf-nosed bats (*Hipposideros vittatus*) in Zambia. *International Journal for Parasitology - Parasites and Wildlife*, **9:** 234 - 238. doi: 10.1016/j.ijppaw.2019.04.009.

Quan, P.-L., C. Firth, J. M. Conte, S. H. Williams, C. M. Zambrana-Torrelio, S. J. Anthony, J. A. Ellison, A. T. Gilbert, I. V. Kuzmin, Niezgoda, M., M. O. V. Osinubi, S. Recuenco, W. Markotter, R. F. Breiman, L. Kalemba, Malekani, J., K. A. Lindblade, M. K. Rostal, R. Ojeda-Flores, G. Suzan, L. B. Davis, D. M. Blau, A. B. Ogunkoya, D. A. Alvarez Castillo, D. Moran, S. Ngam, D. Akaibe, B. Agwanda, T. Briese, J. H. Epstein, P. Daszak, C. E. Rupprecht, E. C. Holmes and W. I. Lipkin (2013). Bats are a major natural reservoir for hepaciviruses and pegiviruses. *Proceedings of the National Academy of Sciences, U.S.A.*, **110 (20):** 8194 - 8199. doi: 10.1073/pnas.1303037110.

Quan, P.-L., C. Firth, C. Street, J. A. Henriquez, A. Petrosov, A. Tashmukhamedova, S. K. Hutchison, M. Egholm, M. O. V. Osinubi, M. Niezgoda, A. B. Ogunkoya, T. Briese, C. E. Rupprecht and W. I. Lipkin (2010). Identification of a severe acute respiratory syndrome coronavirus-like virus in a leaf-nosed bat in Nigeria. *mBio*, **1 (4) e00208-10:** 1 - 9. doi: 10.1128/mBio.00208-10..

Queiroz, A., P. Alves, I. Barroso, P. Beja, M. Fernandes, L. Freitas, M. Mathias, A. Mira, J. Palmeirim, R. Prieto, A. Rainho, L. Rodrigues, M. Santos-Reis and M. Sequeira (2005). *Pipistrellus maderensis.* In Cabral, M., J. Almeida, P. Almeida, T. Dellinger, N. Ferrand de Almeida, M. Oliveira, J. Palmeirim, A. Queiroz, L. Rogado and M. (Eds.). Santos-Reis : *Livro vermelho dos vertebrados de Portugal.* Instituto da Conservação da Natureza, Lisboa: 457 - 458.

Quetglas, J., O. Balvín, R. K. Lucan and P. Benda (2012). First records of the bat bug *Cacodmus vicinus* (Heteroptera: Cimicidae) from Europe and further data on its distribution. *Vespertilio*, **16:** 243 - 248. URL: http://www.ceson.org/vespertilio/16/243_248_Qetglas.pdf.

Qui, Z., D. Han, G. Qi and L. Yufen (2000). A preliminary report on a micromammalian assemblage from the hominoid locality of Lufeng Co. Yunnan Province. *Acta Anthropologica Sinica*, **4 (1):** 13 - 32.

Qumsiyeh, M. B. (1985). The bats of Egypt. *Special Publication of the Museum of the Texas Tech University*, **23:** 1 - 102. [Abstract]

Qumsiyeh, M. B., Z. S. Amr and R. M. Al-Oran (1998). Further records of bats from Jordan and a synopsis. *Turkish Journal of Zoology*, **22:** 277 - 284. [Abstract]

Qumsiyeh, M. B. and R. J. Baker (1985). G- and C-banded karyotypes of the Rhinopomatidae (Microchiroptera). *Journal of Mammalogy*, **66 (3):** 541 - 544.

Qumsiyeh, M. B. and J. W. Bickham (1993). Chromosomes and relationships of long-eared bats of the genera *Plecotus* and *Otonycteris*. *Journal of Mammalogy*, **74:** 376-382.

Qumsiyeh, M. B., A. M. Disi and Z. S. Amr (1992). Systematics and distribution of the bats (Mammalia: Chiroptera) of Jordan. *Dirasat*, **19 B (2):** 101 - 118. [Abstract]

Qumsiyeh, M. B. and J. K. , Jr. Jones (1986). *Rhinopoma hardwickii* and *Rhinopoma muscatellum*. *Mammalian Species*, **263:** 1 - 5, 5 figs.

Qumsiyeh, M. B., R. D. Owen and R. K. Chesser (1988). Differential rates of genic and chromosomal evolution in bats of the family Rhinolophidae. *Genome*, **30:** 326 - 335. [Abstract]

Qumsiyeh, M. B. and D. A. Schlitter (1981). Bat records from Mauritania, Africa (Mammalia: Chiroptera). *Annals of Carnegie Museum*, **50 (13):** 345 - 351. [Abstract]

Qumsiyeh, M. B. and D. A. Schlitter (1982). The bat fauna of Jabal Al Akhdar, Northeast Libya. *Annals of Carnegie Museum*, **51 (19):** 377 - 389. [Abstract]

Qumsiyeh, M. B., D. A. Schlitter and A. M. Disi (1986). New records and karyotypes of small mammals from Jordan. *Zeitschrift für Säugetierkunde*, **51 (3):** 139 - 146. [Abstract]

Racey, P. A. (1982). *Ecology of bat reproduction.* In Kunz, T.H : *Ecology of bats.* Plenum Publishing Corporation - New York & London: 57 - 104.

Racey, P. A. (2002). The role of fruit bats in maintaining biodiversity in Malagasy forests. Abstract. IX th European Bat Research Symposium - 26 - 30 August 2002 - Le Havre: 20.

Racey, P. (A.) (2004a). 8,000,000 fruit bats. Africa's Best-kept Wildlife Secret. *Bats*, **22 (1):** 1 - 5.

Racey, P. (A.) (2004b). Ecology and conservation of Malagasy bats. *Bat Research News*, **45 (4):** 254.

Racey, P. A. and A. C. Entwistle (2000). *9. Life-history and reproductive strategies of bats.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 363 - 414.

Racey, P. A., S. M. Goodman and R. K. B. Jenkins (2009). *The ecology and conservation of Malagasy Bats.* In Fleming, T.H. and P.A. Racey : *Island Bats - Ecology, Evolution and Conservation.* Chicago University Press - Chicago: 369 - 404.
Racey, P. A. and M. E. Nicoll (1984). *Chapter 31: Mammals of the Seychelles.* In Stoddart, D. R. : *Biogeography and ecology of the Seychelles Islands.* Dr. W. Junk - The Hague: 607 - 626.
Radjhabli, S. I., N. N. Vorontsov and V. T. Volobujev (1970). The karyological analysis of three Myotis species (Chiroptera-Vespertilionidae). *Citologia (Moscow)*, **12:** 767 - 773.
Rafinesque, C. S (1814). *Précis des découvertes et travaux somiologiques.* Palermo: 3 - 55.
Rafinesque, C. S. (1815). *Analyse de la nature : ou tableau de l'univers et des corps organise´s.* Palermo: 244 pp.
Rafinesque, C. S. (1820). *Annals of nature and annual synopsis of new genera and species of animals, plants &c. discovered in North America.* Lexington, Kentucky. 1: 1 - 16.
Rahaingodrahety, V. H. (2007). Ecologie et conservation de *Pteropus rufus* dans la Région de l'Anosy (cas des Communes Rurales d'Amboasary Sud et de Mahatalaky). Unpublished. Mémoire Ingénieur. Ecole Supérieure des Sciences Agronomiques, Département des Eaux et Forêt, Université d'Antananarivo.
Rahaingodrahety, V. N., D. Andriafidison, J. Ratsimbazafy, P. A. Racey and R. K. B. Jenkins (2008). Three flying fox (Pteropodidae: *Pteropus rufus*) roosts, three conservation challenges in southeastern Madagascar. *Madagascar Conservation & Development*, **3 (1):** 17 - 21.
Raharimanga, V., F. Ariey, S. G. Cardiff, S. M. Goodman, A. Tall, D. Rousset and V. Robert (2003). Haemoparasites of bats in Madagascar / Hémoparasites des chauves-souris à Madagascar. *Archives de l'Institut Pasteur de Madagascar.*, **69 (1-2):** 70 - 76.
Raharimihaja, T. E. A., J. L. M. Rakotoarison, P. A. Racey and R. A. Andrianaivoarivelo (2016). A comparison of the effectiveness of methods of deterring Pteropodid bats from feeding on commercial fruit in Madagascar. *Journal of Threatened Taxa*, **8 (13):** 9512 - 9524. doi: 10.11609/jott.2688.8.13.9512-9524.
Raheriarisena, M. (2005). Régime alimentaire de *Pteropus rufus* (Chiroptera: Pteropodidae) dans la région sub-aride du sud de Madagascar. *Revue d'Ecologie (la Terre et la Vie)*, **60 (3):** 255 - 264. URL: http://www.batconservancy.org/siteRoot/pdf/Lubee/Publications/118%20-%20Raheriarisena%20Pt%20rufus%20diet%20Madgascarer.pdf.
Rahm, U. (1965). Distribution et écologie de quelques mammifères de l'est du Congo. *Zoologica Africana*, **1 (1):** 149 - 164. doi: 10.1080/00445096.1965.11447307. [Abstract]
Rahm, U. (1966). Les mammifères de la forêt équatoriale de l'est du Congo. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 149:** 39 - 119. [Abstract]
Rahm, U. and A. Christiaensen (1963). Les Mammifères de la région occidental du lac Kivu. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 118:** 25 - 33.
Rahm, U. and A. Christiaensen (1966). Les mammifères de l'île Idjwi (Lac Kivu, Congo). *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 149:** 1 - 36. [Abstract]
Rainey, W. E. (1998). *Conservation of bats on remote Indo-Pacific islands.* In Kunz, T. H. and P. A. Racey : *Bat Biology and Conservation.* Smithsonian Institution Press - Washington, D.C.: 326 - 341.
Rainho, A. (2007). Summer foraging habitats of bats in a Mediterranean region of the Iberian Peninsula. *Acta Chiropterologica*, **9 (1):** 171 - 181. doi: 10.3161/1733-5329(2007)9[171:SFHOBI]2.0.CO;2.
Rainho, A. (2017). The importance of biotic and abiotic interactions for understanding bat species distributions in an insular system (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 161. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.
Rainho, A. and C. Franco (2001). *Morcegos da Guiné-Bissau. Um contributo para o seu conhecimento.* Instituto da Conservação da Natureza, Lisboa. 86 pp.
Rainho, A., C. F. J. Meyer, S. Thorsteinsdóttir, J. Justino, S. Samba and J. M. Palmeirim (2010a). Distribuição, estatuto e conservação dos morcegos de São Tomé. Centro de Biologia Ambiental - Falculdade de Ciências - Universidade de Lisboa: 1 - 48.
Rainho, A., C. F. J. Meyer, S. Thorsteinsdóttir and J. M. Palmeirim (2010b). Conservation status of bats of the island of São Tomé, Gulf of Guinea. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 256 - 257.
Rainho, A. and J. M. Palmeirim (2013). Prioritizing conservation areas around multispecies bat colonies using spatial modeling. *Animal conservation*, **16 (4):** 438 - 448. doi: 10.1111/acv.12013.
Rainho, A. and J. M. Palmeirim (2017). Understanding the long term consequences of fragmentation: lessons from the bats of Bijagós (Guinea-Bissau,West Africa). *Hystrix, Italian Journal of Mammalogy*, **28 (2):** 173 - 179. doi: 10.4404/hystrix-28.2-12350.
Rajemison, B. and S. M. Goodman (2007). The diet of *Myzopoda schliemanni*, a recently described Malagasy endemic, based on scat analysis. *Acta Chiropterologica*, **9 (1):** 311 - 313.
Rajemison, F. I., O. S. Noroalintseheno Lalarivoniaina, A. Andrianarimisa and S. M. Goodman (2017a). Host-parasite relationships between a Malagasy fruit bat (Pteropodidae) and associated bat fly (Diptera: Nycteribiidae): seasonal variation of host body condition and the possible impact of parasite abundance. *Acta Chiropterologica*, **19 (2):** 229 - 238. doi: 10.3161/15081109ACC2017.19.2.002.
Rajemison, F. I., O. S. Noroalintseheno Lalarivoniaina and S. M. Goodman (2017b). Bat flies (Diptera: Nycteribiidae, Streblidae) parasitising *Rousettus madagascariensis* (Chiroptera: Pteropodidae) in the Parc National d'Ankarana, Madagascar: species diversity, rates of parasitism and sex ratios. *African Entomology*, **25 (1):** 72 - 85. doi: 10.4001/003.025.0072.
Rajemison, F. I., O. S. Noroalintseheno Lalarivoniaina and S. M. Goodman (2017c). Parasitism by Nycteribiidae and Streblidae flies (Diptera) of a Malagasy fruit bat (Pteropodidae): Effects of body size and throat gland development on parasite abundance. *Journal of medical entomology*, **54 (4):** 805 - 811. doi: 10.1093/jme/tjw245.
Rakotoarivelo, A. A., M. Ralisata, O. R. Ravoahangimalala, M. R. Rakotomalala, P. A. Racey and R. K. B. Jenkins (2009). The food habits of a Malagasy Giant: *Hipposideros commersoni* (E. Geoffroy, 1813). *African Journal of Ecology*, **47:** 283 - 288. doi: 10.1111/j.1365-2028.2008.00947.x.
Rakotoarivelo, A. A., N. Ranaivoson, O. R. Ramilijaona, A. F. Kofoky, P. A. Racey and R. K. B. Jenkins (2007). Seasonal food habits of five sympatric forest microchiropterans in western Madagascar. *Journal of Mammalogy*, **88 (4):** 959 - 966. doi: 10.1644/06-MAMM-A-112R1.1.

Rakotoarivelo, A. R., S. M. Goodman, M. C. Schoeman and S. Willows-Munro (2019). Phylogeography and population genetics of the endemic Malagasy bat, *Macronycteris commersoni* s.s. (Chiroptera: Hipposideridae). *PeerJ*, **7:** e5866. doi: 10.7717/peerj.5866.

Rakotoarivelo, A. R. and F. H. Randrianandrianina (2007). A chiropteran survey of the Lac Kinkony-Mahavavy area in western Madagascar. *African Bat Conservation News*, **12:** 2 - 5.

Rakotoarivelo, A. R., J. H. Razafimanahaka, S. Rabesihanaka, J. P. G. Jones and R. K. B. Jenkins (2011). Lois et règlements sur la faune sauvage à Madagascar: Progrès accomplis et besoins du futur. *Madagascar Conservation & Development*, **6 (1):** 37 - 44.

Rakotoarivelo, A. R., S. Willows-Munro, M. C. Schoeman, J. M. Lamb and S. M. Goodman (2015). Cryptic diversity in *Hipposideros commersoni* sensu stricto (Chiroptera: Hipposideridae) in the western portion of Madagascar. *BMC Evolutionary Biology*, **15:** 235. doi: 10.1186/s12862-015-0510-2.

Rakotonandrasana, E. N. and S. M. Goodman (2007). Bat inventories of the Madagascar offshore islands of Nosy Be, Nosy Komba and Ile Sainte-Marie. *African Bat Conservation News*, **12:** 6 - 10.

Rakotondramanana, C. F. and S. M. Goodman (2017). A review of the bacular morphology of Malagasy bats. *Acta Chiropterologica*, **19 (1):** 51 - 70. doi: 10.3161/15081109ACC2017.19.1.004.

Rakotondramanana, C. F., S. M. Goodman, B. Ramasindrazana and M. C. Schoeman (2014). Vocalisations de *Pipistrellus* spp. *sensu lato* de Madagascar: Expérience sur l'effet de confinement. *Malagasy Nature*, **8:** 80 - 88.

Rakotondramanana, C. F., B. Rajemison and S. M. Goodman (2015). Comportement alimentaire des communautés de chauves-souris animalivores de Kirindy (CNFEREF) et d'Antsahabe, Madagascar: répartition, partage et disponibilité de niche alimentaire. *Malagasy Nature*, **9:** 68 - 87.

Rakotondramanana, C. F., Z. Rakotomalala and B. Ramasindrazana (2017). Occurrence of *Taphozous mauritianus* (Emballonuridae) in Maintirano, western Madagascar. *Malagasy Nature*, **12:** 112 - 113.

Rakotondraparany, F. and J. Medard (2005). *Diversité et distribution des micromammifères dans le corridor Mantadia-Zahamena, Madagascar.* In Schimd, J. and L.E. Alonso : *A rapid biological assessment of the Mantadia-Zahamena corridor à Madagascar. Rapide du corridor Mantadia-Zahamena … Madagascar.* Conservation International - Washington, DC, USA: 87 - 97.

Rakotondravony, H. (2006). Communautés locales et gibiers dans la région de Daraina, extrême Nord-Est de Madagascar. *Madagascar Conservation & Development*, **1:** 19-21.

Ralisata, M., F. R. Andriamboavonjy, D. Rakotondravony, O. R. Ravoahangimalala, F. H. Randrianandrianina and P. A. Racey (2010). Monastic *Myzopoda*: the foraging and roosting ecology of a sexually segregated Malagasy endemic bat. *Journal of Zoology*, **282 (2):** 130 - 139. doi: 10.1111/j.1469-7998.2010.00724.x.

Ralisata, M., D. Rakotondravony and P. A. Racey (2015). The relationship between male sucker-footed bats *Myzopoda aurita* and the traveller's tree *Ravenala madagascariensis* in south-eastern Madagascar. *Acta Chiropterologica*, **17 (1):** 95 - 103. doi: 10.3161/15081109ACC2015.17.1.008.

Ralph, T. [M. C.], J. [M.] Lamb, P. J. Taylor and S. [M.] Goodman (2005). Analysis of the genetic diversity of *Otomops* (Chiroptera: Molossidae) in Africa and Madgascar (Abstract). *African Bat Conservation News*, **6:** 6.

Ralph, T. M. C., L. R. Richards, P. J. Taylor, M. C. Napier and J. M. Lamb (2015). Revision of Afro-Malagasy *Otomops* (Chiroptera: Molossidae) with the description of a new Afro-Arabian species. *Zootaxa*, **4057 (1):** 1 - 49. doi: 10.11646/zootaxa.4057.1.1.

Ramanantsalama, R. V., A. Andrianarimisa, A. P. Raselimanana and S. M. Goodman (2018). Rates of hematophagous ectoparasite consumption during grooming by an endemic Madagascar fruit bat. *Parasites & Vectors*, **11:** 330. doi: 10.1186/s13071-018-2918-1.

Ramasindrazana, B., K. Dellagi, E. Lagadec, M. Randrianarivelojosia, S. M. Goodman and P. Tortosa (2016). Diversity, host specialization, and geographic structure of filarial Nematodes infecting Malagasy Bats. *PLoS ONE*, **11 (1):** e0145709. doi: 10.1371/journal.pone.0145709.

Ramasindrazana, B. and S. M. Goodman (2014). Documented record of *Triaenops menamena* (Family Hipposideridae) in the Central Highlands of Madagascar. *African Bat Conservation News*, **35:** 6 - 7.

Ramasindrazana, B., S. M. Goodman, N. Dsouli, Y. Gomard, E. Lagadec, M. Randrianarivelojosia, K. Dellagi and P. Tortosa (2018). *Polychromophilus* spp. (Haemosporida) in Malagasy bats: host specificity and insights on invertebrate vectors. *Malaria Journal*, **17:** 318. doi: 10.1186/s12936-018-2461-8.

Ramasindrazana, B., S. M. Goodman, Y. Gomard, C. W. Dick and P. Tortosa (2017). Hidden diversity of Nycteribiidae (Diptera) bat flies from the Malagasy region and insights on host-parasite interactions. *Parasites & Vectors*, **10:** 630. doi: 10.1186/s13071-017-2582-x.

Ramasindrazana, B., S. M. Goodman, C. F. Rakotondramanana and M. C. Schoeman (2013). Morphological and echolocation call variation in Malagasy trident bats, *Triaenops* Dobson, 1871 (Chiroptera: Hipposideridae). *Acta Chiropterologica*, **15 (2):** 431 - 439. doi: 10.3161/150811013X679053.

Ramasindrazana, B., S. M. Goodman, M. C. Schoeman and B. (R.) Appleton (2011). Identification of cryptic species of *Miniopterus* bats (Chiroptera: Miniopteridae) from Madagascar and the Comoros using bioacoustics overlaid on molecular genetic and morphological characters. *Biological Journal of the Linnean Society*, **104 (2):** 284 - 302. doi: 10.1111/j.1095-8312.2011.01740.x.

Ramasindrazana, B., G. Le Minter and E. Lagadec (2015a). Documented occurrence of *Taphozous mauritianus* (E. Geoffroy, 1818) in Mayotte (Comoros Archipelago). *Malagasy Nature*, **9:** 109 - 110.

Ramasindrazana, B., B. Rajemison and S. M. Goodman (2012). Bio-écologie des chauves-souris du Parc National de Tsimanampetsotsa. 2. Variation interspécifique et saisonnière du régime alimentaire. *Malagasy Nature*, **6:** 117 - 124.

Ramasindrazana, B., C. F. Rakotondramanana, M. C. Schoeman and S. M. Goodman (2015b). Evidence of echolocation call divergence in *Hipposideros commersoni* sensu stricto (E. Geoffroy, 1803) from Madagascar and correlation with body size. *Acta Chiropterologica*, **17 (1):** 85 - 94. doi: 10.3161/15081109ACC2015.17.1.007.

Ramasindrazana, B., D. A. Wilkinson, M. Beral and M. Dietrich (2014). An albino molossid bat from the southwestern Indian Ocean region. *Malagasy Nature*, **8:** 103 - 104.

Rambaldini, D. A. (2010). *Glauconycteris variegata* (Chiroptera: Vespertilionidae). *Mammalian Species*, **42 (870):** 251 - 258. doi: 10.1644/870.1.

Ramírez de Arellano, E., M. Sanchez-Lockhart, M. J. Perteguer, M. Bartlett, M. Ortiz, P. Campioli, A. Hernández, J. Gonzalez, K. Garcia, M. Ramos, M. A. Jiménez-Clavero, A. Tenorio, M. P. Sánchez-Seco, F. González, J. E. Echevarría, G. Palacios and A. Negredo (2019). First evidence of antibodies against Lloviu virus in Schreiber's bent-winged insectivorous bats demonstrate a wide circulation of the virus in spain. *Viruses*, **11 (4):** 360. doi: 10.3390/v11040360.

Ramírez-Pulido, J., J. Arroyo-Cabrales and A. Castro-Campillo (2005). Estado actual y relación nomenclatural de los mamíferos terrestres de México. *Acta Zoologica Mexicana, nueva serie*, **21 (1):** 21 - 82.

Ranaivoson, H. C., J.-M. Héraud, H. K. Goethert, S. R. III Telford, L. Rabetafika and C. E. Brook (2019). Babesial infection in the Madagascan flying fox, *Pteropus rufus* É. Geoffroy, 1803. *Parasites & Vectors*, **12:** 51. doi: 10.1186/s13071-019-3300-7.

Rand, A. L. (1935). On the habits of some Madagascar mammals. *Journal of Mammalogy*, **16 (2):** 89 - 104. [Abstract]

Randrianandrianananina, F., A. Andriafidison, A. F. Kofoky, O. Ramilijaona, F. Ratrimomanarivo, P. A. Racey and R. K. B. Jenkins (2006). Habitat use and conservation of bats in rainforest and adjacent human-modified habitats in eastern Madagascar. *Acta Chiropterologica*, **8 (2):** 429 - 437.

Randrianandrianina, F. H., P. A. Racey and R. K. B. Jenkins (2010). Hunting and consumption of mammals and birds by people in urban areas of western Madagascar. *Oryx*, **44 (3):** 411 - 415. doi: 10.1017/S003060531000044X. URL: http://journals.cambridge.org/action/displayFulltext?type=1&fid=7852113&jid=ORX&volumeId=44&issueId=03&aid=7852111&bodyId=&membershipNumber=&societyETOCSession=.

Ranivo, J. (2001). Contribution à l'étude de la biologie et de l'effet de la prédation humaine sur la roussette: *Eidolon dupreanum* (Pollen, 1866). Unpublished Mémoire de D.E.A. Département de Biologie Animale, Faculté des Sciences, Université d'Antanarivo.

Ranivo, J. and S. M. Goodman (2006). Révision taxinomique des *Triaenops* malgaches (Mammalia, Chiroptera, Hipposideridae). *Zoosystema*, **28 (4):** 963 - 985.

Ranivo, J. and S. M. Goodman (2007a). Patterns of ecomorphological variation in the bats of western Madagascar: Comparisons among and between communities along a latitudinal gradient. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **72 (1):** 1 - 13. doi: 10.1016/j.mambio.2006.08.004.

Ranivo, J. and S. M. Goodman (2007b). Variation géographique de *Hipposideros commersoni* de la zone sèche de Madagascar (Mammalia, Chiroptera, Hipposideridae). *Verhandlungen der naturwissenschaftliche Verein von Hamburg*, **(NF) 43:** 33 - 56.

Ransome, R. D. (1989). Population changes of Greater horseshoe bats studied near Bristol over the past twenty-six years. *Biological Journal of the Linnean Society*, **38:** 71 - 82. [Abstract]

Ransome, R. D. and A. M. Hutson (2000). Action plan for the conservation of the greater horseshoe bat in Europe (*Rhinolophus ferrumequinum*). Nature and Environment, no. 109: 55 pp.

Raselimanana, A. P., M. J. Raherilalao, V. Soarimalala, C. J. Gardner, L. D. Jasper, M. C. Schoeman and S. M. Goodman (2012). Un premier aperçu de la faune de vertébrés du bush épineux de Salary-Bekodoy, à l'ouest du Parc National de Mikea, Madagascar. *Malagasy Nature*, **6:** 1 - 23.

Rasoanoro, M., B. Ramasindrazana, S. M. Goodman, M. Rajerison and M. Randrianarivelojosia (2019). A review of *Trypanosoma* species known from Malagasy vertebrates. *Malagasy Nature*, **13:** 65 - 75.

Rasoanoro, M., B. Ramasindrazana, B. Rajemison, E. Razafimahatratra and S. M. Goodman (2015). Préférence alimentaire des chauves-souris de Kianjavato, région de Vatovavy-Fitovinany, Madagascar. *Malagasy Nature*, **9:** 58 - 67.

Rasolozaka, I. N. (1994). *Les Microchiropteres.* In Goodman, S. M. and O. Legrand : *Inventaire biologique Foret de Zombitse.* Recherches our le development, Serie Sciencies biologiques. No. Special 1994. Antananarivo.

Rasoma, J. and S. M. Goodman (2006). Food habits of the Barn Owl (*Tyto alba*) in spiny bush habitat of arid southwestern Madagascar. *Journal of Arid Environments*, **69:** 537 - 543 (for 2007). doi: 10.1016/j.jaridenv.2006.10.004.

Rasweiler, J. J. IV and N. K. Badwaik (2000). *5. Anatomy and physiology of the female reproductive tract.* In Crichton, E.G. and P.H. Krutzsch [Eds]: *Reproductive biology of bats.* Academic Press - London San Diego: 157 - 219.

Ratcliffe, J. M. (2002). *Myotis welwitschii. Mammalian Species*, **701:** 1 - 3, 3 figs.

Ratrimomanarivo, F. H. (2007). Étude du régime alimentaire d'*Eidolon dupreanum* (Chiroptera: Pteropodidae) dans la région anthropisée des hautes terres du centre de Madagascar. *Revue d'Ecologie (la Terre et la Vie)*, **62:** 229 - 244.

Ratrimomanarivo, F. H. and S. M. Goodman (2005). The first records of the synanthropic occurrence of *Scotophilus* spp. on Madagascar. *African Bat Conservation News*, **6:** 3 - 5.

Ratrimomanarivo, F. H., S. M. Goodman, N. Hoosen, P. J. Taylor and J. Lamb (2008). Morphological and molecular variation in *Mops leucostigma* (Chiroptera: Molossidae) of Madagascar and the Comoros: phylogeny, phylogeography, and geographic variation. *Mittheilungen des hamburgisches zoologisches Museum und Institut*, **105:** 57 - 101.

Ratrimomanarivo, F. H., S. M. Goodman, W. T. Stanley, T. Naidoo, P. J. Taylor and J. Lamb (2009a). Geographic and phylogeographic variation in *Chaerephon leucogaster* (Chiroptera: Molossidae) of Madagascar and the western Indian Ocean islands of Mayotte and Pemba. *Acta Chiropterologica*, **11 (1):** 25 - 52.

Ratrimomanarivo, F. H., S. M. Goodman, P. J. Taylor, B. Melson and J. Lamb (2009b). Morphological and genetic variation in *Mormopterus jugularis* (Chiroptera: Molossidae) in different bioclimatic regions of Madagascar with natural history notes. *Mammalia*, **73:** 110-129. doi: 10.1515/MAMM.2009.032.

Ratrimomanarivo, F. H., J. Vivian, S. M. Goodman and J. Lamb (2007). Morphological and molecular assessment of the specific status of *Mops midas* (Chiroptera: Molossidae) from Madagascar and Africa. *African Zoology*, **42 (2):** 237 - 253.

Rautenbach, I. L. (1971). Notes on the small mammals of the Kalahari Gemsbok National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **14 (1):** 137 - 143. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/724.

Rautenbach, I. L. (1975). Another new bat record for the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **18 (1):** 203 - 204. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/925.

Rautenbach, I. L. (1976). A survey of the mammals occurring in the Golden Gate Highlands National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **19:** 133 - 144.

Rautenbach, I. L. (1982). *Mammals of the Transvaal.* Ecoplan Monograph, N° 1, Ecoplan - Pretoria: 1 - 211.

Rautenbach, I. L. (1985). A new technique for the efficient use of Macro-mistnets. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **28:** 81 - 86. [Abstract]

Rautenbach, I. L. (1986). Karyotypical variation in Southern African Rhinolophidae (Chiroptera and non-geographic morphometric variation in *Rhinolophus denti* Thomas, 1904. *Cimbebasia*, **8 (15):** 129 - 139. [Abstract]

Rautenbach, I. L., G. N. Bronner and D. A. Schlitter (1993). Karyotypic data and attendant systematic implications for the bats of southern Africa. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **36 (2):** 87 - 104. [Abstract]

Rautenbach, I. L., G. De Graaff and U. de V. Pienaar (1979a). Records of seven small mammal species (Insectivora, Chiroptera) new to the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **22 (1):** 81 - 87. [Abstract]

Rautenbach, I. L., N. J. Dippenaar, J. Meester and D. A. Wolhuter (1981a). The status of Southern African mammal taxonomy. Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 39. [Abstract]

Rautenbach, I. L. and I. W. Espie (1982). First records of occurrence for two species of bats in the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **25:** 111 - 112.

Rautenbach, I. L. and M. B. Fenton (1992). Bats from Mana Pools National Park in Zimbabwe and the first record of *Eptesicus rendallii* from that country. *Zeitschrift für Säugetierkunde*, **57:** 112 - 115.

Rautenbach, I. L., M. B. Fenton and L. E. O. Braack (1985). First records of five species of insectivorous bats from the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **28:** 73 - 80. [Abstract]

Rautenbach, I. L., M. B. Fenton, A. C. Kemp and S. J. Van Jaarsveld (1990). Home range and activity of African goshawk *Accipiter tachiro* in relation to their predation on bats. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **33 (2):** 17 - 21. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/437. [Abstract]

Rautenbach, I. L., M. B. Fenton and M. J. Whiting (1996). Bats in riverine forests and woodlands: a latitudinal transect in southern Africa. *Canadian journal of zoology*, **74:** 312 - 322. [Abstract]

Rautenbach, I. L., A. C. Kemp and C. H. Scholtz (1988). Fluctuations in availability of Arthropods correlated with Microchiropteran and Avian predator activities. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **31 (1):** 77 - 90. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/486. [Abstract]

Rautenbach, I. L. and J. A. J. Nel (1978a). Coexistence on Transvaal Carnivora. *Bulletin of the Carnegie Museum of Natural History*, **6:** 138 - 145. [Abstract]

Rautenbach, I. L. and J. A. J. Nel (1978b). Three species of microchiropteran bats recorded for the first time from the south-west Cape Biotic zone. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **31 (11):** 157 - 163. [Abstract]

Rautenbach, I. L. and J. A. J. Nel (1980). Mammal diversity and ecology in the Cedarberg wilderness area, Cape Province. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **32 (5):** 101 - 124. [Abstract]

Rautenbach, I. L., J. A. J. Nel and G. A. Root (1981b). Mammals of Itala Nature Reserve, Natal. *The Lammergeyer: the journal of the Natal Parks, Game & Fish Preservation Board*, **31:** 21 - 37. [Abstract]

Rautenbach, I. L., D. A. Schlitter and L. E. O. Braack (1984). New distributional records of bats for the Republic of South Africa, with special reference to the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **27:** 131 - 135. [Abstract]

Rautenbach, I. L., D. A. Schlitter and G. de Graaff (1979b). Notes on the mammal fauna of the Augrabies falls National Park, and surrounding areas, with special reference to regional zoogeographical implications. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **22 (1):** 157 - 175. [Abstract]

Ravel, A., M. Adaci, M. Bensalah, A.-L. Charruault, E. M. Essid, H. K. AMmar, W. Marzougui, M. Mahboubi, F. Mebrouk, G. Merzeraud, M. Vianey-Liaud, R. Tabuce and L. Marivaux (2016). Origine et radiation initiale des chauves-souris modernes : nouvelles découvertes dans l'Éocène d'Afrique du Nord. *Geodiversitas*, **38 (3):** 355 - 434. doi: 10.5252/g2016n3a3.

Ravel, A., M. Adaci, M. Bensalah, M. Mahboubi, F. Mebrouk, E. M. Essid, W. Marzougui, H. K. Ammar, A.-L. Charruault, R. Lebrun, R. Tabuce, M. Vianey-Liaud and L. Marivaux (2014). New philisids (Mammalia, Chiroptera) from the Early - Middle Eocene of Algeria and Tunisia: new insight into the phylogeny, palaeobiogeography and palaeoecology of the Philisidae. *Journal of Systematic Palaeontology*, **13 (8):** 691 - 709 (for 2015). doi: 10.1080/14772019.2014.941422.

Ravel, A., L. Marivaux, R. Tabuce, M. Adaci, M. Mahboudi, F. Mebrouk and M. Bensalah (2011). The oldest African bat from the early Eocene of El Kohol (Algeria). *Die Naturwissenschaften*, **98 (5):** 397 - 405. doi: 10.1007/s00114-011-0785-0.

Ravel, A., L. Marivaux, R. Tabuce, M. Bel Haj Ali, E. M. Essid and M. Vianey-Liaud (2012). A new large Philisid (Mammalia, Chiroptera, Vespertilionoidea) from the late Early Eocene of Chambi, Tunisia. *Palaeontology*, **55 (5):** 1035 - 1041. doi: 10.1111/j.1475-4983.2012.01160.x.

Ravel, A., L. Marivaux, R. Tabuce and M. Mahboubi (2010). Oldest bat (Chiroptera, Eochiroptera) from Africa: Early Eocene from El Kohol (Algeria). 70th Anniversary Meeting Society of Vertebrate Paleontology. Pittsburgh, Pennsylvania USA, October 10-13, 2010: 149. URL: http://www.vertpaleo.org/meetings/documents/SVP10Abstracts_WEB.pdf.

Ravel A., M. Adaci, M. Bensalah, A-L. Charruault, E. M. Essid, H. K. Ammar, W. Marzougui, M. Mahboubi, F. Mebrouk, G. Merzeraud, M. Vianey-Liaud, R. Tabuce and L. Marivaux (2016). Origine et radiation initiale des chauves-souris modernes: nouvelles découvertes dans l'Éocène d'Afrique du Nord. *Geodiversitas*, **38(3):** 355–434. doi: 10.5252/g2016n3a3.

Ravelomanantsoa, N. A. F., F. Razafimalala, Z. Rakotomalala, J. Ranivo, G. Razafimanjato, L.-A. Rene de Roland, B. Ramasindrazana, C. F. Rakotondramanana and S. M. Goodman (2019). Les chauves-souris du paysage harmonieux protégé du complexe Tsimembo Manambolomaty, region Melaky, Madagascar: diversité et biogéographie. *Malagasy Nature*, **13:** 105 - 116.

Raw, R. N. V., A. Bastian and D. S. Jacobs (2018). It's not all about the Soprano: Rhinolophid bats use multiple acoustic components in echolocation pulses to discriminate between conspecifics and heterospecifics. *PLoS ONE*, **13(7):** e0199703. doi: 10.1371/journal.pone.0199703.

Ray-Chaudhuri, S., S. Rathak and T. Sharma (1968). Chromosomes and affinities of the Pteropodidae and Rhinopomatidae. *The Nucleus*, **(Suppl.):** 96 - 101.

Razafimanahaka, J. H., M. Ralisata, F. Randrianandrianina, R. K. B. Jenkins, J. Ratsirarson and P. A. Racey (2016). Habitat use by the endemic Malagasy bat *Hipposideros commersoni* in a littoral forest. *Acta Chiropterologica*, **18 (2):** 423 - 431. doi: 10.3161/15081109ACC2016.18.2.009.

Razafindrakoto, N., A. Harwell and R. K. B. Jenkins (2010). Bats roosting in public buildings: A preliminary assessment from Moramanga, eastern Madagascar. *Madagascar Conservation & Development*, **5 (2):** 85 - 88. URL: http://www.ajol.info/index.php/mcd/article/viewFile/63136/51000.

Razafindratsimandresy, R., E. M. Jeanmaire, D. Counour, P. F. Vasconcelos, A. A. Sall and J.-M. Reynes (2009). Partial molecular characterization of alphaherpesviruses isolated from tropical bats. *Journal of general virology*, **90 (1):** 44 - 47. doi: 10.1099/vir.0.006825-0.

Razakarivony, V., B. Rajemison and S. M. Goodman (2005). The diet of Malagasy Microchiroptera based on stomach contents. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **70 (5):** 312 - 316. doi: 10.1016/j.mambio.2005.03.005.

Razanajatovo, N. H., L. A. Nomenjanahary, D. A. Wilkinson, J. H. Razafimanahaka, S. M. Goodman, R. K. Jenkins, J. P. G. Jones and J.-M. Heraud (2015). Detection of new genetic variants of Betacoronaviruses in Endemic Frugivorous Bats of Madagascar. *Virology Journal*, **12:** 42. doi: 10.1186/s12985-015-0271-y.

Razgour, O. and Cooper-Bohannon (2015). Bats without borders. Working together to secure a future for bats in southern Africa. *IUCN Bat Specialist Group Newsletter*, **1 (2):** 26 pp.

Razgour, O., C. Korine and D. Saltz (2010). Pond characteristics as determinants of species diversity and community composition in desert bats. *Animal conservation*, **13:** 505 - 513. doi: 10.1111/j.1469-1795.2010.00371.x.

Reardon, S. and M. C. Schoeman (2017). Species richness, functional diversity and assemblage structure of insectivorous bats along an elevational gradient in tropical West Africa. *Acta Chiropterologica*, **19 (2):** 273 - 285. doi: 10.3161/15081109ACC2017.19.2.005.

Reardon, T. (2009). Mega Micro, Yino Yango; what's going on? And who do bats relate to now? *The Australasian Bat Society Newsletter*, **32:** 39 - 40.

Reardon, T. B., N. L. McKenzie, S. J. B. Cooper, B. Appleton, S. Carthew and M. Adams (2014). A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats *Mormopterus* (Chiroptera : Molossidae). *Australian Journal of Zoology*, **62 (2):** 109 - 136. doi: 10.1071/ZO13082.

Reason, P. F., W. J. Trewhella, J. G. Davies and S. Wray (1994). Some observations on the Comoro rousette *Rousettus obliviosus* on Anjouan (Comoro Islands: Western Indian Ocean). *Mammalia*, **58 (3):** 397 - 403. doi: 10.1515/mamm.1994.58.3.397. [Abstract]

Rebelo, H. and J. C. Brito (2007). Bat guild structure and habitat use in the Sahara desert. *African Journal of Ecology*, **45:** 228 - 230. doi: 10.1111/j.1365-2028.2006.00721.x.

Rebelo, H., E. Froufe, J. C. Brito, D. Russo, L. Cistrone, N. Ferrand and G. Jones (2012). Postglacial colonization of Europe by the barbastelle bat: agreement between molecular data and past predictive modeling. *Molecular Ecology*, **21 (11):** 2761 - 2774. doi: 10.1111/j.1365-294X.2012.05566.x.

Rebelo, H. and G. Jones (2013). Effects of climate change on bat distributions: what do we know? What can we do? 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 126. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Reddy, D. (2008). Genetic analysis of *Chaerephon pumilus* (Chiroptera: Molossidae) from southern Africa. Master's thesis - University of KwaZulu-Natal, Durban: i - xiv; 1 - 76.

Reddy, S. and L. M. Dávalos (2003). Geographical sampling bias and its implications for conservation priorities in Africa. *Journal of Biogeography*, **30 (11):** 1719 - 1727.

Reeder, D. A. (2013). Where east (Africa) meets west: bat biodiversity and biogeography in southwestern South Sudan. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 127. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Reeder, D. M., K. M. Helgen, M. E. Vodzak, D. P. Lunde and I. Ejotre (2013). A new genus for a rare African vespertilionid bat: insights from South Sudan. *ZooKeys*, **285:** 89 - 115. doi: 10.3897/zookeys.285.4892.

Rees, A. (1964). A check list of the mammals and amphibia of Ulanga District. *Tanganyika Notes and Records*, **63:** 245 - 248. [Abstract]

Regan, E. C., L. Santini, L. Ingwall-King, M. Hoffmann, C. Rondinini, A. Symes, J. Taylor and S. H. M. Butchart (2015). Global trends in the status of bird and mammal pollinators. *Conservation Letters*, **8 (6):** 397 - 403. doi: 10.1111/conl.12162.

Reguera (1881). *Fauna de Sierra Morena.* .

Rehák, Z. and J. Zukal (2014). Professor Jirí Gaisler 3 July 1934 - 17 July 2014. *Vespertilio*, **17:** 5 - 15.

Reher, S., H. Rabarison, M. Schoroth and K. Dausmann (2019). Seasonal movements of insectivorous bat species in southwestern Madagascar. *Malagasy Nature*, **13:** 117 - 124.

Reichard, J. D., S. I. Prajapati, S. N. Austad, C. Keller and T. H. Kunz (2010). Thermal windows on Brazilian free-tailed bats facilitate thermoregulation during prolonged flight. *Integrated Comparative Biology*, **50 (3):** 1 - 13. doi: 10.1093/icb/icq033.

Reinhardt, K., E. Harney, R. Naylor, S. Gorb and M. T. Siva-Jothy (2007a). Female-limited polymorphism in the copulatory organ of a traumatically inseminating insect. *American Naturalist*, **170 (6):** 931 - 935.

Reinhardt, K. and D. S. Jacobs (2006). Abundance of *Cacodmus villosus* (Stal, 1855) (Heteroptera: Cimicidae) on its host, *Neoromicia capensis* (Chiroptera: Vespertillionidae). *African Entomology*, **14 (2):** 398 - 400.

Reinhardt, K., R. (A.) Naylor and M. T. Siva-Jothy (2005). Bugs from African bats and their roosting sites wanted. *African Bat Conservation News*, **3:** 2.

Reinhardt, K., R. A. Naylor and M. T. Siva-Jothy (2007b). Estimating the mean abundance and feeding rate of a temporal ectoparasite in the wild: *Afrocimex constrictus* (Heteroptera: Cimicidae). *International Journal for Parasitology*, **37 (8-9):** 937 - 942.

Reinhardt, K., R. A. Naylor and M. T. Siva-Jothy (2008). Temperature and humidity differences between roosts of the fruit bat, *Rousettus aegyptiacus* (Geoffroy, 1810), and the refugia of its ectoparasite, *Afrocimex constrictus*. *Acta Chiropterologica*, **10 (1):** 173 - 176. doi: 10.3161/150811008X331207.

Reiter, A., P. Benda and J. Hotový (2007). First record of the Kuhl's Pipistrelle, *Pipistrellus kuhlii* (Kuhl, 1817), in the Czech Republic. *Lynx (Praha)*, **n.s. 38:** 47 - 54.

Reiter, G. (2004). Postnatal growth and reproductive biology of *Rhinolophus hipposideros* (Chiroptera: Rhinolophidae). *Journal of Zoology*, **262 (3):** 231 - 241. doi: 10.1017/S0952836903004588.

Reiter, G., E. Pölzer, H. Mixanig, F. Bontadina and U. Hüttmeir (2012). Impact of landscape fragmentation on a specialised woodland bat, *Rhinolophus hipposideros*. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **78 (4):** 283 - 289 (for 2013). doi: 10.1016/j.mambio.2012.11.003.

Renner, S. S. and R. E. Ricklefs (1994). Systematics and biodiversity. *Trends in Ecology and Evolution*, **9 (6):** 78 - 79.

Rerucha, Š., T. Bartonicka, P. Jedlicka, M. Cižek, O. Hlouša, R. Lucan and I. Horácek (2014). The BAARA (Biological AutomAted RAdiotracking) System: A new approach in ecological field studies. *PLoS ONE*, **10 (2):** e0116785. doi: 10.1371/journal.pone.0116785.

Reside, A. (2003). Bat research in Madagascar with *Lamin'asa Fiarovana Ramanavy* (Conservation of Malagasy Microchiroptera). *The Australasian Bat Society Newsletter*, **21:** 34 - 37.

Reside, A. (2006a). Swazi bats. *The Australasian Bat Society Newsletter*, **26:** 52 - 53.

Reside, A. (2006b). Bats Research in Swaziland. *African Bat Conservation News*, **9:** 2.

Reside, A. (2007). Bat surveys in Mozambique: Maputo to Niassa. *The Australasian Bat Society Newsletter*, **28:** 78 - 80.

Restif, O., D. T. S. Hayman, J. R. C. Pulliam, R. K. Plowright, D. B. George, A. D. Luis, A. A. Cunningham, R. A. Bowen, A. R. Fooks, T. J. O'Shea, J. L. N. Wood and C. T. Webb (2012). Model-guided fieldwork: practical guidelines for

multidisciplinary research on wildlife ecological and epidemiological dynamics. *Ecology Letters*, **15 (10):** 1083 - 1094. doi: 10.1111/j.1461-0248.2012.01836.x.

Reuben, R. (1963). Note on the breeding season of *Rhinopoma hardwickei* Gray. *Journal of the Bombay Natural History Society*, **60:** 722.

Reusken, C. and P. Heyman (2013). Factors driving hantavirus emergence in Europe. *Current Opinion in Virology*, **3 (1):** 92 - 99. doi: 10.1016/j.coviro.2013.01.002.

Reuter, K. E., A. R. Wills, R. W. Lee, E. E. Cordes and B. J. Sewall (2016). Using stable isotopes to infer the impacts of habitat change on the diets and vertical stratification of frugivorous bats in Madagascar. *PLoS ONE*, **11 (4):** e0153192. doi: 10.1371/journal.pone.0153192.

Reuven, Y. (1991). Foraging habits, hunting and breeding success of Lanner Falcons (*Falco biarmicus*) in Israel. *Journal of Raptor Research*, **25 (3):** 77 - 81. [Abstract]

Revilliod, P. A. (1922). Contribution à l'étude des Chiroptères des terrains tertiaires, troisième partie en fin. *Mémoires de la Société Paléontologique Suisse*, **45:** 133 - 195.

Reynes, J.-M., S. F. Andriamandimby, G. M. Razafitrimo, J. Razainirina, E. M. Jeanmaire, H. Bourhy and J.-M. Heraud (2011). Laboratory surveillance of rabies in humans, domestic animals, and bats in Madagascar from 2005 to 2010. *Advances in Preventive Medicine*, **2011:** 727821. doi: 10.4061/2011/727821.

Riad, Z. M., F. M. Mazhar and N. H. M. Zaatar (2000). Cytogenetic classification of some common bats from Egypt. *Egyptian Journal of Zoology*, **34:** 181 - 204.

Riccucci, M. (2011). Same-sex sexual behaviour in bats. *Hystrix, Italian Journal of Mammalogy*, **(n.s.) 22 (1):** 139 - 147. doi: 10.4404/Hystrix-22.1-4478.

Riccucci, M. (2012). Bats as materia medica: an ethnomedical review and implications for conservation. *Vespertilio*, **16:** 249 - 270. URL: http://www.ceson.org/vespertilio/16/249_270_Riccucci.pdf.

Riccucci, M. (2014). Pipistrelli come cibo. Aspetti etnografici e sanitari. *Alimenti & Bevande*, **XVI (6):** 39 - 44.

Riccucci, M. (2016). Play in bats: general overview, current knowledge and future challenges. *Vespertilio*, **18:** 91 - 97.

Riccucci, M. and B. Lanza (2008). *Neoromica* Roberts, 1926 (Mammalia Vespertilionidae): Correction of gender and etymology. *Hystrix, Italian Journal of Mammalogy*, **19 (2):** 175 - 177.

Richard, A., J. Ratsirarson, E. Jaonarisoa, I. A. Youssouf Jacky, I. Fiorentino and J. Ranaivonasy (2016). Chapter 3. Mammalian biodiversity at Bezà Mahafaly: An update. *Malagasy Nature*, **10:** 25 - 35.

Richard, J. (1966). Trématodes de chiroptères de Madagascar. I. Identification de *Plagiorchis vespertilionis* et description de trois *Lecithodendriidae* nouveaux. *Annales de Parasitologie humaine et comparée*, **41 (5):** 413 - 427.

Richards, L. R., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, A. Monadjem, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016a). *A conservation assessment of Scotophilus viridis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Richards, L. R., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, A. Monadjem, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016b). *A conservation assessment of Taphozous perforatus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Richards, L. R., G. C. Contrafatto, J. Lamb and P. J. Taylor (2005). Morphometric variation in populatoins of *Otomops* (Chiroptera: Mollosidae) from mainland Africa and Madagascar (Abstract). *African Bat Conservation News*, **6:** 5.

Richards, L. R., K. (L.) MacEwan, W. White, L. Cohen, D. (S.) Jacobs, A. Monadjem, (M.) C. Schoeman and P. J. Taylor (2016c). *A conservation assessment of Miniopterus inflatus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Richards, L. R., R. V. Rambau, S. M. Goodman, P. J. Taylor, M. C. Schoeman, F. Yang and J. M. Lamb (2016d). Karyotypic evolution in Malagasy Flying Foxes (Pteropodidae, Chiroptera) and their hipposiderid relatives as determined by comparative chromosome painting. *Cytogenetics and cell genetics*, **148 (2-3):** 185 - 198. doi: 10.1159/000446297.

Richards, L. R., R. V. Rambau, J. M. Lamb, P. J. Taylor, F. Yang, M. C. Schoeman and S. M. Goodman (2010). Cross-species chromosome painting in bats from Madagascar: The contribution of Myzopodidae to revealing ancestral syntenies in Chiroptera. *Chromosome Research*, **18 (6):** 635 - 653. doi: 10.1007/s10577-010-9139-6.

Richards, L. R., (M.) C. Schoeman, P. J. Taylor, W. White, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, T. Sethusa and A. Monadjem (2016e). *A conservation assessment of Otomops martiensseni.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Richards, L. R., P. J. Taylor, M. C. Schoeman, S. M. Goodman, P. A. A. G. Van Daele and L. M. Lamb (2012). Cranial size and shape variation in Afrotropical *Otomops* (Mammalia: Chiroptera: Molossidae): testing species limits using a morphometric approach. *Biological Journal of the Linnean Society*, **106 (4):** 910 - 925.

Richards, L. R., W. White, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, A. Monadjem, (M.) C. Schoeman and P. J. Taylor (2016f). *A conservation assessment of Scotoecus albofuscus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Richardson, E. J. and P. J. Taylor (1997). New observations on the large-eared free-tailed bat *Otomops martiensseni*. *Durban Museum Novitates*, **20:** 72 - 74.

Richardson, P. W. (1994). A new method of distinguishing Daubenton's bat (*Myotis daubentonii*) up to one year old from adults. In Gorman, M. L. : *Communications from the Mammal Society- No 68. Journal of Zoology*307 - 344.

Richter, H. V. (2004). The foraging ecology of fruit bats in the seasonal environment of central Zambia. Master's thesis - University of Florida: i - xii; 1 - 143. URL: http://etd.fcla.edu/UF/UFE0006800/richter_h.pdf.

Richter, H. V. and G. S. Cumming (2004). Food availability and animal migrations: The peculiar behaviour of the straw-colored fruit bat at Kasanka National Park, Zambia. *Bat Research News*, **45 (4):** 257.

Richter, H. V. and G. S. Cumming (2006). Food availability and annual migration of the straw-colored fruit bat (*Eidolon helvum*). *Journal of Zoology*, **268 (1):** 35 - 44. doi: 10.1111/j.1469-7998.2005.00020.x.

Richter, H. V. and G. S. Cumming (2008). First application of satellite telemetry to track African straw-coloured fruit bat migration. *Journal of Zoology*, **275 (2):** 172 - 176. doi: 10.1111/j.1469-7998.2008.00425.x.

Riesle-Sbarbaro, S. A., K. Amponsah-Mensah, S. de Vries, V. Nicolas, A. Lalis, R. Suu-Ire, A. A. Cunningham, J. L. N. Wood and D. R. Sargan (2018). The Gambian epauletted fruit bat shows increased genetic divergence in the Ethiopian highlands and in an area of rapid urbanization. *Ecology and Evolution*, **8:** 12803 - 12820. doi: 10.1002/ece3.4709.

Riesle-Sbarbaro, S. A., S. P. W. de Vries, S. Stubbs, K. Amponsah-Mensah, A. A. Cunnigham, J. L. N. Wood and D. R. Sargan (2016). The complete mitochondrial genome of *Epomophorus gambianus* (Chiroptera: Pteropodidae) and its phylogenetic analysis. *Mitochondrial DNA*, **B 1 (1):** 447 - 449. doi: 10.1080/23802359.2016.1181993.

Rijsdijk, K. F., J. P. Hume, F. Bunnik, F. B. V. Florens, C. Baider, B. Shapiro, J. van der Plicht, A. Janoo, O. Griffiths, L. W. van den Hoek Ostende, H. Cremer, T. Vernimmen, P. G. B. De Louw, A. Bholah, S. Saumtally, N. Porch, J. Haile, M. Buckley, M. Collins and E. Gittenberger (2009). Mid-Holocene vertebrate bone Concentration-Lagerstätte on oceanic island Mauritius provides a window into the ecosystem of the dodo (*Raphus cucullatus*). *Quaternary Science Review*, **28 (1-2):** 14 - 24. doi: 10.1016/j.quascirev.2008.09.018.

Rimoin, A. W., V. H. Alfonso, N. A. Hoff, R. H. Doshi, P. Mulembakani, N. K. Kisalu, J.-J. Muyembe, E. W. Okitolonda and L. L. Wright (2017). Human exposure to wild animals in the Sankuru province of the Democratic Republic of the Congo. *EcoHealth*, **14 (3):** 552 - 563. doi: 10.1007/s10393-017-1262-9.

Riskin, D. K. (2001). *Pipistrellus bodenheimeri*. *Mammalian Species*, **651:** 1 - 3, 3 figs.

Riskin, D. K., A. Bergou, K. S. Breuer and S. M. Swartz (2012). Upstroke wing flexion and the inertial cost of bat flight. *Proceedings of the Royal Society of London*, **B 279 (1740):** 2945 - 2950. doi: 10.1098/rspb.2012.0346.

Riskin, D. K., J. Iriarte-Díaz, K. M. Middleton, K. S. Breuer and S. M. Swartz (2010). The effect of body size on the wing movements of pteropodid bats, with insights into thrust and lift production. *Journal of experimental biology*, **213 (23):** 4110 - 4122. doi: 10.1242/jeb.043091.

Riskin, D. K. and P. A. Racey (2010). How do sucker-footed bats hold on, and why do they roost head-up?. *Biological Journal of the Linnean Society*, **99 (2):** 233 - 240.

Robbins, C. B. (1978a). Taxonomic identification and history of *Scotophilus nigrita* (Scheber) (Chiroptera: Vespertilionidae). *Journal of Mammalogy*, **59 (1):** 212 - 213.

Robbins, C. B. (1978b). The Dahomey gap - A reevaluation of its significance as a faunal barrier to west african High Forest Mammals. *Bulletin of the Carnegie Museum of Natural History*, **6:** 168 - 174. [Abstract]

Robbins, C. B. (1980). Small mammals of Togo and Benin. I. Chiroptera. *Mammalia*, **44 (1):** 83 - 88. [Abstract]

Robbins, C. B. (1981). A new high forest species of the bat genus *Scotophilus* (Mammalia: Vespertilionidae). Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 9. [Abstract]

Robbins, C. (B.) (1983). A new high forest species in the African genus *Scotophilus* (Vespertilionidae). In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 19 - 24. [Abstract]

Robbins, C. B. and F. De Vree (1981). Systematic revision of African *Scotophilus* (Chiroptera, Vespertilionidae). Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 41. [Abstract]

Robbins, C. B., F. De Vree and V. Van Cakenberghe (1983). A review of the systematics of the African bat genus *Scotophilus* (Vespertilionidae). In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 25. [Abstract]

Robbins, C. B., F. De Vree and V. Van Cakenberghe (1985). A systematic revision of the African bat genus *Scotophilus* (Vespertilionidae). *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **246:** 51 - 84. [Abstract]

Robbins, L. W. and R. J. Baker (1978). Karyotypic data for African mammals, with a description of an *in vivo* bone marrow technique. *Bulletin of the Carnegie Museum of Natural History*, **6:** 188 - 210. [Abstract]

Robbins, L. W., M. W. Haiduk and D. A. Schlitter (1981). Chromosomal banding studies and their systematic implications in African fruit bats (Chiroptera: Pteropodidae). Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 7. [Abstract]

Robbins, L. W. and V. M. Sarich (1988). Evolutionary relationships in the family Emballonuridae (Chiroptera). *Journal of Mammalogy*, **69 (1):** 1 - 13. doi: 10.2307/1381742. [Abstract]

Roberts, A. (1913). The collection of mammals in the Transvaal Museum registered up to the 31st March, 1913, with descriptions of new species. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **4 (2):** 65 - 107.

Roberts, A. (1914). Supplementary list of African Mammals in the collection of the Transvaal Museum, with descriptions of some species. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **4 (4):** 180 - 186. [Abstract]

Roberts, A. (1915). Additions to the collection of mammals in the Transvaal Museum. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **5 (2):** 116 - 124.

Roberts, A. (1917a). Descriptions of some new mammals. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **5:** 112 - 115.

Roberts, A. (1917b). Fourth supplementary list of mammals in the collection of the Transvaal Museum. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **5 (4):** 263 - 278.

Roberts, A. (1917c). Description of two new species of a new subgenus of bats and a new species of molerats. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **6 (1):** 4 - 6.

Roberts, A. (1919). Descriptions of some new mammals. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **6:** 112 - 115.

Roberts, A. (1924). Some additions to the list of South African Mammals. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **10:** 59 - 76.

Roberts, A. (1926). Some new S. African mammals and some changes in nomenclature. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **11:** 245 - 263.

Roberts, A. (1932a). Preliminary description of fifty-seven new forms of South African mammals. (Mainly 38 from Vernay-Lang Kalahari Expedition, 1930). *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **15 (1):** 1 - 19.

Roberts, A. (1932b). Scientific results of the Vernay-Lang Kalahari expedition, March to September, 1930. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **15:** 187 - 245.

Roberts, A. (1935). Scientific results of the Vernay-Lang Kalahari Expedition, March to September, 1930. Mammals. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **16 (1):** 187 - 249.

Roberts, A. (1946). Descriptions of numerous new subspecies of mammals. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **20 (4):** 303 - 328. [Abstract]

Roberts, A. (1948). ?? Title still needs to be checked. ?? *Special Publication of the Royal Society of South Africa, Robert Broom Commemorative Issue*.
Roberts, A. (1951). *The mammals of South Africa.* The Trustees of "The Mammals of South Africa" book fund. Central News Agency - South Africa: i - xlviii; 1 - 700.
Roberts, A. (1954). *The mammals of South Africa. 2nd edition.* The Trustees of "The Mammals of South Africa" book fund. Central News Agency - South Africa: I - xlvii; 1 - 701.
Roberts, A. (1956). The mammals of the Wonderboom Nature Reserve. *Fauna & flora*, **7:** 125 - 139.
Roberts, P. and W. A. Seabrook (1989). A relationship between black rats (*Rattus rattus*), Seychelle fruit bats (*Pteropus seychellensis aldabrensis*) and the coccoid (*Icerya seychellarum*) (Insecta, Homoptera) on Aldabra Atoll, Seychelles. *Journal of Zoology*, **218 (2):** 332 - 334. doi: 10.1111/j.1469-7998.1989.tb02543.x.
Roberts, T. J. (1977). *Mammals of Pakistan.* Ernest Benn Ltd. London. 361 pp.
Robin, M. H. A. (1881). Diagnoses de deux chiroptères nouveaux de la collection du Muséum d'histoire naturelle. *Bulletin de la Société Philom. de Paris*, **(7) 5:** 90 - 91.
Robin, S. (2007). Suivi et essai d'estimation de la population de chauve-souris frugivore (Pteropus niger) a l'ile Maurice. Proffessionnel Sciences de l'Environnement Terrestre, Universite Paul Cezanne.
Robinson, J. E., D. J. Bell, F. M. Saleh, A. A. Suleiman and I. Barr (2010). Recovery of the Vulnerable Pemba flying fox *Pteropus voeltzkowi*: Population and conservation status. *Oryx*, **44 (3):** 416 - 423. doi: 10.1017/S0030605310000463. URL: http://journals.cambridge.org/action/displayFulltext?type=1&fid=7852119&jid=ORX&volumeId=44&issueId=03&aid=7852117&bodyId=&membershipNumber=&societyETOCSession=.
Robinson, J. E., N. C. D'Cruze, J. S. Dawson and K. E. Green (2006). Bat survey in Montagne des Francais, Antsiranana, northern Madagascar (6 April - 14 December 2005). *African Bat Conservation News*, **9:** 8 - 12.
Rocamora, G. and F. Joubert (2004). The Seychelles sheath-tailed bat *Coleura seychellensis*: monitoring methodologies and recommended priority actions. *Phelsuma*, **12:** 48 - 53. URL: http://islandbiodiversity.com/Phelsuma%2012-1.pdf.
Rocha, R. (2015). Look what the cat dragged in: *Felis silvestris catus* as predators of insular bats and instance of predation on the endangered *Pipistrellus maderensis*. *Barbastella*, **8 (1):** 16 - 19. doi: 10.14709/BarbJ.8.1.2015.04.
Roche, J. (1972). Recherches mammalogiques en Guinée forestière. *Bulletin du Muséum national d'histoire naturelle de Paris*, **(3) 16 (zool 16):** 757 - 781 (for 1971). [Abstract]
Rode, P. (1933). Les mammifères de la mission Dakar-Djibouti (Mission Griaule). *Bulletin du Muséum national d'histoire naturelle de Paris*, **(2) 5 (5):** 353 - 354.
Rode, P. (1937). Etude d'une collection de mammifères de l'Afrique occidentale. *Bulletin du Muséum national d'histoire naturelle de Paris*, **sér. 2, 9:** 234 - 246. [Abstract]
Rode, P. (1941). Catalogue des types de mammifères du Muséum Nationale d'Histoire Naturelle. Ordre des Chiroptères. *Bulletin du Muséum national d'histoire naturelle de Paris*, **(2) 13 (4):** 227 - 252. [Abstract]
Rode, P. (1947). Les mammifères de l'Afrique du Nord. 1. *La terre at la vie: revue d'écologie appliquée*, **94:** 120 - 142. [Abstract]
Rodenas-Cuadrado, P. M., J. Mengede, L. Baas, P. Devanna, T. A. Schmid, M. Yartsev, U. Firzlaff and S. C. Vernes (2018). Mapping the distribution of language related genes *FoxP1, FoxP2*, and *CntnaP2* in the brains of vocal learning bat species. *The Journal of Comparative Neurology*, **526:** 1235 - 1266. doi: 10.1002/cne.24385.
Rodgers, W. A. and K. M. Homewood (1982). Species richness and endemism in the Usambara mountains forests, Tanzania. *Biological Journal of the Linnean Society*, **18:** 197 - 242. [Abstract]
Rodgers, W. A., C. F. Owen and K. M. Homewood (1982). Biogeography of East African forest mammals. *Journal of Biogeography*, **9:** 41 - 54. [Abstract]
Rodhain, J. (1923). Trypanosome d'un Cheiroptère insectivore *Nycteris hispida* Schreber au Congo belge. *Bulletin de la Société de Pathologie exotique et ses filiales*, **16:** 659 - 663.
Rodhain, J. (1926). Plasmodium de *Nycteris hispida* Schreber au Congo Belge. *Bulletin de la Société de Pathologie exotique et ses filiales*, **19:** 780 - 781.
Rodrigues, L. and J. M. Palmeirim (1999). *Rhinolophus mehelyi.* In Mitchell-Jones, A. J., G. Amori, W. Bogdanowicz, B. Kryštufek, P. J. H. Reijnders, F. Spitzenberger, M. Stubbe, J. B. M. Thissen, V. Vohralík and J. Zima : *The Atlas of European Mammals,* Academic Press, London, UK.
Rodrigues, L., H. Rebelo and J. M. Palmeirim (2003). Avaliação da tendência populacional de algumas espécies de morcegos cavernícolas. Estudo integrado no Projecto do Instituto de Canservacao da Natureza "Livro Vermelho dos Vertebrados de Portugal - Revisao", Lisboa.
Rodriguez, R. M., F. Hoffmann, C. A. Porter and R. Baker (2006). *The bat community of the Rabi Oilfield in the Gamba Complex of protected areas, Gabon.* In Alonso, A., M. E. Lee, P. Campbell, O. S. G. Pauwels and F. Dallmeier : *Biodiversity of an Equatorial African Rainforest. Bulletin of the Biological Society of Washington*, **12:** 423 - 428.
Rodríguez-Durán A. (1995). Metabolic rates and thermal conductance in four species of neotropical bats roosting in hot caves. *Comparative Biochemistry and Physiology*, **110A (4):** 347 - 355. [Abstract]
Rodriguez-Luengo, J. L. and J. Garacia Casanova (2002). *Especies invasoras en Canarias. Contributions of the "Workshop on invasive alien species on European Islands and evolutionary isolated ecosystems and group of experts on invasive alien species. Horta, Azores, Portugal (10-12 October).* Directorate of Culture and of Cultural and Natural Heritage, Council of Europe, 44pp.
Roehrs, Z. P. (2009). Vespertilioninae systematics: using mitochondrial and nuclear markers to elucidate phylogenetic relationships. PhD Thesis - Oklahoma State University: i - xv; 1 - 149. URL: http://media.proquest.com/media/pq/classic/doc/1968563941/fmt/ai/rep/NPDF?_s=VUoM136Y1X3yBcu3xhkQSmh9Wcw%3D.
Roehrs, Z. P., J. B. Lack and R. A. Van den Bussche (2010). Tribal phylogenetic relationships within Vespertilioninae (Chiroptera: Vespertilionidae) based on mitochondrial and nuclear sequence data. *Journal of Mammalogy*, **91 (5):** 1073 - 1092. doi: 10.1644/09-MAMM-A-325.1.
Roehrs, Z. P., J. B. Lack and R. A. Van Den Bussche (2011). A molecular phylogenetic reevaluation of the tribe Nycticeiini (Chiroptera: Vespertilionidae). *Acta Chiropterologica*, **13 (1):** 17 - 31. doi: 10.3161/150811011X578598.
Roer, H. (1970). Zur Wasserversorgung der Microchiropteren *Eptesicus zuluensis vansoni* (Vespertilionidae) und *Sauromys petrophilus erongensis* (Molossidae) der Namibwüste. *Bijdragen tot de Dierkunde*, **40 (1):** 71 - 73. [Abstract]
Roer, H. (1971). Zur Lebensweise einiger Microchiropteren der Namibwüste. *Zoologische Abhandlungen - Staatliches Museum für Tierkunde, Dresden*, **32 (4):** 43 - 53. [Abstract]
Roer, H. (1972). Stachelschwein-Erdhöhle als Fledermaus-Tagesquartier. *Myotis*, **10:** 17 - 18.
Roer, H. (1975). Zur kenntnis der Chiropterafauna Suidwestafrikas. *JL.Südwest Afrikanischen Wissenschaftlichen Gesellschaft, Windhoek*, **24:** 105 - 127.

Rollinson, D. P., J. C. Coleman and C. T. Downs (2013). Seasonal differences in foraging dynamics, habitat use and home range size of Wahlberg's epauletted fruit bat in an urban environment. *African Zoology*, **48 (2):** 340 - 350. doi: 10.3377/004.048.0218.

Rollinson, D. P., J. C. Coleman and C. T. Downs (2014). Roost temperature and fidelity of Wahlberg's epauletted fruit bat, *Epomophorus wahlbergi*, in an urban environment. *African Zoology*, **49 (2):** 173 - 180. doi: 10.3377/004.049.0218.

Romagnoli, M. L. and M. S. Springer (2000). Evolutionary relationships among Old World fruitbats (Megachiroptera: Pteropodidae) based on 12S rRNA, tRNA valine, and 16S rRNA gene sequences. *Journal of Mammalian Evolution*, **7 (4):** 259 - 284.

Romankowowa, A. (1963). Comparative study of the skeleton of the hyoid apparatus in some bat species. *Acta Theriologica*, **7 (3):** 15 - 23.

Römer, A. (1862). Verzichniss der im Herzogthum Nassau, insbesondere in der Umgegend von Wiesbaden vorkommenden Säugethiere une Vögel. *Jahresbücher des Vereins für Naturkunde im Herzogthum Nassau*, **18:** 1 - 13.

Rookmaaker, K. (2016). The zoological contributions of Andrew Smith (1797 - 1872) with an annotated bibliography and a numerical analysis of newly described animal species. *Transactions of the Royal Society of South Africa*, **72 (2):** 105 - 173 (for 2017). doi: 10.1080/0035919X.2016.1230078.

Root, J. J. (2012). West Nile virus associations in wild mammals: a synthesis. *Archives of Virology*, **158 (4):** 735 - 752 (for 2013). doi: 10.1007/s00705-012-1516-3.

Rosevear, D. R. (1953). *Checklist and atlas of Nigerian mammals with a foreword on vegetation.* Government printer - Lagos: 131 pp.

Rosevear, D. R. (1962). A review of some African species of *Eptesicus* Rafinesque. *Mammalia*, **26 (4):** 457 - 477. [Abstract]

Rosevear, D. R. (1965). *The bats of West Africa.* Trustees of the British Museum (Natural History) - London: i - xvii; 1 - 418.

Rosin, G., I. Landau and J.-P. Hugot (1978). Considérations sur le genre *Nycteria* (Haemoproteidae) parasite de Microchiroptères africains avec description de quatre espèces nouvelles. *Annales de Parasitologie*, **53 (5):** 447 - 459. [Abstract]

Rossiter, S. J., P. Benda, C. Dietz, S. Zhang and G. Jones (2007). Rangewide phylogeography in the greater horseshoe bat inferred from microsatellites: Implications for population history, taxonomy and conservation. *Molecular Ecology*, **16 (22):** 4699 - 4714. doi: 10.1111/j.1365-294X.2007.03546.x..

Rossiter, S. J., G. Jones, R. D. Ransome and E. M. Barratt (2000a). Parentage, reproductive success and breeding behaviour in the greater horseshoe bat (*Rhinolophus ferrumequinum*). *Proceedings of the Royal Society of London*, **B 267 (1443):** 545 - 551. doi: 10.1098/rspb.2000.1035.

Rossiter, S. J., G. Jones, R. D. Ransome and E. M. Barratt (2000b). Parentage, reproductive success and breeding behaviour in the greater horseshoe bat (*Rhinolophus ferrumequinum*). *Proceedings of the Royal Society of London*, **B 267:** 545 - 551. doi: 10.1046/j.1365-294x.2000.00982.x.

Rosskopf, S. P., J. Held, M. Gmeiner, B. Mordmüller, P.-B. Matsiégui, I. Eckerle, N. Weber, K. Matuschewski and J. Schaer (2018). *Nycteria* and *Polychromophilus* parasite infections of bats in Central Gabon. *Infection, Genetics and Evolution*, **68:** 30 - 34 (for 2019). doi: 10.1016/j.meegid.2018.11.022.

Roth, H. H. and G. Merz (1988). Vorkommen und relative Haufigkeit von Saugetieren im Tai-Regenwald. *Säugetierkundlige Mitteilungen*, **33 (2/3):** 171 - 193.

Rotureau, B., F. Catzeflis and B. Carme (2006). Short report: Absence of Leishmania in Guianan bats. *The American Journal of Tropical Medicine and Hygiene*, **74 (2):** 318 - 321.

Rougeron, V., E. Suquet, G. D. Maganga, D. Jiolle, I. M. Mombo, M. Bourgarel, P. Motsch, C. Arnathau, P. Durand, F. Drexler, C. Drosten, F. Renaud, F. Prugnolle and E. M. Leroy (2016). Characterization and phylogenetic analysis of new bat astroviruses detected in Gabon, Central Africa. *Acta Virologica*, **60 (4):** 386 - 392. doi: 10.4149/av_2016_04_386.

Rousselot, R. (1950). Les roussettes du Soudan (animaux nuisibles). *Comptes Rendus de la première conférence internationale de l'Afrique du Ouest*, **1:** 233 - 238.

Rousset, D. and M. R. Andrianarivelo (2003). *Viruses.* In Goodman, S. M. and J. P. Benstead : *The Natural History of Madagascar.* The University of Chicago Press - Chicago: 165 - 170.

Rowe-Rowe, D. T. and P. J. Taylor (1996). Distribution patterns of terrestrial mammals in KwaZulu-Natal. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **31 (3):** 131 - 144. [Abstract]

Rudoler, N., E. Rubin, S. W. Babyesiza, S. Sebuliba, R. Kityo, J. J. Lutwama, J. Dye and L. Lobel (2018). Metagenomic study of blood samples from bats, Uganda. *International Journal of Infectious Diseases*, **73 (Suppl.):** 392. doi: 10.1016/j.ijid.2018.04.4303.

Rudolph, B.-U., M. Hammer and A. Zahn (2003). Die Mopsfledermaus *Barbastella barbastellus* in Bayern. .

Ruedas, L. A., T. E. , Jr. Lee, J. W. Bickham and D. A. Schlitter (1990). Chromosomes of five species of Vespertilionid bats from Africa. *Journal of Mammalogy*, **71 (1):** 94 - 100.

Ruedi, M. and R. Arlettaz (1991). Biochemical systematics of the Savi's bat (*Hypsugo savii*) (Chiroptera: Vespertilionidae). *Zeitschrift für zoologischen Systematik und Evolutions-forschung*, **29:** 115 - 122. [Abstract]

Ruedi, M. and R. Arlettaz (2013). *Myotis punicus Maghreb Myotis.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 703 - 705.

Ruedi, M., P. Benda, P. Berthier and D. Scaravelli (2004). A molecular appraisal of the *Myotis myotis - blythii - punicus* species complex: the Good, the Bad and the Ugly. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 12.

Ruedi, M., J. L. Eger, B. K. Lim and G. Csorba (2017). A new genus and species of vespertilionid bat from the Indomalayan Region. *Journal of Mammalogy*, **99 (1):** 209 - 222 (for 2018). doi: 10.1093/jmammal/gyx156.

Ruedi, M. and F. Mayer (2001). Molecular systematics of bats of the genus *Myotis* (Vespertilionidae) suggests deterministic ecomorphological convergences. *Molecular phylogenetics and evolution*, **21 (3):** 436 - 448. doi: 10.1006/mpev.2001.1017. URL: http://www.idealibrary.com.

Ruedi, M., S. Puechmaille, C. Ibáñez and J. Juste (2019). Unavailable names in the *Myotis nattereri* species complex. *Journal of Biogeography*, **Xxx (x):** xxx - xxx (in press). doi: 10.1111/jbi.13665.

Ruedi, M., B. Stadelmann, Y. Gager, E. J. P. Douzery, C. M. Francis, L.-K. Lin, A. Guillén-Servent and A. Cibois (2013). Molecular phylogenetic reconstructions identify East Asia as the cradle for the evolution of the cosmopolitan genus *Myotis* (Mammalia, Chiroptera). *Molecular and Phylogenetic Evolution*, **69 (3):** 437 - 449. doi: 10.1016/j.ympev.2013.08.011.

Rughetti, M. and R. Toffoli (2014). Sex-specific seasonal change in body mass in two species of vespertilionid bats. *Acta Chiropterologica*, **16 (1):** 149 - 155. doi: 10.3161/150811014X683363.

Rulli, M. C., M. Santini, D. T. S. Hayman and P. D'Odorico (2017). The nexus between forest fragmentation in Africa and Ebola virus disease outbreaks. *Scientific Reports*, **7:** 41613. doi: 10.1038/srep41613.

Rüppell, E. (1842a). Beschreibung mehrerer neuer Säugethiere, in der zoologischen Sammlung der Senckenbergischen naturforschenden Gesellschaft befindlich. *Museum Senckenberg*, **3 (2):** 131 - 144.

Rüppell, E. (1842b). Verzeichniss der in dem Museum der Senckenbergischen naturforschenden Gesellschaft aufgestellten Sammlungen. 1. Abteilung. Säugethiere und deren Skeletten. *Museum Senckenberg*, **3 (2):** 145 - 196.

Rupprecht, C. E., A. Turmelle and I. V. Kuzmin (2011). A perspective on lyssavirus emergence and perpetuation. *Current Opinion in Virology*, **1 (6):** 662 - 670. doi: 10.1016/j.coviro.2011.10.014.

Rushton, A. R. (1970). Cytotaxonomy and chromosomal evolution of the bats (Mammalia - Chiroptera). *Annales de génétique et de sélection animale*, **2 (4):** 457 - 469. [Abstract]

Russ, J. M. and D. Bennet (1999). *The bats of the Masoala Peninsular, Madagascar and the use of time expansion ultrasound detectors in surveying microchiropteran communities.* Queen's University Belfast - Belfast.

Russ, J. (M.), D. Bennett, K. Ross and A. Kofoky (2001). *A guide to the bats of Madagascar.* Viper Press - Glossop, U.K. URL: http://mampam.50megs.com/madbats/part1.htm.

Russ, J. (M.), D. Bennett, K. Ross and A. Kofoky (2003). *The bats of Madagascar: a field guide with descriptions of echolocation calls.* Viper Press. Glossop. 96 pp.

Russell, A. (L.), F. Bonaccorso, M. Vonhof, C. Pinzari, K. Olival and L. Dávalos (2013). Cautionary tales in reconstructing the evolutionary history of island bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 135. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Russell, A. L., S. M. Goodman and M. P. Cox (2008a). Coalescent analysis support multiple mainland-to-island dispersals in the evolution of Malagasy *Triaenops* bats (Chiroptera: Hipposideridae). *Journal of Biogeography*, **35:** 995 - 1003. doi: 10.1111/j.1365-2699.2008.01891.x.

Russell, A. L., S. M. Goodman, I. Fiorentino and A. D. Yoder (2008b). Population genetic analysis of *Myzopoda* (Chiroptera: Myzopodidae) in Madagascar. *Journal of Mammalogy*, **89 (1):** 209 - 221.

Russell, A. L., E. Palkovacs, S. M. Goodman, J. Ranivo and A. D. Yoder (2004a). A complex inter-species phylogeny reveals distinctive biogeographic patterns of diversification in triple nose-leaf bats (*Triaenops* spp.) in Madagascar. *Bat Research News*, **45 (4):** 259.

Russell, A. L., E. Palkovacs, S. M. Goodman, J. Ranivo and A. D. Yoder (2004b). Trees on Islands: Biogeographic patterns of diversification in Madagascar. *Bat Research News*, **45 (4):** 260.

Russell, A. L., J. Ranivo, E. P. Palkovacs, S. M. Goodman and A. D. Yoder (2007). Working at the interface of phylogenetics and population genetics: a biogeographical analysis of *Triaenops* spp. (Chiroptera: Hipposideridae). *Molecular Ecology*, **16:** 839 - 851. doi: 10.1111/j.1365-294X.2007.03192.x.

Russell, D. E. and B. Sigé (1970). Révision des chiropters lutétiens de Messel (Hesse, Allemagne). *Palaeovertebrata, Montpelier*, **3:** 83 - 102.

Russo, D., D. Almenar, J. (R.) Aihartza, U. Goiti, E. Salsamendi and I. Garin (2005). Habitat selection in sympatric *Rhinolophus mehelyi* and *R. euryale* (Mammalia: Chiroptera). *Journal of Zoology*, **266 (3):** 327 - 332. doi: 10.1017/S0952836905006990.

Russo, D., L. Ancillotto, A. C. Hughes, A. Galimberti and E. Mori (2017). Collection of voucher specimens for bat research: conservation, ethical implications, reduction, and alternatives. *Mammal Review*, **47 (4):** 237 - 246. doi: 10.1111/mam.12095.

Russo, D., M. Di Febbraro, H. Rebelo, M. Mucedda, L. Cistrone, P. Agnelli, P. P. De Pasquale, A. Martinoli, D. Scaravelli, C. Spilinga and L. Bosso (2014). What story does geographic separation of insular bats tell? A case study on Sardinian Rhinolophids. *PLoS ONE*, **9 (10):** e110894. doi: 10.1371/journal.pone.0110894.

Russo, D. and G. Jones (1999). The social calls of Kuhl's pipistrelles *Pipistrellus kuhlii* (Kuhl, 1819): structure and variation (Chiroptera: Vespertilionidae). *Journal of Zoology*, **249:** 476 - 481.

Russo, D., G. Maglio and J. Palmeirim (2010a). Out of the dark: Diurnal activity in *Hipposideros ruber* on São Tomé island, West Africa. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 271 - 272.

Russo, D., G. Maglio, A. Rainho, C. F. J. Meyer and J. M. Palmeirim (2010b). Out of the dark: Diurnal activity in the bat *Hipposideros ruber* on São Tomé island (West Africa). *Mammalian biology (Zeitschrift für Säugetierkunde)*, **76 (6):** 701 - 708. doi: 10.1016/j.mambio.2010.11.007.

Russo, D., S. Teixeira, L. Cistrone, J. Jesus, D. Teixeira, T. Freitas and G. Jones (2009). Social calls are subject to stabilizing selection in insular bats. *Journal of Biogeography*, **36:** 2212 - 2221. doi: 10.1111/j.1365-2699.2009.02158.x.

Rutherford, M. C. and R. H. Westfall (1994). Biomes of Southern Africa: an objective categorization. *Memoirs of the Botanical Survey of South Africa*, **63:** 1 - 94.

Ruxton, A. E. (1926). On mammals collected by Captain C.R.S. Pitman, Game Warden, Entebbe, Uganda. *Annals and Magazine of Natural History*, **ser. 9, 18 (105):** 28 - 33. [Abstract]

Ryan, M. J. and M. D. Tuttle (1987). The role of prey-generated sounds, vision, and echolocation in prey localization by the African bat *Cardioderma cor* (Megadermatidae). *Journal of Comparative Physiology*, **A 161:** 59-66.

Ryan, R. M. (1965). Taxonomic status of the vespertilionid genera *Kerivoula* and *Phoniscus*. *Journal of Mammalogy*, **46:** 517 - 518.

Rydell, J. and R. Arlettaz (1994). Low-frequency echolocation enables the bat *Tadarida teniotis* to feed on tympanate insects. *Proceedings of the Royal Society of London*, **B 257 (1349):** 175 - 178:. doi: 10.1098/rspb.1994.0112. [Abstract]

Rydell, J. and W. Bogdanowicz (1997). *Barbastella barbastellus.* *Mammalian Species*, **557:** 1 - 8, 3 figs.

Rydell, J. and D. W. Yalden (1997). The diets of two high-flying bats from Africa. *Journal of Zoology*, **242 (1):** 69 - 76. doi: 10.1111/j.1469-7998.1997.tb02930.x. [Abstract]

Saavedra, D., A. Such-Sanz, G. Díaz, R. Mariné, I. Regalado, M. López and L. Dantart (2009). *The mammals of the Abune Yosef.* In Saavedra, D. [Ed]: *The Abune Yosef Massif: Birds and mammals of a hidden jewel of Ethiopia.* Centre de Recursos de Biodiversitat Animal. Universitat de Barcelona. Barcelona: 24 - 70. URL: www.ub.edu/crba/publicacions/etiopia/abune.pdf?.

Sabatier, M. and S. Legendre (1985). *Une faune à rongeurs et chiroptères plio-pléistocènes de Madagascar.* Actes du 110e congrès national des sociétés savantes. Montpellier: 21 - 28. [Abstract]

Saéz, A. M., S. Weiss, K. Nowak, V. Lapeyre, F. Zimmermann, A. Düx, H. S. Ku¨hl, M. Kaba, S. Regnaut, K. Merkel, A. Sachse, U. Thiesen, L. Villányi, C. Boesch, P. W. Dabrowski, A. Radonic, A. Nitsche, S. A. J. Leendertz, S. Petterson, S. Becker, V. Krähling, E. Couacy-Hymann, C. Akoua-Koffi, N. Weber, L. Schaade, J. Fahr, M. Borchert, J. F. Gogarten, S.

Calvignac-Spencer and F. H. Leendertz (2014). Investigating the zoonotic origin of the West African Ebola epidemic. *EMBO Molecular Medecin*, **7 (1):** 17 - 23 (for 2015). doi: 10.15252/emmm.201404792.
Safi, K. and D. K. N. Dechmann (2004). Adaptation of brain regions to habitat complexity: a comparative analysis in bats (Chiroptera). Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 8.
Safi, K. and D. K. N. Dechmann (2005). Adaptation of brain regions to habitat complexity: a comparative analysis in bats (Chiroptera). *Proceedings of the Royal Society of London*, **272:** 179 - 186. doi: 10.1098/rspb.2004.2924.
Sagot, M. and G. Chaverri (2015). Effects of roost specialization on extinction risk in bats. *Conservation Biology*, **29 (6):** 1666 - 1673. doi: 10.1111/cobi.12546.
Salamon, M. and B. Klettenheimer (1994). A new technique for marking and later recognizing small mammals in the field. *Journal of Zoology*, **233:** 314 - 317.
Salata, H. A. B. (2012). Environmental factors influencing the distribution of bats (Chiroptera) in South Africa. PhD. Thesis - University of Cape Town: i - xix; 1 - 303. URL: https://open.uct.ac.za/handle/11427/6887.
Salgueiro, P., M. M. Coelho, J.(M.) Palmeirim and M. Ruedi (2002). Genetics and conservation of the Azorean bat *Nyctalus azoreum*. Abstract. IX th European Bat Research Symposium, 26 - 30 August 2002 - Le Havre: 4.
Salgueiro, P., M. M. Coelho, J. M. Palmeirim and M. Ruedi (2004). Mitochondrial DNA variation and population structure of the island endemic Azorean bat (*Nyctalus azoreum*). *Molecular Ecology*, **13 (11):** 3357 - 3366. doi: 10.1111/j.1365-294X.2004.02354.x.
Salgueiro, P., J. M. Palmeirim and M. M. Coelho (2010). Lack of gene flow between the insular bat, *Nyctalus azoreum* and its mainland ancestor *Nyctalus leisleri* (Vespertilionidae, Chiroptera): evidence from microsatellites. *Folia zoologica: International journal of vertebratology*, **59 (1):** 26 - 34.
Salgueiro, P., J. M. Palmeirim, M. Ruedi and M. M. Coelho (2008). Gene flow and population structure of the endemic Azorean bat (*Nyctalus azoreum*) based on microsatellites: implications for conservation. *Conservation Genetics*, **9:** 1163 - 1171 (for 2008). doi: 10.1007/s10592-007-9430-z.
Salgueiro, P., M. Ruedi, M. M. Coelho and J. M. Palmeirim (2006). Genetic divergence and phylogeography in the genus *Nyctalus* (Mammalia, Chiroptera): Implications for population history of the insular bat *Nyctalus azoreum*. *Genetica*, **130:** 169 - 181. doi: 10.1007/s10709-006-9004-x.
Salicini, I., C. Ibáñez and J. Juste (2011). Multilocus phylogeny and species delimitation within the Natterer's bat species complex in the Western Palearctic. *Molecular biology and evolution*, **61 (3):** 888 - 898. doi: 10.1016/j.ympev.2011.08.010.
Salicini, I., C. Ibáñez and J. Juste (2012). Deep differentiation between and within Mediterranean glacial refugia in a flying mammal, the *Myotis nattereri* bat complex. *Journal of Biogeography*, **40 (6):** 1182 - 1193 (for 2013). doi: 10.1111/jbi.12062.
Salleh, M. A., E. S. U. Hang, M. A. Rahman and M. T. Abdulla (1999). *Isolation of genomic DNA from fruit bats of Kelabit Highlands for DNA archiving and determination of genetic variation.* ASEAN Review of Biodiversity and Environmental Conservation (ARBEC). September-October 1999: 1 - 6: 1 - 6. URL: http://www.arbec.com.my/pdf/art11sepoct99.pdf.
Salsamendi, E., I. Arostegui, J. (R.) Aihartza, D. Almenar, U. Goiti and I. Garin (2012a). Foraging ecology in Mehely's horseshoe bats: influence of habitat structure and water availability. *Acta Chiropterologica*, **14 (1):** 121 - 132. doi: 10.3161/150811012X654330.
Salsamendi, E., I. Garin, D. Almenar, U. Goiti, M. Napal and J. (R.) Aihartza (2009). Diet and prey selection in Mehelyi's horseshoe bat *Rhinolophus mehelyi* (Chiroptera, Rhinolophidae) in the south-western Iberian Peninsula. *Acta Chiropterologica*, **10 (2):** 279 - 286 (for 2008). doi: 10.3161/150811008X414854.
Salsamendi, E., I. Garin, I. Arostegui, U. Goiti and J. (R.) Aihartza (2012b). What mechanism of niche segregation allows the coexistence of sympatric sibling rhinolophid bats? *Frontiers in Zoology*, **9:** 30. doi: 10.1186/1742-9994-9-30.
Samonds, K. E. (2007). Late Pleistocene bat fossils from Anjohibe Cave, northwestern Madagascar. *Acta Chiropterologica*, **9 (1):** 39 - 65.
Samonds, K. E., L. R. Godfrey, J. R. Ali, S. M. Goodman, M. Vences, M. R. Sutherland, M. T. Irwin and D. W. Krause (2012). Spatial and temporal arrival patterns of Madagascar's vertebrate fauna explained by distance, ocean currents, and ancestor type. *Proceedings of the National Academy of Sciences, U.S.A.*, **109 (14):** 5352 - 5357. doi: 10.1073/pnas.1113993109.
Sanborn, C. C. (1936). Descriptions and records of African bats. *Field Museum of Natural History, Zoölogical Series*, **20 (14):** 107 - 114. [Abstract]
Sanborn, C. C. (1939). Eight new bats of the genus *Rhinolophus*. *Field Museum of Natural History, Zoölogical Series*, **24 (5):** 37 - 43. [Abstract]
Sanborn, C. C. (1949a). Extension of range of the African bat *Myotis bocagei cupreolus* Thomas. *Journal of Mammalogy*, **30:** 315.
Sanborn, C. C. (1949b). Bats of the genus *Micronycteris* and its subgenera. *Fieldiana: zoology*, **31 (27):** 215 - 233. [Abstract]
Sanborn, C. C. (1950). Chiroptera from Dundo, Lunda, North-eastern Angola. *Publicaçoes culturais - Companhia de Diamantes Angola. Serviços Culturais*, **10:** 51 - 62. [Abstract]
Sanborn, C. C. (1953). Notes sur quelques mammifères de l'Afrique équatoriale française. *Mammalia*, **17 (3):** 164 - 169. doi: 10.1515/mamm.1953.17.3.164. [Abstract]
Sanborn, C. C. and H. Hoogstraal (1953). Some mammals of Yemen and their ectoparasites. *Fieldiana: zoology*, **34 (23):** 229 - 252. [Abstract]
Sanborn, C. C. and H. Hoogstraal (1955). The identification of Egyptian bats. *Journal of the Egyptian Public Health Association*, **30 (4):** 103 - 120. [Abstract]
Sanchez, F. (2006). Harvest rates and patch-use strategy of Egyptian fruit bats in artificial food patches. *Journal of Mammalogy*, **87 (6):** 1140 - 1144.
Sánchez, F., C. Korine, B. P. Kotler and B. Pinshow (2008a). Ethanol concentration in food and body condition affect foraging behavior in Egyptian fruit bats (*Rousettus aegyptiacus*). *Die Naturwissenschaften*. doi: 10.1007/s00114-008-0359-y.
Sanchez, F., C. Korine, M. Steeghs, L.-J. Laarhoven, S. M. Cristescu, F. J. M. Harren, R. Dudley and B. Pinshow (2006). Ethanol and methanol as possible odor cues for Egyptian fruit bats (*Rousettus aegyptiacus*). *Journal of Chemical Ecology*, **32 (6):** 1289 - 1300. doi: 10.1007/s10886-006-9085-0.
Sánchez, F., B. P. Kotler, C. Korine and B. Pinshow (2008b). Sugars are complementary resources to ethanol in foods consumed by Egyptian fruit bats. *Journal of experimental biology*, **211:** 1475 - 1481. doi: 10.1242/jeb.013268.
Sánchez-Villagra, M. R., E. R. Seiffert, T. Martin, E. L. Simons, G. F. Gunnell and Y. Attia (2007). Enigmatic new mammals from the late Eocene of Egypt. *Paläontologische Zeitschrift*, **81 (4):** 406 - 415.

Sanderson, I. T. (1937). *Animal Treasure.* The Viking Press, London: 325 pp.
Sanderson, I. T. (1940). The mammals of the North Cameroons Forest Area. Being the results of the Percy Sladen Expedition to the Mamfe Division of the British Cameroons. *Transactions of the Zoological Society of London*, **24 (for 1939) (7):** 623 - 725.
Santana, S. E. and S. E. Lofgren (2013). Does nasal echolocation influence the modularity of the mammal skull? *Journal of Evolutionary Biology*, **26 (11):** 2520 - 2526. doi: 10.1111/jeb.12235.
Santos, H., J. Juste, C. Ibáñez, J. Palmeirim, R. Godinho, G. Jones and H. Rebelo (2013). Three tales of six bats: factors shaping cryptic bats distribution in Iberia. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 138. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Santos, H., J. Juste, C. Ibáñez, J. M. Palmeirim, R. Godinho, F. Amorim, P. Alves, H. Costa, O. de Paz, G. Pérez-Suarez, S. Martínez-Alos, G. Jones and H. Rebelo (2014). Influences of ecology and biogeography on shaping the distributions of cryptic species: three bat tales in Iberia. *Biological Journal of the Linnean Society*, **112 (1):** 150 - 162.
Saoud, M. F. and M. M. Ramadan (1977). On a new trematode, *Prohemistomum azimi* n.sp. (Trematoda: Cyathocotylidae) from the Egyptian Slit-faced bat. *Zeitschrift für Parasitenkunde*, **53:** 281 - 285.
Sapir, N., N. Horvitz, D. K. N. Dechmann, J. Fahr and M. Wikelski (2014). Commuting fruit bats beneficially modulate their flight in relation to wind. *Proceedings of the Royal Society of London*, **B 281:** 20140018. doi: 10.1098/rspb.2014.0018.
Sara, D. M. J. (2002). Chauves-souris et zoonoses. Thèse pour le doctorat vétérinaire - Ecole nationale vétérinaire d'Alfort: 120 pp. URL: http://www.google.be/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CDAQFjAA&url=http%3A%2F%2Ftheses.vet-alfort.fr%2Ftelecharger.php%3Fid%3D318&ei=zA0zUYLMM-i90QXH9IGgCg&usg=AFQjCNFqHuYjo6q7Zt6E8eZfSZSjNVmOHg.
Sasaki, M., M. Kajihara, K. Changula, A. Mori-Kajihara, H. Ogawa, B. M. Hang'ombe, A. S. Mweene, M. Simuunza, R. Yoshida, M. Carr, Y. Orba, A. Takada and H. Sawa (2018). Identification of group A rotaviruses from Zambian fruit bats provides evidence for long-distance dispersal events in Africa. *Infection, Genetics and Evolution*, **63:** 104 - 109. doi: 10.1016/j.meegid.2018.05.016.
Sasaki, M., Y. Orba, S. Sasaki, G. Gonzalez, A. Ishii, B. M. Hang'ombe, A. S. Mweene, K. Ito and H. Sawa (2016). Multi-reassortant G3P[3] group a rotavirus in a horseshoe bat in Zambia. *Journal of general virology*, **97(10):** 2488–2493. doi: 10.1099/jgv.0.000591.
Satunin, K. A. (1905). Neue und wenig bekannte Säugetiere aus dem Kaukasus und aus Transkaspien. *Isvestija kaukazstrago Muzej*, **2:** 70 - 90. [Abstract]
Satunin, K. A. (1908). Materialy k" poznaniû mlekopitaûsih" Kavkazskago kraâ i Zakaspijskoj oblasti. VIII. Èkskursiâ Kavkazskago Muzeâ v" stepi i predgor'â Vostocnago Zakavkaz'â vesnoû 1907 g. [Materials to the knowledge of mammals of Caucasia and Transcaspia. VIII. Excursion of the Caucasian Museum to the steppes and foothills of Eastern Caucasus in spring 1907]. *Isvestija kaukazstrago Muzej*, **4 (1-2):** 41 - 67.
Satunin, K. A. (1909). Beiträge zur Kenntnis der Säugetierfauna Kaukasiens und Transkaspiens. XII - XVI. *Mitteilungen des Kaukasisches Museums*, **4:** 286 - 300.
Satunin, K. A. (1911). ?? Title still needs to be checked. ?? .
Satunin, K. A. (1912). ?? Title still needs to be checked. ?? .
Savage, D. E. (1951). A Miocene phyllostomatid bat from Colombia, South America. *University of California Publications. Bulletin of the Department of Geology*, **28:** 357 - 366.
Savi (1825). ?? Title still needs to be checked. ?? *Nuova Giornata Letter. Pisa, Scienca*10.
Sayed, N. H. M. (2011). Phylogenetic relationship between the Fruit Bat (*Rousettus aegyptiacus*) and Lesser Tailed Bat (*Rhinopoma Hardwickei*) inferred from G-banded chromosomes and electrophoretic protein pattern analysis. *American Journal of Science*, **7 (10):** 656 - 669.
Scalley, M., O. Madsen, C. J. Douady, E. De Jong, M. J Stanhope and M. S. Springer (2001). Molecular evidence for the major clades of placental mammals. *Journal of Mammalian Evolution*, **8:** 239 - 277.
Scaramella, D. (1975). I mammiferi dello Yemen (Y.A.R.) controllati al livello della sottospecie. *Bollettino - Società dei naturalisti [Napoli]*, **84:** 373 - 403. [Abstract]
Schaer, J., S. L. Perkins, J. Decher, F. H. Leendertz, J. Fahr, N. Weber and K. Matuschewski (2013a). High diversity of West African bat malaria parasites and a tight link with rodent *Plasmodium* taxa. *Proceedings of the National Academy of Sciences, U.S.A.*, **110 (43):** 17415 - 17419. doi: 10.1073/pnas.1311016110.
Schaer, J., S. L. Perkins, I. Ejotre, M. E. Vodzak, K. Matuschewski and D. M. Reeder (2017). Epauletted fruit bats display exceptionally high infections with a *Hepatocystis* species complex in South Sudan. *Scientific Reports*, **7:** 6928. doi: 10.1038/s41598-017-07093-z.
Schaer, J., D. A. Reeder, M. Vodzak, K. Matuschewski, F. Mayer and S. Perkins (2013b). Bat malaria - a focus on *Hepatocystis* in African epauletted fruit bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 139. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Schaer, J., D. M. Reeder, M. E. Vodzak, K. J. Olival, N. Weber, F. Mayer, K. Matuschewski and S. L. Perkins (2015). *Nycteria* parasites of Afrotropical insectivorous bats. *International Journal for Parasitology*, **45 (6):** 375 - 384. doi: j.ijpara.2015.01.008.
Schalk, G. and R. M. Brigham (1995). Prey selection by insectivorous bats: are essential fatty acid important?. *Canadian journal of zoology*, **73:** 1855 - 1859.
Scharff, R. F. (1900). LXXIII. *Mormopterus Whitleyi* - a new species of bat from W. Africa. *Annals and Magazine of Natural History*, **ser. 7, 6 (36):** 569 - 570.
Schätti, B. (1984). Fledermäuse als Nahrung von Schlangen. *Bonner zoologische Beitrage*, **35 (4):** 335 - 342. URL: http://zfmk.de/BZB/1984/1984%20Sch%E4tti%20B.%20p335%20orginal.pdf. [Abstract]
Schinz, H. (1840). *Europäische Fauna oder Verzeichniss der Wirbelthiere Europa's. 1. Band. Säugethiere und Vögel.* Schweizerbarts Verlagshandlung - Stuttgart.
Schinz, H. R. (1821). *Das Thierreich eingetheilt nach dem Bau der Thiere als Grundlage ihrer Naturgeschichte und der vergleichenden Anatomie von dem Herrn Ritter von Cuvier. Erster band. Säugethiere und Vögel. Volume 1.* J.G. Cotta'schen Buchhandlung - Stuttgart und Tübingen: 894 pp. URL: http://babel.hathitrust.org/cgi/pt?id=chi.65465343;view=1up;seq=204.
Schlegel, H. (1867). List of the most remarkable species of mammals and birds collected by Messrs. Fr. Pollen and D.C. van Dam in Madagascar. and about to be described in a work entitled 'Recherches sur la Faune de Madagascar et de ses dependances, par MM. H. Schlegel et Fr.Pollen'. *Proceedings of the Zoological Society of London*, **1866, III:** 419 - 426.

Schlegel, H. (1881). XIV. On the zoological researches in West Africa. *Notes Leyden Museum*, **3 (2):** 53 - 58.
Schlegel, H. and F. Pollen (1867). ?? Title still needs to be checked. ?? *Proceedings of the Zoological Society of London*1866, III.
Schliemann, H. (1970). Bau und Funktion der Haftorgane von *Thyroptera* und *Myzopoda* (Vespertilionoidea, Microchiroptera, Mammalia). *Zeitschrift für wissenschaftliche Zoologie*, **181:** 353 - 400.
Schliemann, H. (1971). Die Haftorgane von *Thyroptera* und *Myzopoda* (Microchiroptera Mammalia) - Gedanken zu ihr Entstehung als Parallelbildungen. *Zeitschrift für zoologischen Systematik und Evolutions-forschung*, **9:** 61 - 80.
Schliemann, H. and S. M. Goodman (2003). *Myzopoda aurita, Old World Suker-footed Bats.* In Goodman, S.M. and J.P. Benstead : *The Natural History of Madagascar.* University of Chicargo - Chicargo, USA: 1303 - 1306.
Schliemann, H. and B. Maas (1978). *Myzopoda aurita*. *Mammalian Species*, **116:** 1 - 2, 3 figs.
Schliemann, H. and E. Schlosser (1978). Zur Frage der Festheftung von *Pipistrellus nanus* in den Blattüten von Bananenpflanzen. *Zeitschrift für Säugetierkunde*, **43:** 243 - 244.
Schlitter, D. A. (1974). Comments on Harrison, D.L.: The mammals of Arabia. vol III. Lagomorpha, Rodentia. *Journal of Mammalogy*, **55 (2):** 483 - 484.
Schlitter, D. A. (1975). Kitti Thonglongya, 1928 - 1974. *Journal of Mammalogy*, **56 (1):** 279 - 280.
Schlitter, D. A. (1978a). Ecology and taxonomy of African small mammals. *Bulletin of the Carnegie Museum of Natural History*, **6:** 1 - 214.
Schlitter, D. A. (1978b). Problems and priorities of research on the taxonomy and ecology of African small mammals. *Bulletin of the Carnegie Museum of Natural History*, **6:** 211 - 214.
Schlitter, D. (A.) (2004a). *Laephotis wintoni*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004b). *Laephotis namibensis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004c). *Laephotis botswanae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004d). *Glauconycteris machadoi*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004e). *Eptesicus platyop*. In IUCN 2006 : *2006 IUCN Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004f). *Glauconycteris curryae*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004g). *Miniopterus fraterculus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004h). *Miniopterus africanus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004i). *Miniopterus schreibersii*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004j). *Miniopterus inflatus*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2004k). *Glauconycteris humeralis*. In IUCN 2006 : *2006 IUCN Red List of Threatened Species.* . URL: www.iucnredlist.org.
Schlitter, D. (A.) (2008a). *Eptesicus platyops*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. (A.) (2008b). *Glauconycteris curryae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. (A.) (2008c). *Glauconycteris humeralis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. (A.) (2008d). *Glauconycteris machadoi*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. (A.) (2008e). *Laephotis botswanae*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. (A.) (2008f). *Laephotis namibensis*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. (A.) (2008g). *Laephotis wintoni*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. (A.) (2008h). *Miniopterus inflatus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. A. and I. R. Aggundey (1986). Systematics of African bats of the genus *Eptesicus* (Mammalia: Vespertilionidae). 1. Taxonomic status of the large serotines of Eastern and southern Africa. *Cimbebasia*, **(A) 8 (20):** 167 - 174. [Abstract]
Schlitter, D. A., I. R. Aggundey, M. B. Qumsiyeh, K. Nelson and R. L. Honeycutt (1986). Taxonomic and distributional notes on bats from Kenya. *Annals of Carnegie Museum*, **55 (12):** 297 - 302. [Abstract]
Schlitter, D. A. and A. F. DeBlase (1974). Taxonomy and geographic distribution of *Rhinopoma microphyllum* (Chiroptera: Rhinopomatidae) in Iran, with the description of a new subspecies. *Mammalia*, **38 (4):** 647 - 665. [Abstract]
Schlitter, D. A. and M. J. Delany (1985). Geographic areas of Africa poorly represented in mammal research collections. *Acta zoologica Fennica*, **170:** 47 - 48. [Abstract]
Schlitter, D. (A.), A. M. Hutson, P. A. Racey and J. Ravino (2008). *Miniopterus fraterculus*. In IUCN 2009 : *IUCN Red List of Threatened Species.* Version 2009.2. <www.iucnredlist.org>.
Schlitter, D. A. and S. B. McLaren (1981). An additional record of *Myonycteris relicta* Bergmans, 1980, from Tanzania (Mammalia: Chiroptera). *Annals of Carnegie Museum*, **50 (16):** 385 - 389. [Abstract]
Schlitter, D. A. and M. B. Qumsiyeh (1996). *Rhinopoma microphyllum*. *Mammalian Species*, **542:** 1 - 5, 4 figs.
Schlitter, D. A. and I. L. Rautenbach (1977). The occurrence of the Aloe bat *Eptesicus zuluensis* in the Kruger National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **20:** 187 - 188.
Schlitter, D. A., I. L. Rautenbach and D. A. Wolhuter (1980). Karyotypes and morphometrics of two species of *Scotophilus* in South Africa (Mammalia: Vespertilionidae). *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **32 (9):** 231 - 239. [Abstract]
Schlitter, D. A. and L. W. Robbins (1973). Presence of *Tadarida* in the Central Sahara. *Mammalia*, **37 (1):** 199.

Schlitter, D. A., L. W. Robbins and S. A. Buchanan (1982). Bats of the Central African Republic (Mammalia: Chiroptera). *Annals of Carnegie Museum*, **51 (8):** 133 - 155. [Abstract]
Schlitter, D. A., S. L. Williams and J. E. Hill (1983). Taxonomic review of Temminck's trident bat, *Aselliscus tricuspidatus* (Temminck, 1834) (Mammalia: Hipposideridae). *Annals of Carnegie Museum*, **52 (15):** 337 - 358. [Abstract]
Schlosser, M. (1910). Über einige fossile Saugetiere aus dem Oligocän von Ägypten. *Zoologischer Anzeiger*, **53:** 500 - 508.
Schlosser, M. (1911). Beiträge zur Kentniss der Oligozänen Landsäugetiere aus dem Fayum: Aegypten. *Beitr. Paläont. Geol. Öst.-Ung.*, **24:** 51 - 167.
Schmid, J. and L. E. Alonso (2005). *A rapid biological assessment of the Mantadia-Zahamena corridor, Madagascar.* Conservation International, Washington, DC, USA.
Schmid, J. and L. E. Alonso (2007). A rapid biological assessment of the Mantadia-Zahamena corridor, Madagascar. Conservation International, Washington, DC, USA.
Schmidt, D. F., C. A. Ludwig and M. D. Carleton (2008). The Smithsonian Institution African Mammal Project (1961-1972): An Annotated Gazetteer of Collecting Localities and Summary of Its Taxonomic and Geographic Scope. *Smithsonian Contributions to Zoology*, **628:** viii + 320 pp.
Schmidt, K. M. and E. Mühlberger (2016). Marburg virus reverse genetics systems. *Viruses*, **8:** 178. doi: 10.3390/v8060178.
Schmidt, U. and G. Joermann (1983). Untersuchungen zur Echoortung um Gruppenflug bei Mausschwanzfledermäusen (*Rhinopoma microphyllum*). *Zeitschrift für Säugetierkunde*, **48:** 201 - 210. [Abstract]
Schmidt, U. and G. Joermann (1986). The influence of acoustical interferences on echolocation in bats. *Mammalia*, **50:** 379-389.
Schmieder, D. A., H. A. Benítez, I. M. Borissov and C. Fruciano (2015). Bat species comparisons based on external morphology: a test of traditional versus geometric morphometric approaches. *PLoS ONE*, **10 (5):** e0127043. doi: 10.1371/journal.pone.0127043.
Schmieder, D. (A.), R. Heckel, B. Siemers and T. Kingston (2013). Sympatric horseshoe bats differ in flight performance in confined space. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 140. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Schneider (1871). ?? Title still needs to be checked. ?? *Nouvelles Mémoires du Société Helvétique*24.
Schneider, R., H.-J. Kuhn and G. Kelemen (1967). Der Larynx des mannlichen *Hypsignathus monstrosus* Allen, 1861 (Pteropodidae, Megachiroptera, Mammalia). Ein Unikum in der Morphologie des Kehlkopfes. *Zeitschrift für wissenschaftliche Zoologie*, **175 (1-2):** 1 - 53.
Schnitzler, H., E. Kalko, L. Miller and A. Surlykke (1987). The echolocation and hunting behavior of the bat, *Pipistrellus kuhli*. *Journal of Comparative Physiology*, **A 161:** 267 - 274.
Schoeman, C. M., F. D. P. Cotterill, P. J. Taylor and A. Monadjem (2010). Environmental correlates of bat species richness in Central and southern Africa: Effects of spatial structure, taxonomy and model selection. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 279.
Schoeman, C. M. and D. S. Jacobs (2004). The influence of prey defense, competition and environmental factors on the structure of insectivorous bat ensembles in South Africa. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 16.
Schoeman, C. M., S. Moonsamy and S. Naidoo (2009). Ecological light pollution affects the influence of competition and prey defences on the community structure of insectivorous bats. 50th Anniversary Conference of the Zoological Society of Southern Africa. 21 - 25 July 2009 - Natalia, Illovo Beach, KwaZulu-Natal: 63. URL: http://academic.sun.ac.za/botzoo/zssa/ZSSA_2009_Abstract_Booklet.pdf.
Schoeman, M. C. (2005). The distribution range of *Rhinolophus clivosus* in Africa may be the result of an adaptive shift to an alternative prey type and not a consequence of its niche breadth (Abstract). *African Bat Conservation News*, **6:** 7 - 8.
Schoeman, M. C. (2015). Light pollution at stadiums favors urban exploiter bats. *Animal conservation*, **19 (2):** 120 - 130 (for 2016). doi: 10.1111/acv.12220.
Schoeman, M. C., F. P. D. Cotterill, P. J. Taylor and A. Monadjem (2013a). Using potential distributions to explore environmental correlates of bat species richness in southern Africa: Effects of model selection and taxonomy. *Current Zoology*, **59 (3):** 279 - 293.
Schoeman, M. C. and S. M. Goodman (2012). Vocalizations in the Malagasy cave-dwelling fruit bat, *Eidolon dupreanum*: Possible evidence of incipient echolocation? *Acta Chiropterologica*, **14 (2):** 409 - 416. doi: 10.3161/150811012X661729.
Schoeman, (M.) C., S. (M.) Goodman, B. Ramasindrazana and B. (R.) Appleton (2013b). Species interactions during diversification and community assembly in *Miniopterus* bats in Madagascar. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 141. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Schoeman, M. C., S. M. Goodman, B. Ramasindrazana and D. Koubínova (2014). Species interactions during diversification and community assembly in Malagasy *Miniopterus* bats. *Evolutionary Ecology*, **29 (1):** 17 - 47 (for 2015). doi: 10.1007/s10682-014-9745-4.
Schoeman, M. C. and D. S. Jacobs (2002). Support for the allotonic frequency hypothesis in an insectivorous bat community. *Oecologia*, **134 (1):** 154 - 162 (for 2003). doi: 10.1007/s00442-002-1107-1.
Schoeman, M. C. and D. S. Jacobs (2008). The relative influence of competition and prey defenses on the phenotypic structure of insectivorous bat ensembles in Southern Africa. *PLoS ONE*, **3 (11) e3715:** 1 - 10. doi: 10.1371/journal.pone.0003715.
Schoeman, M. C. and D. S. Jacobs (2010). The relative influence of competition and prey defences on the trophic structure of animalivorous bat ensembles. *Oecologia*, **166 (2):** 493 - 506 (for 2011). doi: 10.1007/s00442-010-1854-3.
Schoeman, (M.) C., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, A. Monadjem, L. R. Richards, T. Sethusa and P. J. Taylor (2016a). *A conservation assessment of Rhinolophus denti.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Schoeman, M. C. and A. Monadjem (2018). Community structure of bats in the savannas of southern Africa: influence of scale and human land-use. *Hystrix, Italian Journal of Mammalogy*, **29 (1):** 3 - 10. doi: 10.4404/hystrix–00038-2017.
Schoeman, (M.) C., A. Monadjem, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, T. Sethusa and P. J. Taylor (2016b). *A conservation assessment of Nycteris woodi.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Schoeman, (M.) C., P. J. Taylor, W. White, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, T. Sethusa and A. Monadjem (2016c). *A conservation assessment of Glauconycteris variegata.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Schoeman, M. C. and K. J. Waddington (2011). Do deterministic processes influence the phenotypic patterns of animalivorous bat ensembles at urban rivers? *African Zoology*, **46 (2):** 288 - 301.

Schoeman, (M.) C., W. White, A. Monadjem, L. R. Richards, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, T. Sethusa and P. J. Taylor (2016d). *A conservation assessment of Epomophorus wahlbergi.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Schofield, H. W. (1999). *Rhinolophus hipposideros.* In Mitchell-Jones, A. J., G. Amori, W. Bogdanowicz, B. Kryštufek, P. J. .H. Reijnders, F., Stubbe, M., Thissen, J. B. M. Spitzenberger, V. Vohralík and J. Zima : *The Atlas of European Mammals.* Academic Press, London, UK.

Schönenberger, N. and H. C. Lane (1971). Quelques données sur le cordon nerveux digital alaire des Megachiroptères (*Rousettus aegyptiacus* et *Pteropus giganteus*). *Revue suisse de zoologie*, **78 (3) 28:** 650 - 655. [Abstract]

Schountz, T. (2014). Immunology of bats and their viruses: challenges and opportunities. *Viruses*, **6 (12):** 4880 - 4901. doi: 10.3390/v6124880.

Schountz, T., M. L. Baker, J. Butler and V. Munster (2017). Immunological control of viral infections in bats and the emergence of viruses highly pathogenic to humans. *Frontiers in Immunology*, **8:** 1098. doi: 10.3389/fimmu.2017.01098.

Schouteden, H (1934). Les mammifères du secteur méridional du Parc National Albert (Kivu). *Revue de zoologie et de botanique africaines*, **25:** 291 - 304.

Schouteden, H. (1935). Les mammifères du secteur septentrional du Parc National Albert (Kivu). *Revue de zoologie et de botanique africaines*, **26:** 202 - 210.

Schouteden, H. (1943a). Catalogue des mammiferes du Congo belge et du Ruanda-Urundi. *Revue de zoologie et de botanique africaines*, **37:** 102 - 125.

Schouteden, H. (1943b). Note sur deux Chiroptères congolais: Otomops et Pieces. *Revue de zoologie et de botanique africaines*, **37:** 320 - 322.

Schouteden, H. (1944). De zoogdieren van Belgisch Congo en van Ruanda-Urundi. I. Primates, Chiroptera, Insectivora, Pholidota. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **1 (3):** 1 - 168.

Schouteden, H. (1947). De Zoogdieren van Belgisch Congo en van Ruanda-Urundi. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(2) 3:** 1 - 576, 610 figs.

Schouteden, H. (1948). Faune du Congo Belge et du Ruanda-Urundi. I. Mammifères. *Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **(8) 1:** 1 - 331, 295 figs.

Schrank, F. von P. (1798). *Fauna Boica. Bd. 1-3. Durchgedachte Geschichte der in Baiern einheimischen und zahmen Thiere.* Nürnberg: Stein 1798-1803: xii, 720 pp.

Schreber, J. C. D. von (1774a). *Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen. Vol. 1.* 1 (7): 190 pp., 62 pls.

Schreber, J. C. D. von (1774b). *Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen. Vol. 1.* 1 (9).

Schreber, J. C. D. von (1774c). *Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen. Vol. 1.* 1 (8).

Schuchmann, M., S. J. Puechmaille and B. M. Siemers (2012). Horseshoe bats recognise the sex of conspecifics from their echolocation calls. *Acta Chiropterologica*, **14 (1):** 161 - 166. doi: 10.3161/150811012X654376.

Schuh, A. J., B. R. Amman, D. A. Apanaskevich, T. K. Sealy, S. T. Nichol and J. S. Towner (2016). No evidence for the involvement of the argasid tick *Ornithodoros faini* in the enzootic maintenance of Marburgvirus within Egyptian rousette bats *Rousettus aegyptiacus*. *Parasites & Vectors*, **9:** 128. doi: 10.1186/s13071-016-1390-z.

Schuh, A. J., B. R. Amman, M. E. B. Jones, T. K. Sealy, L. S. Uebelhoer, J. R. Spengler, B. E. Martin, J. A. D. Coleman-McCray, S. T. Nichol and J. S. Towner (2017a). Modelling filovirus maintenance in nature by experimental transmission of Marburg virus between Egyptian rousette bats. *Nature Communications*, **8:** 14446. doi: 10.1038/ncomms14446.

Schuh, A. J., B. R. Amman, T. K. Sealy, J. R. Spengler, S. T. Nichol and J. S. Towner (2017b). Egyptian rousette bats maintain long-term protective immunity against Marburg virus infection despite diminished antibody levels. *Scientific Reports*, **7:** 8763. doi: 10.1038/s41598-017-07824-2.

Schuh, A. J., B. R. Amman and J. S. Towner (2017c). Filoviruses and bats. *Microbiology Australia*, **38(5):** 12 - 16. doi: 10.1071/MA17005.

Schulenberg, J. (2005). *Säugetiere (Mammalia).* In Gunther, A., U. Nigmann and R. Achtziger [Eds]: *Analyse der Gefährdungsursachen von planungsrelevanten Tiergruppen in Deutschland zur Ergänzung der bestehenden Roten Listen gefährdeter Tiere.- Schriftenr* Biol Vielfalt, BfN, Bonn-Bad Godesberg, 70-112 pp.

Schulze (1893). ?? Title still needs to be checked. ?? .

Schulze (1897). ?? Title still needs to be checked. ?? .

Schutt, W. A. , Jr. and N. B. Simmons (1998). Morphology and homology of the chiropteran calcar, with comments on the phylogenetic relationships of *Archaeopteropus*. *Journal of Mammalian Evolution*, **5 (1):** 1 - 32. [Abstract]

Schwan, T. and N. Hikes (1979). Fiscal Shrike predation on the bat *Pipistrellus kuhli* in Kenya. *Biotropica*, **11 (1):** 21.

Schwann, H. (1905). A list of the mammals collected by the Hon. N.C. Rothschild, the Hon. F.R. Henley, and Mr. A.F.R. Wollaston in Egypt and the Soudan in January, February and March 1904. *Novitates Zoologicae*, **12 (1):** 1 - 5. [Abstract]

Schwann, H. (1906). A list of the mammals obtained by Messrs. R.B. Woosnam and R.E. Dent in Bechuanaland. *Proceedings of the Zoological Society of London*, **1906, I:** 101 - 111. [Abstract]

Schwarz, E. (1915). Saugetiere von der Ostgrenze von Neu-Kamerun. *Jahresbücher der Nassauer Verein für Naturkunde, Wiesbaden*, **2 (68):** 56 - 71.

Schwarz, E. (1920). *Fledermäuse aus West- und Zentralafrika.* In ??? : *Ergebnisse der Zweiten Deutschen Zentral-Afrika Expedition 1910-1911 unter Führung Adolf Friedrichs, Herzogs zu Mecklenburg.* Klinkhardt & Biermann - Leipzig; 1: 1045 - 1058.

Scillitani, G., S. Zizza, G. E. Liquori and D. Ferri (2005). Histochemical and immunohistochemical evidence for a gradient in gastric juice production in the greater horseshoe bat, *Rhinolophus ferrumequinum* (Schreber, 1774). *Acta Chiropterologica*, **7 (2):** 301 - 308. doi: 10.3161/1733-5329(2005)7[301:HAIEFA]2.0.CO;2.

Sclater, P. L. (1864). I. On the mammals collected and observed by Capt. J. H. Speke during the East-African Expedition. With notes by Capt. J. H. Speke. *Proceedings of the Zoological Society of London*, **1864, I:** 98 - 106.

Sclater, P. L. (1865). I. Report on a collection of animals from Madagascar, transmitted to the society by Mr. J. Caldwell. *Proceedings of the Zoological Society of London*, **1865, II:** 467 - 470.
Sclater, P. L. (1868). Notices of the more important additions to the Society's Menagerie during the month of May. *Proceedings of the Zoological Society of London*, **1868, II:** 404.
Sclater, W. L. (1896). The geography of mammals. No. IV. The Ethiopian region (Continued). *The Geographical Journal*, **7 (3):** 282 - 296.
Sclater, W. L. (1901). *The mammals of South Africa. Volume II. Rodentia, Chiroptera, Insectivora, Cetacea and Edentata.* R.H. Porter - London: 241 pp.
Scortecci, G. (1937). *Capitolo V: La Fauna.* In Corni, G. : *Somalia Italiana, Vol. I.* Milano: 207 - 283.
Scott, J. E., J. B. Lack and M. J. Ravosa (2012). On the reversibility of mandibular symphyseal fusion. *Evolution*, **66 (9):** 2940 - 2952. doi: 10.1111/j.1558-5646.2012.01639.x.
Seabra, A. F. (1898a). Sobre um caracter importante para a determinação dos generos e especies dos "Microchiropteros", e lista de especies d'este grupo existentes nas collecções do Museu Nacional. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **(2) 5 (20):** 247-258.
Seabra, A. F. (1898b). Sobre a determinação dos generos da familia Pteropodidae fundada nos caracteres extrahidos da fórma, disposição e numero das pregas do paladar, e lista das especies d'esta familia, existentes nas collecções do museu de Lisboa. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **(2) 5 (19):** 163 - 171.
Seabra, A. F. (1900a). Sobre um caracter importante para a determinação dos generos e especies dos "Microchiropteros" e lista das especies d'este grupo existentes nas collecções do museu nacional. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **(2) 6 (21):** 16 - 35.
Seabra, A. F. (1900b). Diagnoses de quelques nouvelles espèces et varietés de Chiroptères d'Afrique. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **(2) 6 (22):** 116 - 128.
Seabra, A. F. (1900c). Sobre um caracter importante para a determinação dos generos e especies dos "Microchiropteros" e lista das especies d'este grupo existentes nas collecções do museu nacional. *Jornal de Sciencas mathematicas, physicas e naturaes, Lisboa*, **(2) 6 (22):** 76-89.
Seabra, A. F. (1906). A proposito de algumas especies de Microchiropteros d'Angola. *Annaes de Sciencias Naturaes, Porto*, **10 (1):** 81 - 82.
Seabra, A. F. (1909). Note sur quelques mammifères de l'Afrique occidentale captures par Fr. Newton en 1905 et appartenant au muséum d'histoire naturelle de porto. *Annaes Scientificos da Academia Politécnica do Porto*, **4 (4):** 218 - 220.
Seal, U. S. and D. G. Makey (1974). *ISIS Mammalian Taxonomic Directory*. ISIS - Minnesota Zoological Garden - St. Paul.
Seamark, E. C. J. [Ed] (2004a). African Bat Conservation News. *African Bat Conservation News*, **1:** 1 - 18.
Seamark, E. C. J. [Ed] (2004b). African Bat Conservation News. *African Bat Conservation News*, **2:** 1 - 27.
Seamark, E. C. J. [Ed] (2005a). African Bat Conservation News. *African Bat Conservation News*, **3:** 1 - 11.
Seamark, E. C. J. [Ed] (2005b). African Bat Conservation News. *African Bat Conservation News*, **4:** 1 - 12.
Seamark, E. C. J. (2005c). Correction and update of distribution data for *Cloeotis percivali* Thomas, 1901 (Chiroptera: Rhinolophidae: Hipposderniae) in southern Africa. *African Bat Conservation News*, **4:** 3 - 6.
Seamark, E. C. J. [Ed] (2005d). African Bat Conservation News. *African Bat Conservation News*, **5:** 1 - 14.
Seamark, E. C. J. [Ed] (2005e). African Bat Conservation News. *African Bat Conservation News*, **6:** 1 - 12.
Seamark, E. C. J. [Ed] (2006a). African Bat Conservation News. *African Bat Conservation News*, **7:** 1 - 7.
Seamark, E. C. J. [Ed] (2006b). African Bat Conservation News. *African Bat Conservation News*, **8:** 1 - 13.
Seamark, E. C. J. [Ed] (2006c). African Bat Conservation News. *African Bat Conservation News*, **9:** 1 - 14.
Seamark, E. C. J. [Ed] (2006d). African Bat Conservation News. *African Bat Conservation News*, **10:** 1 - 12.
Seamark, E. C. J. [Ed] (2007a). African Bat Conservation News. *African Bat Conservation News*, **11:** 1 - 9.
Seamark, E. C. J. [Ed] (2007b). African Bat Conservation News. *African Bat Conservation News*, **12:** 1 - 15.
Seamark, E. C. J. [Ed] (2007c). African Bat Conservation News. *African Bat Conservation News*, **13:** 1 - 11.
Seamark, E. C. J. [Ed] (2007d). African Bat Conservation News. *African Bat Conservation News*, **14:** 1 - 12.
Seamark, E. C. J. [Ed] (2008a). African Bat Conservation News. *African Bat Conservation News*, **15:** 1 - 11.
Seamark, E. C. J. [Ed] (2008b). African Bat Conservation News. *African Bat Conservation News*, **16:** 1 - 12.
Seamark, E. C. J. [Ed] (2008c). African Bat Conservation News. *African Bat Conservation News*, **17:** 1 - 15.
Seamark, E. C. J. (2008d). My midday encounter with a *Myotis welwitchii*: editorial response. *African Bat Conservation News*, **17:** 3.
Seamark, E. C. J. (2008e). Lapsus in Goodman et al. (2007): TM46881 not TM 46481. *African Bat Conservation News*, **16:** 3.
Seamark, E. C. J. [Ed] (2008f). African Bat Conservation News. *African Bat Conservation News*, **18:** 1 - 14.
Seamark, E. C. J. [Ed] (2009a). African Bat Conservation News. *African Bat Conservation News*, **19:** 1 - 7.
Seamark, E. C. J. [Ed] (2009b). African Bat Conservation News. *African Bat Conservation News*, **20:** 1 - 8.
Seamark, E. C. J. [Ed] (2009c). African Bat Conservation News. *African Bat Conservation News*, **21:** 1 - 17.
Seamark, E. C. J. [Ed] (2010a). African Bat Conservation News. *African Bat Conservation News*, **22:** 1 - 6.
Seamark, E. C. J. [Ed] (2010b). African Bat Conservation News. *African Bat Conservation News*, **23:** 1 - 55.
Seamark, E. C. J. [Ed] (2011a). African Bat Conservation News. *African Bat Conservation News*, **24:** 1 - 5.
Seamark, E. C. J. [Ed] (2011b). African Bat Conservation News. *African Bat Conservation News*, **25:** 1 - 16.
Seamark, E. C. J. [Ed] (2011c). African Bat Conservation News. *African Bat Conservation News*, **26:** 1 - 20.
Seamark, E. C. J. [Ed] (2012a). African Bat Conservation News. *African Bat Conservation News*, **27:** 1 - 22.
Seamark, E. C. J. [Ed] (2012b). African Bat Conservation News. *African Bat Conservation News*, **28:** 1 - 24.
Seamark, E. C. J. [Ed] (2012c). African Bat Conservation News. *African Bat Conservation News*, **29:** 1 - 18.
Seamark, E. C. J. [Ed] (2013a). African Bat Conservation News. *African Bat Conservation News*, **30:** 1 - 8.
Seamark, E. C. J. [Ed] (2013b). African Bat Conservation News. *African Bat Conservation News*, **31:** 1 - 20.
Seamark, E. C. J. [Ed] (2013c). African Bat Conservation News. *African Bat Conservation News*, **32:** 1 - 9.
Seamark, E. C. J. [Ed] (2013d). African Bat Conservation News. *African Bat Conservation News*, **33:** 1 - 26.
Seamark, E. C. J. (2013e). The use of incidence data to estimate bat (Mammalia: Chiroptera) species richness and taxonomic diversity and distinctness within and between the biomes of South Africa, Lesotho and Swaziland. University of the Witwatersrand; School of Animal, Plant and Environmental Sciences: 31 pp. URL: http://wiredspace.wits.ac.za/handle/10539/13420.
Seamark, E. C. J. [Ed] (2014a). African Bat Conservation News. *African Bat Conservation News*, **34:** 1 - 15.
Seamark, E. C. J. [Ed] (2014b). African Bat Conservation News. *African Bat Conservation News*, **35:** 1 - 14.
Seamark, E. C. J. [Ed] (2014c). African Bat Conservation News. *African Bat Conservation News*, **36:** 1 - 15.
Seamark, E. C. J. [Ed] (2015a). African Bat Conservation News. *African Bat Conservation News*, **37:** 1 - 14.

Seamark, E. C. J. [Ed] (2015b). African Bat Conservation News. *African Bat Conservation News*, **38:** 1 - 20.
Seamark, E. C. J. [Ed] (2015c). African Bat Conservation News. *African Bat Conservation News*, **39:** 1 - 19.
Seamark, E. C. J. [Ed] (2015d). African Bat Conservation News. *African Bat Conservation News*, **40:** 1 - 10.
Seamark, E. C. J. [Ed] (2016a). African Bat Conservation News. *African Bat Conservation News*, **41:** 1 - 15.
Seamark, E. C. J. [Ed] (2016b). African Bat Conservation News. *African Bat Conservation News*, **42:** 1 - 10.
Seamark, E. C. J. [Ed] (2016c). African Bat Conservation News. *African Bat Conservation News*, **43:** 1 - 23.
Seamark, E. C. J. [Ed] (2016d). African Bat Conservation News. *African Bat Conservation News*, **44:** 1 - 27.
Seamark, E. C. J. [Ed] (2017a). African Bat Conservation News. *African Bat Conservation News*, **45:** 1 - 21.
Seamark, E. C. J. [Ed] (2017b). African Bat Conservation News. *African Bat Conservation News*, **46:** 1 - 19.
Seamark, E. C. J. and W. Bogdanowicz (2002). Feeding ecology of the common slit-faced bat (*Nycteris thebaica*) in KwaZulu-Natal, South Africa. *Acta Chiropterologica*, **4 (1):** 49 - 54.
Seamark, E. C. J. and M. Brand (2005). Bat survey in the Cederberg Wilderness Area, Western Cape, South Africa (28 January - 3 Febuary 1999). *African Bat Conservation News*, **3:** 7 - 9.
Seamark, E. C. J. and T. C. Kearney (2004). Bats (Chiroptera) of Ithala Game Reserve, northern KwaZulu-Natal, South Africa. *Durban Museum Novitates*, **29:** 1 - 4.
Seamark, E. C. J. and T. C. Kearney (2006). New distribution of the Angolan wing-gland bat (*Cistugo seabrae* Thomas, 1912). *African Bat Conservation News*, **7:** 2 - 4.
Seamark, E. C. J. and T. C. Kearney (2007). Field notes (February 2005): Kliphuis camp site, Cederberg, Western Cape Province South Africa. *African Bat Conservation News*, **13:** 4 - 5.
Seamark, E. C. J. and T. C. Kearney (2008). Bats of Messina Nature Reserve, Limpopo Province, South Africa. *African Bat Conservation News*, **18:** 5 - 7.
Seamark, E. C. J., T. C. Kearney and J. Watson (2012). An updated distribution map and additional museum voucher specimens of the genus *Cistugo* (Chiroptera: Cistugonidae), with a review of the distinction between *Cistugo seabrae* Thomas, 1912 and *C. lesueuri* Roberts, 1919, and aspects concerning their allopatric distribution. *Annals of the Ditsong National Museum of Natural History*, **2:** 111 - 119.
Sedlácek, O., D. Horák, J. Riegert, J. Reif and I. Horácek (2006). Comments on Welwitsch's mouse-eared bat (*Myotis welwitschii*) with the first record from Cameroon. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **71 (2):** 120 - 123.
Segerman, J. and L. E. O. Braack (1988). New records of bat fleas (Siphonaptera) from South Africa. *Journal of the Entomological Society of Southern Africa*, **51:** 149 - 150.
Seiffert, E. R. (2006). Revised age estimates for the later Paleogene mammal faunas of Egypt and Oman. *Proceedings of the National Academy of Sciences of the USA*, **103:** 5000 - 5005.
Seiffert, E. R., E. L. Simon, W. C. Clyde, J. B. Rossie, Y. Attia, T. M. Bown, P. Chatrath and M. E. Mathison (2005). Basal anthropoids from Egypt and the antiquity of Africa's higher primate radiation. *Science*, **310:** 300 - 304.
Selim, A., N. E. Nahla and M. Shelfeh (2008). Comparative anatomical and histological studies of the tongue between the Egyptian bat Pipistrillus Kuhli and the Syrian bat Pipstrillus Kuhli. *Tishreen University Journal for Research and Scientific Studies - Biological Sciences Series*, **30 (1):** 247 - 255. URL: http://tishreen.edu.sy/sites/default/files/Tishreen_Magazine/18_0.pdf.
Seltzer, C. E., H. J. Ndangalasi and N. J. Cordeiro (2013). Seed dispersal in the dark: shedding light on the role of fruit bats in Africa. *Biotropica*, **45 (4):** 450 - 456. doi: 10.1111/btp.12029.
Senacha, K. R. and S. Dookia (2013). Geoffroy's Trident Leaf-nosed bat, *Asellia tridens* (Geoffroy, E., 1813) from India. *Current Science, Madras*, **105 (1):** 21 - 22.
Senior, P., N. Doak, R. Bristol and I. Valmont (2007). Bringing bats off the brink: conservation action for the Critically Endangered Seychelles sheath-tailed bat. BP Follow-up Award Preliminary Report: 27 pp. URL: http://www.conservationleadershipprogramme.org/project/conservation-action-seychelles-sheath-tailed-bat/.
Senna, A. (1905). Contributo alla conoscenza dei Chirotteri Eritrei. *Archivio zoologico italiano*, **2:** 249 - 308.
Senna, A. (1914). ?? Title still needs to be checked. ?? *Annuario del Museo Zoologia del Real Universita di Napoli*(2) 4 (9).
Serra-Cobo, J. , López-Roig, M. , Bayer, X. , Amengual, B. , Guasch, C. (2008). *Ratpenats. Ciència i mite.* Universitat de Barcelona: 266 pp.
Serra-Cobo, J., M. López-Roig, R. Lavenir, E. Abdelatif, W. Boucekkine, M. Elharrak, B. Harif, S. El Ayachi, A. A. Salama, M. A. Nayel, A. Elsify, S. G. El Rashedy, P. Benedictis, F. Mutinelli, B. Zecchin, D. Scaravelli, C. Balhoul, A. Zaghawa, H. Y. Hassan, A. H. Zaghloul and H. Bourhy (2018). Active sero-survey for European bat lyssavirus type-1 circulation in North African insectivorous bats. *Emerging microbes & infections*, **7:** 213. doi: 10.1038/s41426-018-0214-y.
Servent, A. G., C. M. Francis and R. E. Ricklets (2003). *Phylogeny and biogeography of the horseshoe bats.* In Csorba, G., P. Ujhelyi and N. Thomas : *Horseshoe bats of the World (Chiroptera: Rhinolophidae).* Alana Books - Shropshire: xii-xxiv.
Setzer, H. W. (1952). Notes on mammals from the Nile Delta Region of Egypt. *Proceedings of the United States National Museums*, **102 (3305):** 347 - 348. [Abstract]
Setzer, H. W. (1971). New bats of the genus *Laephotis* from Africa (Mammalia: Chiroptera). *Proceedings of the Biological Society of Washington*, **84 (32):** 259 - 264. [Abstract]
Ševcík, M., P. Benda and R. K. Lucan (2012). Diptera Pupipara from bats of two large eastern Mediterranean islands, Crete and Cyprus. *Turkish Journal of Zoology*, **37 (1):** 31 - 37 (for 2013). doi: 10.3906/zoo-1112-20.
Ševcík, M., P. Benda, A. Reiter and M. Uhrin (2010). New records of bat ectoparasites (Nycteribiidae, Ixodidae, Argasidae, Spinturnicidae) from the Eastern Mediterranean and Middle East. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 283.
Severtzoff, N. A. (1876). V. The mammals of Turkestan [translated by F. Carl Craemers]. *Annals and Magazine of Natural History*, **ser. 4, 18 (103):** 40 - 57.
Severtzov, N. A. (1873). Vertical and horizontal distribution of Turkestan mammals (in Russian). *Izvestiya imp.Obschch.Lyub.Estest.Antrop.Etnog.Imp.Mosk.U*, **(8) 2:** 157 pp.
Sewall, B. J. (2004). Giant bats face a shrinking forest. Conserving Livingstone's flying foxes on the Comoros Islands. *Bats*, **21 (4):** 8 - 11. URL: http://www.batcon.org/pdfs/BATSmag/WinterBATS03.pdf.
Sewall, B. (J.) (2009). Rainforest reserves for Critically Endangered Comorian fruit bats. The "Comoros Forest Reserves Project". Final Report. BP Conservation Programme Gold Award. Project # 100905: 21 pp. URL: http://www.conservationleadershipprogramme.org/UserDataWEB/ProjectData%5C000405/Comoros_Fruit%20Bats_2005_FR.pdf.
Sewall, B. ([J.), A. L. Freestone, M. F. E. Moutui, N. Toilibou, I. Saïd, D. Attoumane, S. M. Toumani and C. M. Iboura (2005). Rainforest Reserves for Critically Endangered Comorian Fruit Bats. The "Comoros Forest Reserves Project". Final

Report. BP Conservation Programme Gold Award. Project # 100905: 21 pp. URL: http://www.conservationleadershipprogramme.org/project/rainforest-reserves-critically-endangered-comorian-fruit-bats/.
Sewall, B. J., E. F. Granek and W. J. Trewhella (2003). The endemic Comoros Islands fruit bat *Rousettus obliviosus*: ecology, conservation, and Red List status. *Oryx*, **37 (3):** 344 - 352. doi: 10.1017/S0030605303000607.
Seyler, J. R., D. Thomas, N. Mwanza and A. Mpoyi (2010). *Democratic Republic of Congo: biodiversity and tropical forestry assessment (118/119) Final Report.* USAID/Democratic Republic of the Congo: i - xxix; 1 - 175. URL: http://pdf.usaid.gov/pdf_docs/PNADS946.pdf.
Shaimardanov, R. T. (2007). Bats of the State National Nature Park "Altyn-Emel" and adjacent territories in the Ili Basin (In Russian with English summary). *Plecotus et al.*, **9:** 32 - 37 (for 2006).
Shapiro, J. T., E. Barbier and A. Monadjem (2016). First record of Streblidae, *Raymondia alulata* Speiser, 1908 (Diptera: Streblidae), in Swaziland and a review of the genus *Raymondia* and their hosts in Africa. *Acta Chiropterologica*, **18 (1):** 249 - 268. doi: 10.3161/15081109ACC2016.18.1.015.
Shapiro, J. T. and A. Monadjem (2015). Two new bat species for Swaziland and a revised list for the country. *Mammalia*, **80 (3):** 353 - 357 (for 2016). doi: 10.1515/mammalia-2014-0174.
Sharifi, M. (2004). Postnatal growth and age estimation in the Mehely's horseshoe bat (*Rhinolophus mehelyi*). *Acta Chiropterologica*, **6 (1):** 155 - 161. doi: 10.3161/001.006.0112.
Sharifi, M., F. Mozafari, N. Taghinezhad and H. Javanbakht (2008). Variation in ectoparasite load reflects life history traits in the lesser mouse-eared bat *Myotis blythii* (Chiroptera: Vespertilionidae) in western Iran. *Journal of parasitology*, **94 (3):** 622 - 625. doi: 10.1645/GE-1334.1.
Sharifi, M., N. Taghinezhad, F. Mozafari and S. Vaissi (2013). Variation in ectoparasite load in the Mehely's horseshoe bat, *Rhinolophus mehelyi* (Chiroptera: Rhinolophidae) in a nursery colony in western Iran. *Acta Parasitologica*, **58 (2):** 180 - 184. doi: 10.2478/s11686-013-0122-1.
Sharifi, M. and S. Vaissi (2013). Postnatal growth in the long-fingered bat, *Miniopterus schreibersii pallidus*, in Iran (Chiroptera: Miniopteridae). *Zoology in the Middle East*, **59 (1):** 1 - 5. doi: 10.1080/09397140.2013.795053.
Sharifi, M., S. Vaissi, H. Javanbakht and V. Akmali (2012). Postnatal growth and wing development in Kuhl's pipistrelle *Pipistrellus kuhlii* (Chiroptera: Vespertilionidae) in captivity. *Zoological Studies*, **51 (8):** 1235 - 1247. URL: http://zoolstud.sinica.edu.tw/Journals/51.8/1235.pdf.
Shehab, A. H., I. H. Mamkhair and Z. S. Amr (2006). First record of the lesser horseshoe bat, *Rhinolophus hipposideros* (Bechstein, 1800) (Rhinolophidae, Chiroptera) from Syria. *Hystrix, Italian Journal of Mammalogy*, **(N.S.) 17 (2):** 161 - 166.
Shehata, M. M., D. K. W. Chu, M. R. Gomaa, M. AbiSaid, R. El Shesheny, A. Kandeil, O. Bagato, S. M. S. Chan, E. K. Barbour, H. S. Shaib, P. P. McKenzie, R. J. Webby, M. A. Ali, M. Peiris and G. Kayali (2016). Surveillance for coronaviruses in bats, Lebanon and Egypt, 2013 - 2015. *Emerging Infectious Diseases*, **22 (1):** 148 - 150. doi: 10.3201/eid2201.151397.
Sheil, D. (1992). Tanzanian coastal forests - unique, threatened, and overlooked. *Oryx*, **26 (2):** 107 - 114. [Abstract]
Shen, B., T. Fang, M. Dai, G. Jones and S. Zhang (2013). Independent losses of visual perception genes *Gja10* and *Rbp3* in echolocating Bats (Order: Chiroptera). *PLoS ONE*, **8 (7):** e68867. doi: 10.1371/journal.pone.0068867.
Shepherd, R. C. and M. C. Williams (1964). Studies on viruses in East African bats (Chiroptera) I. Haemagglutination inhibition and circulation of arboviruses. *Zoonose Research*, **3 (3):** 125 - 139. [Abstract]
Sherborn, C. D. (1892). On the dates of the parts, plates and text of Schreber's 'Säugethiere'. *Proceedings of the Zoological Society of London*, **1891, IV:** 587 - 592.
Sherborn, C. D. (1897). On the dates of the Natural History portion of Savigny's 'Description de l'Egypte'. *Proceedings of the Zoological Society of London*, **1897, II:** 258 - 288.
Sherwin, H. A., W. I. Montgomery and M. G. Lundy (2012). The impact and implications of climate change for bats. *Mammal Review*, **43 (3):** 171 - 182 (for 2013). doi: 10.1111/j.1365-2907.2012.00214.x.
Sheshurak, P. N. and B. Y. Kedrov (2002). Chiropterofauna of Chernigov region of Ukraine: the history of investigation and prospects for further research. In Russian with English summary. *Plecotus et al.*, **pars spec:** 60 - 64.
Shi, J. J., L. M. Chan, A. J. Peel, R. Lai, A. D. Yoder and S. M. Goodman (2014). A deep divergence time between sister species of *Eidolon* (Pteropodidae) with evidence for widespread panmixia. *Acta Chiropterologica*, **16 (2):** 279 - 292. doi: 10.3161/150811014X687242.
Shi, J. J. and D. L. Rabosky (2015). Speciation dynamics during the global radiation of extant bats. *Evolution*, **69 (6):** 1528 - 1545. doi: 10.1111/evo.12681.
Shi, J. J., E. P. Westeen, N. T. Katlein, E. R. Dumont and D. L. Rabosky (2018a). Ecomorphological and phylogenetic controls on sympatry across extant bats. *Journal of Biogeography*, **45 (5):** 1560 - 1570. doi: 10.1111/jbi.13353.
Shi, J. J., E. P. Westeen and D. L. Rabosky (2018b). Digitizing extant bat diversity: An open-access repository of 3D µCT-scanned skulls for research and education. *PLoS ONE*, **13 (9):** e0203022. doi: 10.1371/journal.pone.0203022.
Shi, Z. L. (2013). Emerging infectious diseases associated with bat viruses. *Science China Life Sciences*, **56 (8):** 678 - 682. doi: 10.1007/s11427-013-4517-x.
Shilton, L. A., J. D. Altringham, S. G. Compton and R. J. Whittaker (1999). Old World fruit bats can be long-distance seed dispersers through extended retention of viable seeds in the gut. *Proceedings of the Royal Society of London*, **B 266:** 219 - 223.
Shope, R. E., F. A. Murphy, A. K. Harrison, O. R. Causey, G. E. Kemp, D. I. H. Simpson and D. L. Moore (1970). Two African viruses serologically and morphologically related to rabies virus. *Journal of Virology*, **6 (5):** 690 - 692. [Abstract]
Shortridge, G. C. (1934). *The mammals of South West Africa. A biological account of the forms occurring in that region.* William Heinemann Ltd - London.
Shortridge, G. C. (1942). 2. Field notes on the first and second expeditions of the Cape Museum's Mammal Survey of the Cape Province; and descriptions of some new subgenera and subspecies. *Annals of the South African Museum / Annale van die suid-afrikaanse museum*, **36:** 27 - 100. [Abstract]
Shortridge, G. C. and D. Carter (1938). 16. A new genus and new species and subspecies of mammals from Little Namaqualand and the North-West Cape Province; and a new subspecies of *Gerbillus paeba* from the Eastern Cape Province. *Annals of the South African Museum / Annale van die suid-afrikaanse museum*, **32 (4):** 282 - 291.
Sidiyène, E. A. and M. Tranier (1990). Données récentes sur les Mammifères de l'Adrar des Iforas (Mali). *Mammalia*, **54 (3):** 471 - 477. [Abstract]
Siegal-Willott, J., D. , Sliess, N. Heard, D. Naydan and J. Roberts (2007). Microchip-associated leiomyosarcoma in an Egyptian fruit bat (*Rousettus aegyptiacus*). *Journal of Zoo and Wildlife Medicine*, **38 (2):** 352 - 356. doi: 10.1638/1042-7260(2007)038[0352:MLIAEF]2.0.CO;2.

Siemers, B. M. and T. Ivanova (2004). Ground gleaning in horseshoe bats: comparative evidence from *Rhinolophus blasii, R. Euryale* and *R. mehelyi*. *Behavioral ecology and sociobiology*, **56 (5):** 464 - 471. doi: 10.1007/s00265-004-0807-4.
Sierro, A. (2013). *Barbastella barbastellus Western Barbastelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 547 - 549.
Sigé, B. (1974). Donées nouvelles sur le genre *Stehlinia* (Vespertilionoidea, Chiroptera) du Paléogène d'Europe. *Palaeovertebrata, Montpelier*, **6:** 253 - 272.
Sigé, B. (1985). Les chiropteréres oligocénes du Fayum, Egypte. *Geological Palaeontology*, **19:** 161 - 189.
Sigé, B. (1991). Rhinolophoidea et Vespertililionoidea (Chiroptera) du Chambi (Eocéne inférieur de Tunisie) - Aspects biostratigraphique, biogéographique et paléoécologique de l'origine des chiroptéres modernes. *Neues Jahrbuch für Geologie und Paläontologie. Abhandlungen.*, **182:** 355 - 376.
Sigé, B. and S. Legendre (1982). L'Histoire des peuplements de chiroptères du Bassin méditerranéen: L'apport comparé des remplissages karstiques et des dépôts fluviolacustres. *Revue de Biosp.*manuscript version.
Sigé, B., P. Mein, H. Jousse and J.-P. Aguilar (2014). Un nouveau Rhinopomatidae (Chiroptera) du Paléokarst miocène de Baixas (Pyrénées-Orientales, France) ; apport zoogéographique. *Geodiversitas*, **36 (2):** 257 - 281. doi: 10.5252/g2014n2a3.
Sigé, B., H. Thomas, S. Sen, E. Gheerbrant, J. Roger and Z. Al-Sulaimani (1994). Les Chiroptères de Taqah (Oligocène Inférieur, Sultanat D'Oman). Premier inventaire systématique. *Münchner Geowissenschaftliche Abhandlungen*, **26:** 35 - 48.
Simbauni, J. A. and R. T. F. Bernard (2001). Changes in the abundance of cells in the anterior pituitary gland and the possible roles of luteinizing hormone, prolactin and progesterone in the control of delayed implantation in the straw-coloured fruit bat (*Eidolon helvum*). *African Zoology*, **36 (1):** 63 - 70.
Simmons, J. A., S. A. Kick and B. D. Lawrence (1984). Echolocation and hearing in the mouse-tailed bat, *Rhinopoma hardwickei*: acousting evolution of echolocation in bats. *Journal of Comparative Physiology*, **A 154 (3):** 347 - 356. doi: 10.1007/BF00605234. [Abstract]
Simmons, J. A. and R. A. Stein (1980). Acoustic imaging in bat sonar: Echolocation signals and the evolution of echolocation. *Journal of Comparative Physiology*, **A 135:** 61 - 84.
Simmons, N. B. (1994). The case for Chiropteran Monophyly. *American Museum Novitates*, **3103:** 1 - 54. [Abstract]
Simmons, N. B. (1998). *A reappraisal of interfamilial relationships of bats.* In Kunz, T. H. and P. A. Racey : *Bat biology and conservation.* Smithsonian Institution Press - Washington, D.C.: 3 - 26. [Abstract]
Simmons, N. B. (2005). *Order Chiroptera.* In Wilson, D. E. and D. M. Reeder [Eds]: *Mammal Species of the World: A taxonomic and geographic reference.* The John Hopkins University Press - Baltimore.
Simmons, N. (B.), A. Cirranello and G. Gunnell (2013). Noctilionoid bat diversity: how many fossil and living species are there?. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 145 - 146. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Simmons, N. B. and J. H. Geisler (1998). Phylogenetic relationships of *Icaronycteris*, *Archaeonycteris*, *Hassianycteris*, and *Palaeochiropteryx* to extant bat lineages, with comments on the evolution of echolocation and foraging strategies in Microchiroptera. *Bulletin of the American Museum of Natural History*, **235:** 1 - 182. [Abstract]
Simmons, N. B. and N. P. Giannini (2004). A total-evidence phylogeny of megabats: Implications for understanding biogeography and dietary evolution. *Bat Research News*, **45 (4):** 263.
Simmons, N. B., M. J. Novacek and R. J. Baker (1991). Approaches, Methods, and the future of the Chiropteran monophyly controversy: A reply to J.D. Pettigrew. *Systematic zoology*, **40 (2):** 239 - 243.
Simmons, N. B., E. R. Seiffert and G. F. Gunnell (2016). A new family of large omnivorous bats (Mammalia, Chiroptera) from the late Eocene of the Fayum Depression, Egypt, with comments on use of the name "Eochiroptera". *American Museum Novitates*, **3857:** 1 - 43.
Simons, R. R. L., P. Gale, V. Horigan, E. L. Snary and A. C. Breed (2014). Potential for introduction of bat-borne zoonotic viruses into the EU: A review. *Viruses*, **6 (5):** 2084 - 2121. doi: 10.3390/v6052084.
Simpson, D. I. H., M. C. Williams, J. P. O'Sullivan, J. C. Cunningham and F. A. Mutere (1968). Studies on arboviruses and bats (Chiroptera) in East Africa. II. Isolation and haemagglutination-inhibition studies on bats collected in Kenya and throughout Uganda. *Annals of Tropical Medicine and Parasitology*, **62 (4):** 432 - 440. [Abstract]
Simpson, G. G. (1945). The principles of classification and a classification of mammals. *Bulletin of the American Museum of Natural History*, **85 (1):** i - xvi, 1 - 350.
Simpson, G. G. (1967). The tertiary Lorisiform Primates of Africa. *Bulletin of the Museum of Comparative Zoology*, **136:** 39 - 62.
Sinha, Y. P. and S. Chakraborty (1971). Taxonomic status of Vespertilionid bat, *Nycticejus emarginatus* Dobson. *Proceedings of the zoological Society, Calcutta*, **24:** 53 - 59.
Sirami, C., D. S. Jacobs and G. S. Cumming (2013). Artificial wetlands and surrounding habitats provide important foraging habitat for bats in agricultural landscapes in the Western Cape, South Africa. *Biological Conservation*, **164:** 30-38. doi: 10.1016/j.biocon.2013.04.017.
Siya, A., W. Bazeyo, D. Tuhebwe, G. Tumwine, A. Ezama, L. Manirakiza, D. R. Kugonza and I. B. Rwego (2019). Lowland grazing and Marburg virus disease (MVD) outbreak in Kween district, Eastern Uganda. *BMC Public Health*, **19:** 136. doi: 10.1186/s12889-019-6477-y.
Sjöstedt, Y. (1896). Über das alte Männchen des Macroglossen Chiropters *Megaloglossus woermanni* Pagenstecher. *Bihang till Kongliga Svenska Vetenskaps-Akademiens Handlingar*, **21 (4) 1:** 1 - 7 (for 1895).
Sjöstedt, Y. (1897). Säugetiere aus Kamerun, West-Afrika. *Beh. Vet. Akad. Handl.*, **23 (1):** 1 - 50.
Sjöstedt, Y. (1910). *Die Tierweld der Mkulmusi-Höhlen bij Tanga.* Palmquist - Stockholm: 67 - 70.
Skead, C. J. (1958). Mammals of the Uitenhage and Cradock districts C.P. in recent times. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **1:** 19 - 59.
Skibiel, A. L., L. M. Downing, T. J. Orr and W. R. Hood (2013). The evolution of the nutrient composition of mammalian milks. *Journal of Animal Ecology*, **82 (6):** 1254 - 1264. doi: 10.1111/1365-2656.12095.
Skinner, J. D. and C. T. Chimimba (2005). *The mammals of southern Africa subregion. 2nd Edition.* Cambridge University Press, Cambridge, UK.
Skinner, J. D. and R. H. N. Smithers (1990). *The Mammals of the Southern African Subregion.* University of Pretoria - Pretoria.
Skliba, J., R. Sumbera and P. Benda (2008). Bocage's fruit bat (*Lissonycteris angolensis*), a new species for Malawi. *Nyala*, **24:** 61 - 64 (for 2007).

Smaers, J. B., D. K. N. Dechmann, A. Goswami, C. Soligo and K. Safi (2012). Comparative analyses of evolutionary rates reveal different pathways to encephalization in bats, carnivorans, and primates. *Proceedings of the National Academy of Sciences, U.S.A.*, **109 (44):** 18006 - 18011. doi: 10.1073/pnas.1212181109.

Smarsh, G. C. and M. Smotherman (2016). Intra- and interspecific variability of echolocation pulse acoustics in the African megadermatid bats. *Acta Chiropterologica*, **17 (2):** 429 - 443 (for 2015). doi: 10.3161/15081109ACC2015.17.2.019.

Smarsh, G. C. and M. Smotherman (2017). Behavioral response to conspecific songs on foraging territories of the heart-nosed bat. *Behavioral ecology and sociobiology*, **71 (10):** 142. doi: 10.1007/s00265-017-2370-9.

Smiley Evans, T., L. Tutaryebwa, K. V. Gilardi, P. A. Barry, A. Marzi, M. Eberhart, B. Ssebide, M. R. Cranfield, O. Mugisha, E. Mugisha, S. Kellermann, J. A. K. Mazet and C. K. Johnson (2018). Suspected exposure to filoviruses among people contacting wildlife in southwestern Uganda. *The Journal of Infectious Diseases*, **218 (Suppl. 5):** S227 - S286. doi: 10.1093/infdis/jiy251.

Smirnov, D. G. and V. P. Vekhnik (2013). Trophic ecology and predation of the Greater noctule bat (*Nyctalus lasiopterus*) in Russia. *Biology Bulletin*, **40 (2):** 206 - 212. doi: 10.1134/S1062359013020143.

Smit, F. G. A. M. (1954). New bat-fleas (Siphonaptera: Ischnopsyllidae). *Parasitology*, **44:** 144-156.

Smit, F. G. A. M. (1957a). The African species of the bat-flea genus Lagaropsylla. *Revue de zoologie et de botanique africaines*, **55:** 163-172.

Smit, F. G. A. M. (1957b). Two new bat-fleas of the genus Lagaropsylla from the Belgian Congo. *Revue de zoologie et de botanique africaines*, **56:** 263-268.

Smith, A. (1829). Contributions to the natural history of South Africa, &c. *Zoological Journal*, **4 (16):** 433 - 444.

Smith, A. (1833). African Zoology. *South African Quarterly Journal*, **ser. 2, 1 (2):** 49 - 64.

Smith, A. (1834). African Zoology. *South African Quarterly Journal*, **(2) 1 (2):** 233 - 248.

Smith, A. (1847). *Illustrations of the zoology of South Africa. Vol. 1.* Elder and Co., London, United Kingdom.

Smith, A., M. C. Schoeman, M. Keith, B. F. N. Erasmus, A. Monadjem, A. Moilanen and E. Di Minin (2016). Synergistic effects of climate and land-use change on representation of African bats in priority conservation areas. *Ecological Indicators*, **69:** 276 - 283. doi: 10.1016/j.ecolind.2016.04.039.

Smith, A. T. and Y. Xie (2008). *The Mammals of China.* Princeton University Press, Princeton, New Jersey: i - xxvi; 1 - 544. URL: http://books.google.be/books?id=ka-9f68nPT4C&pg=PA355&lpg=PA355&dq=smith+xie+barbastella&source=bl&ots=H6PBXNqVok&sig=HhCE5hL0hO51xsTjrg-6eLI2wp0&hl=nl&ei=xl_7TO2PB8Ox8gPUvNyrDA&sa=X&oi=book_result&ct=result&resnum=1&ved=0CBcQ6AEwAA#v=onepage&q&f=false.

Smith, C., H. Field and L.-F. Wang (2011). *Chapter 5. Significant zoonotic diseases identified in bats. Bat Coronaviruses.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 102 - 122. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Smith, C. H. (1842). *An Introduction to the Mammalia.* In Jardine, W. : *Naturalist's Library.* Chatto & Windus, Piccadilly - Volume 15: 304 pp.

Smith, J. D. and C. S. Hood (1980). *Additional material of Rhinolophus ruwenzorii Hill, 1942, with comments on its natural history and taxonomic status.* In Wilson, D. E. and A. L. Gardner : *Proceedings of the Fifth International Bat Research Conference, Texas Press - Lubbock, Texas* 163 - 171.

Smith, J. D. L., J. W. Bickham and T. R. Gregory (2013). Patterns of genome size diversity in bats (order Chiroptera). *Genome*, **45 (8):** 457 - 472. doi: 10.1139/gen-2013-0046.

Smith, J. D. L. and T. R. Gregory (2009). The genome sizes of megabats (Chiroptera: Pteropodidae) are remarkably constrained. *Biology Letters*, **5 (3):** 347 - 351. doi: 10.1098/rsbl.2009.0016.

Smith, S. A., J. W. Bickham and D. A. Schlitter (1986). Karyotypes of eleven species of Molossid bats from Africa (Mammalia: Chiroptera). *Annals of Carnegie Museum*, **55 (7):** 125 - 136. [Abstract]

Smith, S. J. and Jr. , D. M. Leslie (2006). *Pteropus livingstonii. Mammalian Species*, **792:** 1 - 5, 3 figs.

Smithers, R. H. N. (1968). *A check list and atlas of the mammals of Botswana (Africa).* Trustees national Museums of Rhodesia.

Smithers, R. H. N. (1971). The Mammals of Botswana. *Musem Memoir, Salisbury*, **4:** 1 - 193.

Smithers, R. H. N. (1983). *The Mammals of the Southern African Subregion.* University of Pretoria - Pretoria, South Africa: 750 pp.

Smithers, R. H. N. (1986). *South African Red Data Book - Terestrial mammals.* South African National Scientific Programs Report.

Smithers, R. H. N. and J. L. P. Lobão Tello (1976). Check list and atlas of the mammals of Mozambique. *Musem Memoir, Salisbury*, **8:** 1 - 184.

Smithers, R. H. N., J. Meester and I. L. Rautenbach (1987). The type locality of *Pipistrellus* (*Romicia*) *kuhlii brommi* Roberts, 1948 (Chiroptera: Vespertilionidae). *Mammalia*, **51 (3):** 463 - 465.

Smithers, R. H. N. and V. J. Wilson (1979). Checklist and atlas of the mammals of Zimbabwe Rhodesia. *Musem Memoir, Salisbury*, **9:** 193 pp. [Abstract]

Smotherman, M., M. Knörnschild, G. Smarsh and K. Bohn (2016). The origins and diversity of bat songs. *Journal of Comparative Physiology*, **A 202 (8):** 535 - 554. doi: 10.1007/s00359-016-1105-0.

Smuts, J. (1832). *Dissertatio zoologica, enumerationem mammalium capensium continens.* J.C. Cyfveer - Leyden: 108 pp.

Söderlund, F. (1921). 5. Zwei neue Arten der Gattung *Rhinolophus* gefunden im Wildbad Gastein. *Zoologischer Anzeiger*, **52 (5):** 122 - 125.

Sody, H. J. V. (1930). Twee zoogdierlijsten van Java. *Natuurkundig Tijdschrift Nederlands Indië*, **90:** 274 - 289.

Soisook, P., A. Prajakjitr, S. Karapan, C. M. Francis and P. J. J. Bates (2015). A new genus and species of false vampire (Chiroptera: Megadermatidae) from peninsular Thailand. *Zootaxa*, **3931 (4):** 528 - 550. doi: 10.11646/zootaxa.3931.4.4.

Soliman, S. and E. M. E. Mohallal (2014). A survey of the mammalian fauna of Siwa Oasis, Egypt. *Egyptian Journal of Zoology*, **61:** 171 - 185. doi: 10.12816/0005514.

Sordelli, F. (1902). Materiali per la conoscenza della fauna Eritrea raccolti dal Dott. Paolo Magretti. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **41:** 49 - 99.

Sørensen, U. G. and K. Halberg (2001). Mammoth roost of nonbreeding straw-coloured fruit bat *Eidolon helvum* (Kerr, 1792) in Zambia. *African Journal of Ecology*, **39:** 213 - 215.

Souttou, K., B. Baziz, S. Doumandji, C. Denys and R. Brahimi (2006). Analysis of pellets from a suburban common kestrel *Falco tinnunculus* nest in El Harrach, Algiers, Algeria. *Ostrich*, **77 (3-4):** 175 - 178.

Souttou, K., A. Manaa, F. Baziz-Neffah, O. Guezoul, L. Ababsa, M. S. Sekour, C. Denys and S. Doumandji (2018). Geographic variation of the diet of the common kestrel *Falco tinnunculus* Linné, 1758 (Aves, Falconidae) in Algeria. *Vie et milieu - Life and Environment*, **68 (2-3):** 127 - 143.

Sowler, S. G. (1980). Tooth eruption in known age specimens of *Epomophorus wahlbergi*. *South African Journal of Wildlife Research*, **10:** 112 - 117. [Abstract]

Sowler, S. (G.) and S. Stoffberg (2013). South African good practice guidelines for surveying bats in wind farm developments (Third Draft: 2012). Distributed by and produced in cooperation with the Wildlife & Energy Programme of the Endangered Wildlife Trust: 33 pp.

Sowler, S. (G.) and S. Stoffberg (2014). South African good practice guidelines for surveying bats at wind energy facility developments - Pre-construction. Third Edition: 2014. Distributed by and produced in cooperation with the Wildlife & Energy Programme of the Endangered Wildlife Trust and the South African Bat Assessment Advisory Panel: i - v; 1 - 38.

Sowler, S(G.), L. Thibedi and E. C. J. Seamark (2008). In memory of Lloyd R. Wingate (1947-2007). *African Bat Conservation News*, **17:** 2.

Spada, M., S. Szentkuti, N. Zambelli, M. Mattei-Roesli, M. Moretti, F. Bontadina, R. Arlettaz, G. Tosi and A. Martinoli (2008). Roost selection by non-breeding Leisler's bats (*Nyctalus leisleri*) in montane woodlands: implications for habitat management. *Acta Chiropterologica*, **10 (1):** 81 - 88. doi: 10.3161/150811008X331117.

Speakman, J. R. (2001). The evolution of flight and echolocation in bats: another leap in the dark. *Mammal Review*, **31 (2):** 111 - 130.

Speakman, J. R. (2007). The physiological costs of reproduction in small mammals. *Philosophical transactions of the Royal Society of London*, **B 363 (1490):** 375 - 398 (for 2008). doi: 10.1098/rstb.2007.2145.

Speakman, J. R. and P. I. Webb (1993). Taxonomy, status and distribution of the Azorean bat (*Nyctalus azoreum*). *Journal of Zoology*, **231 (1):** 27 - 38. [Abstract]

Spengler, J. R., E. D. Ervin, T. S. Towner, P. E. Rollin and S. T. Nichol (2016). Perspectives on West Africa Ebola virus disease outbreak, 2013 - 2016. *Emerging Infectious Diseases*, **22 (6):** 956 - 963. doi: 10.32032/eid2206.160021.

Spiewak, R., S. G. O. Johansson and B. Wüthrich (1996). Der interessante Falll. Berufsbedingtes Asthma auf Fledermäuse (Chiropteren). *Allergologie*, **19 (11):** 509 - 511. [Abstract]

Spinage, C. A. (1988). First steps in the ecology of the Bamingui-Bangoran National Park, Central African Republic. *African Journal of Ecology*, **26 (2):** 73 - 88. doi: 10.1111/j.1365-2028.1988.tb00959.x. [Abstract]

Spitzenberger, F. (2002). *Die Säugetierfauna Österreichs. Bundesministerium für Land - und Forstwirtschaft.* Umwelt und Wasserwirtschaft, Band.

Spitzenberger, F. and K. Bauer (1979). Die Säugetierfauna Zyperns. Teil II: Chiroptera, Lagomorpha, Carnivora und Artiodactyla. *Annalen des Naturhistorischen Museums in Wien*, **82:** 439 - 465. [Abstract]

Spitzenberger, F., E. Haring and N. Tvrtkovic (2002). *Plecotus microdontus* (Mammalia, Vespertilionidae), a new bat species from Austria. *Natura Croatica*, **11 (1):** 1 - 18.

Spitzenberger, F., J. Piálek and E. Haring (2001). Systematics of the genus *Plecotus* (Mammalia, Vespertilionidae) in Austria based on morphometric and molecular investigations. *Folia zoologica: International journal of vertebratology*, **50 (3):** 161 - 172.

Spitzenberger, F., P. (P.) Strelkov and E. Haring (2003). Morphology and mitochondrial DNA sequences show that *Plecotus alpinus* Kiefer & Veith, 2002 and *Plecotus microdontus* Spitzenberger, 2002 are synonyms of *Plecotus macrobullaris* Kuzjakin, 1965. *Natura Croatica*, **12 (2):** 39 - 53.

Spitzenberger, F., P. P. Strelkov, H. Winkler and E. Haring (2006). A preliminary revision of the genus *Plecotus* (Chiroptera, Vespertilionidae) based on genetic and morphological results. *Zoologica Scripta: an international journal of evolutionary zoology*, **35 (3):** 187 - 230. doi: 10.1111/j.1463-6409.2006.00224.x.

Spitzenberger, F. and O. von Helversen (2001). *Myotis capaccinii (Bonaparte, 1837) - ?Langfußfledermaus.* In Krapp, F. : *Handbuch der Säugetiere Europas. Band 4: Fledertiere. Teil I: Chiroptera I. Rhinolophidae, Vespertilionidae 1.* AULA-Verlag, Wiebelsheim: 281 - 302.

Špoutil, F., P. Linhart, S. Poláková, V. Dornáková, P. Tumová and Š. Demelová (2010). Variability of echolocation calls of bats from Madagascar as observed by the Expedition Biriki. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 288.

Springer, M. S., L. J. Hollar and J. A. W. Kirsch (1995). Phylogeny. molecules versus morphology and rates of character evolution among fruit bats (Chiroptera: Megachiroptera). *Australian Journal of Zoology*, **43 (6):** 557 - 582. doi: 10.1071/ZO9950557.

Springer, M. S., R. W. Meredith, J. E. Janecka and W. J. Murphy (2011). The historical biogeography of Mammalia. *Philosophical transactions of the Royal Society of London*, **B 366 (1577):** 2478 - 2502. doi: 10.1098/rstb.2011.0023.

Springer, M. S., E. C. Teeling, O. Madsen, M. J Stanhope and W. W. De Jong (2001). Integrated fossil and molecular data reconstruct bat echolocation. *Proceedings of the National Academy of Sciences of the USA*, **98 (11):** 6241 - 6246.

Šrámek, J. and P. Benda (2014). Sexual and age size variation in the western Palaearctic populations of Miniopterus bats (Chiroptera: Miniopteridae). *Folia zoologica: International journal of vertebratology*, **63 (3):** 216 - 227.

Šrámek, J., V. Gvoždík and P. Benda (2012). Hidden diversity in bent-winged bats (Chiroptera: Miniopteridae) of the Western Palaearctic and adjacent regions: implications for taxonomy. *Zoological Journal of the Linnean Society*, **167 (1):** 165 - 190 (for 2013). doi: 10.1111/j.1096-3642.2012.00870.x.

Sreepada, K. S., D. Koubínová, A. Konecný, P. Koubek, P. Ráb, R. Rábová and J. Zima (2008). Karyotypes of three species of molossid bats (Molossidae, Chiroptera) from India and western Africa. *Folia zoologica: International journal of vertebratology*, **57 (4):** 347 - 357.

Sreepada, K. S., K. N. Naidu and M. E. Gururaj (1995). Chromosomal variations in four Indian species of *Taphozous* (Chiroptera: Mammalia). *Biologisches Zentralblatt*, **114:** 307 - 314.

Srinivasulu, B., C. Srinivasulu, H. Kaur, T. A. Shah, G. Devender and A. Srinivasulu (2014). The reassessment of the threatened status of the Indian endemic Kolar Leaf-nosed Bat *Hipposideros hypophyllus* Kock & Bhat, 1994 (Mammalia: Chiroptera: Hipposideridae). *Journal of Threatened Taxa*, **6 (12):** 6493 - 6501. doi: 10.11609/JoTT.o4117.6493-501.

Srinivasulu, C., P. A. Racey and S. Mistry (2010). A key to the bats (Mammalia: Chiroptera) of South Asia. *Journal of Threatened Taxa*, **2 (7):** 1001 - 1076.

Srinivasulu, C. and B. Srinivasulu (2005). A review of chiropteran diversity of Bangladesh. *Net: Newsletter of Chiroptera Conservation and Information Network of South Asia*, **2:** 5 - 11.

Stadelmann, B., G. Herrera, J. Arroyo-Cabrales and M. Ruedi (2002). Molecular systematics of the piscivorous bat *Myotis (Pizonyx) vivesi*. IX th European Bat Research Symposium - 26 - 30 August 2002 - Le Havre: 2.

Stadelmann, B., L. G. Herrera, J. Arroyo-Cabrales, J. J. Flores-Martinez, B. P. May and M. Ruedi (2004a). Molecular systematics of the fishing bat *Myotis* (*Pizonyx*) *vivesi*. *Journal of Mammalogy*, **85 (1):** 133 - 139.

Stadelmann, B., D. S. Jacobs, C. Schoeman and M. Ruedi (2004b). Phylogeny of African *Myotis* bats (Chiroptera, Vespertilionidae) inferred from cytochrome *b* sequences. *Acta Chiropterologica*, **6 (2):** 177 - 192.

Stadelmann, B., L. K. Lin, T. H. Kunz and M. Ruedi (2007). Molecular phylogeny of New World *Myotis* (Chiroptera, Vespertilionidae) inferred from mitochondrial and nuclear DNA genes. *Molecular phylogenetics and evolution*, **43 (1):** 32 - 48.

Stadelmann, B. and M. Ruedi (200x). *Phylogentic evolution of the genus Myotis (Chiroptera, Vespertilionidae)*. Poster.

Stanhope, M. J., J. Czelusniak, J.-S. Si, J. Nickerson and M. Goodman (1992). A molecular perspective on mammalian evolution from the gene encoding interphotoreceptor retinoid binding protein, with convincing evidence for bat monophyly. *Molecular and Phylogenetic Evolution*, **1 (2):** 148 - 160. [Abstract]

Stanley, W. T. (2008). A new species of *Mops* (Molossidae) from Pemba Island, Tanzania. *Acta Chiropterologica*, **10 (2):** 183 - 192. doi: 10.3161/150811008X414773.

Stanley, W. T. and L. Collett (2009). Attack or consumption of *Epomophorus* (Chiroptera) by *Paraxerus* (Rodentia) and *Papio* (Primates) in Tanzania. *African Journal of Ecology*, **47:** 792 - 793.

Stanley, W. T. and C. A. H. Foley (2008). A survey of the small mammals of Minziro Forest, Tanzania, with several additions to the known fauna of the country. *Mammalia*, **72 (2):** 116. doi: 10.1515/MAMM.2008.015.

Stanley, W. T. and S. M. Goodman (2011). Chapter 3. Small mammal inventories in the East and West Usambara and South Pare Mountains, Tanzania. 3. Chiroptera. *Fieldiana Life and Earth Sciences*,, **4:** 34 - 52.

Stanley, W. T., S. M. Goodman, P. M. Kihaule and K. M. Howell (2000). A survey of the small mammals of the Gonja Forest Reserve, Tanzania. *Journal of East African Natural History*, **89 (1):** 73 - 83. doi: 10.2982/0012-8317(2000)89[73:ASOTSM]2.0.CO;2.

Stanley, W. T., J. Gunn and P. M. Kihaule (2005a). Results of a preliminary small mammal survey of Malundwe Mountain, Mikumi National Park, Tanzania. *Journal of East African Natural History*, **94 (1):** 213 - 222.

Stanley, W. T., J. C. Kerbis Peterhans, R. M. Kityo and L. Davenport (1996). New records of bats for Uganda and Burundi. *African Journal of Ecology*, **34 (2):** 196 - 201. doi: 10.1111/j.1365-2028.1996.007-89007.x. [Abstract]

Stanley, W. T., P. M. Kihaule, R. Hutterer and K. M. Howell (1999). Small mammals of the Eastern Arc Mountains, Tanzania. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 107.

Stanley, W. T., P. M. Kihaule and M. J. Munissi (2007a). Small mammals of two forest reserves in the North Pare Mountains, Tanzania. *Journal of East African Natural History*, **96 (2):** 215 - 226. doi: 10.2982/0012-8317(2007)96[215:SMOTFR]2.0.CO;2.

Stanley, W. T. and D. Kock (2004). New records and notes on *Laephotis* Thomas, 1901 (Chiroptera: Vespertilionidae). *Mammalian biology (Zeitschrift für Säugetierkunde)*, **69 (3):** 173 - 181.

Stanley, W. T., A. M. Nikundiwe, F. A. Mturi, P. M. Kihaule and P. D. Moehlman (2005b). Small mammals collected in the Udzungwa mountains national park, Tanzania. *Journal of East African Natural History*, **94 (1):** 203 - 212.

Stanley, W. T., G. Norton, P. M. Kihaule, L. Collett and K. McQuaid (2007b). Additional notes on the small mammals of Malundwe Mountain, Mikumi National Park, Tanzania. *Journal of East African Natural History*, **96 (2):** 203 - 214. doi: 10.2982/0012-8317(2007)96[203:ANOTSM]2.0.CO;2.

Stanley, W. T., M. A. Rogers, K. M. Howell and C. A. Msuya (2005c). Results of a survey of small mammals in the Kwamgumi Forest Reserve, East Usambara Mountains, Tanzania. *Journal of East African Natural History*, **94 (1):** 223 - 230.

Stanley, W. T., M. A. Rogers, R. B. M. Senzota, F. A. Mturi, P. M. Kihaule, P. D. Moehlman and B. M. OConner (2007c). Surveys of small mammals in Tarangire National Park, Tanzania. *Journal of East African Natural History*, **96 (1):** 47 - 71. doi: 10.2982/0012-8317(2007)96[47:SOSMIT]2.0.CO;2.

Starrett, A. (1972). *Cyttarops alecto*. *Mammalian Species*, **13:** 1 - 2, 4 figs.

Start, A. N. (1966). A note on the occurrence of *Tadarida africana* Dobson 1876 (Chiroptera: Molossidae) in Kenya. *Mammalia*, **30 (3):** 509 - 511. doi: 10.1515/mamm.1966.30.3.507.

Start, A. N. (1969). A note on three species of bats (Chiroptera) not previously recorded from Kenya. *Mammalia*, **33 (2):** 219 - 224. doi: 10.1515/mamm.1969.33.2.219. [Abstract]

Stasiak, I. M., D. A. Smith, G. J. Crawshaw, J. D. Hammermueller, D. Bienzle and B. N. Lillie (2014). Characterization of the hepcidin gene in eight species of bats. *Research in Veterinary Science*, **96 (1):** 111 - 117. doi: 10.1016/j.rvsc.2013.10.013.

Stebbings, R. E. (1966). A population study of bats of the Genus *Plecotus*. *Journal of Zoology*, **150:** 53 - 75.

Stebbings, R. E. (1973). Size clines in the bat *Pipistrellus pipistrellus* related to climatic factors. *Periodicum biologorum - Societas Scientiarum Naturalium Croatica*, **75:** 189 - 194. [Abstract]

Stebbings, R. E. and F. Griffith (1986). *Distribution and status of bats in Europe*. Institute of Terrestrial Ecology, Huntington: 142 pp. URL: http://nora.nerc.ac.uk/5237/1/Distribution_Bats.pdf.

Stechert, C., M. Kolb, M. Bahadir, B. A. Djossa and J. Fahr (2014). Insecticide residues in bats along a land use-gradient dominated by cotton cultivation in northern Benin, West Africa. *Environmental Science and Pollution Research*, **21 (14):** 8812 - 8821. doi: 10.1007/s11356-014-2817-8.

Stekolnikov, A. A. (2018a). Taxonomy and distribution of African chiggers (Acariformes, Trombiculidae). *European Journal of Taxonomy*, **395:** 1 - 233. doi: 10.5852/ejt.2018.395.

Stekolnikov, A. A. (2018b). African chiggers (Acariformes: Trombiculidae) in the collection of Alex Fain, with a description of a new genus and three new species. *Acarologia*, **58 (2):** 265 - 286. doi: 10.24349/acarologia/20184240.

Stephan, H., H. D. Frahm and G. Baron (1987). Brains of Vespertilionids. I. Subfamily characteristics. *Zeitschrift für zoologischen Systematik und Evolutions-forschung*, **25:** 67 - 80. [Abstract]

Stephens, W. (1983). Wahlberg's Eagle catching bats in Malawi. *The Ostrich*, **54 (1):** 25.

Steyn, P. (1964). Python eats fruit bat. *African Wild Life*, **18:** 257. URL: http://www.catsg.org/cheetah/05_library/5_3_publications/B/Bigalke_1964_The_speed_of_the_cheetah.pdf.

Stiles, C. W. (1914). Eighth list of generic names (Mammals) under consideration in connection with the official list of zoological names. *Science*, **NS 40 (1019):** 66 - 67.

Stirnemann, R. and M. Van Der Merwe (2005). The reproductive biology of the banana bat, *Neoromicia nanus*, in a population from Mpumalanga (Abstract). *African Bat Conservation News*, **6:** 6.

St Leger, J. (1932). On mammals from North-West Damaraland, South-West Africa, obtained during captain Shortridge's Sixth Percy Sladen and Kaffrarian Museum expedition. *Proceedings of the Zoological Society of London*, **4:** 957 - 974.

St Leger, J. (1936). Dr. Karl Jordan's expedition to South-West Africa and Angola: Mammals. *Novitates Zoologicae*, **40:** 75 - 81. [Abstract]
St Leger, J. (1937). Mammals collected by the Lake Rudolf Rift Valley Expedition, 1934. *Annals and Magazine of Natural History*, **ser. 10, 19 (113):** 524 - 531. [Abstract]
Stoetzel, E. (2013). Late Cenozoic micromammal biochronology of northwestern Africa. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **392:** 359 - 381. doi: 10.1016/j.palaeo.2013.09.026.
Stoetzel, E., L. Marion, R. Nespoulet, M. A. El Hajraoui and C. Denys (2011). Taphonomy and palaeoecology of the late Pleistocene to middle Holocene small mammal succession of El Harhoura 2 cave (Rabat-T,mara, Morocco). *Journal of Human Evolution*, **60 (1):** 1 - 33. doi: 10.1016/j.jhevol.2010.07.016.
Stoffberg, S. (2008). *Rhinolophus capensis* (Chiroptera: Rhinolophidae). *Mammalian Species*, **810:** 1 - 4; 3 figs. doi: 10.1644/810.1..
Stoffberg, S. and D. S. Jacobs (2004). The influence of wing morphology and echolocation on the gleaning ability of the insectivorous bat *Myotis tricolor*. *Canadian journal of zoology*, **82 (12):** 1854 - 1863. doi: 10.1139/Z04-172.
Stoffberg, S., D. S. Jacobs, I. J. Mackie and C. A. Matthee (2010a). Molecular phylogenetics and historical biogeography of *Rhinolopus* bats. *Molecular phylogenetics and evolution*, **54:** 1 - 10. doi: 10.1016/j.ympev.2009.09.021.
Stoffberg, S., D. S. Jacobs and C. A. Matthee (2005). Molecular systematics of South African Rhinolophids (Mammalia: Chiroptera). (Abstract of paper presentation at the 5th Systematic Society of Southern Africa Conference.). *African Bat Conservation News*, **4:** 6.
Stoffberg, S., D. S. Jacobs and C. A. Matthee (2010b). The evolution of high-frequency echolocation in horseshoe bats: Moth hearing, body size or habitat? In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 289 - 290.
Stoffberg, S., D. S. Jacobs and C. A. Matthee (2011). The divergence of echolocation frequency in horseshoe bats: Moth hearing, body size or habitat?. *Journal of Mammalian Evolution*, **18 (2):** 117 - 129. doi: 10.1007/s10914-011-9158-x.
Stoffberg, S., D. S. Jacobs and C. M. Miller-Butterworth (2004). Field identification of two morphologically similar bats, *Miniopterus schreibersii natalensis* and *Miniopterus fraterculus* (Chiroptera: Vespertilionidae). *African Zoology*, **39 (1):** 47 - 53. doi: 10.1080/15627020.2004.11407285.
Stoffberg, S., M. C. Schoeman and C. A. Matthee (2012). Correlated genetic and ecological diversification in a widespread southern African horseshoe bat. *PLoS ONE*, **7 (2) e31946:** 1 - 11. doi: 10.1371/journal.pone.0031946.
Storfer, A. (1996). Quantitative genetics: a promising approach for the assessment of genetic variation in endangered species. *Trends in Ecology and Evolution*, **11 (8):** 343 - 348.
Storm, N., P. Jansen van Vuren, W. Markotter and J. T. Paweska (2018). Antibody responses to Marburg Virus in Egyptian rousette bats and their role in protection against infection. *Viruses*, **10 (2):** 73. doi: 10.3390/v10020073.
Strachinis, I., K, Katsiyiannis, P. Kalaentzis and C. Kazilas (2018). First record of the Egyptian fruit bat, *Rousettus aegyptiacus* (Pteropodidae), from Kastellorizo island, Greece. *Mammalia*, **82 (6):** 611 - 613. doi: 10.1515/mammalia-2017-0063.
Strelkov, P. P. (1963). *Otryad Chiroptera - Rukokrylye [II. Order Chiroptera - bats].* In Sokolov, I.I. [Ed]: *Mlekopitayu shchiye fauny SSSR. Chast' 1 [Mammals of the fauna of the USSR. Part 1]* Pp. 122–218.
Strelkov, P. P. (1972). *Myotis blythi* (Tomes, 1857): Distribution, geographical variability and differences from *Myotis myotis* (Borkhausen, 1797) (in Russian with English summary). *Acta Theriologica*, **17 (28):** 355 - 380.
Strelkov, P. P. (1989a). *New data on the structure of baculum in Palaearctic bats. 1. The genera Myotis, Plecotus, and Barbastella.* In Hanák, V., I. Horácek and J. Gaisler : *European Bat Research 1987*. Charles University Press - Praha: 89 - 94. [Abstract]
Strelkov, P. P. (1989b). *New data on the structure of baculum in Palaearctic bats. 2. Genus Eptesicus.* In Hanák, V., I. Horácek and J. Gaisler : *European Bat Research 1987*. Charles University Press - Praha: 95 - 100. [Abstract]
Strelkov, P. P. (1997a). Breeding area and its position in range of migratory bat species (Chiroptera, Vespertilionidae) in East Europa and adjacent countries. Communication 1. *Zoologicheskii Zhurnal*, **78:** 1073 - 1082.
Strelkov, P. P. (1997b). Breeding area and its position in range of migratory bat species (Chiroptera, Vespertilionidae) in East Europa and adjacent countries. Communication 2. *Zoologicheskii Zhurnal*, **78:** 1381 - 1390.
Strelkov, P. P., V. P. Sosnovtzeva and H. B. Babaev (1978). The bats of Turkmenia. Functional morphology and systematisation of mammals [In Russian]. *Proceedings of the Zoological Institute, Academy of Sciences of the USSR*, **79:** 3 - 71.
Streseman, E. (1954). Hemprich und Ehrenberg. Reisen zweier naturforschender Freunde im Orient geschildert in ihren Briefen aus den Jahren 1819 - 1826. *Abhandlungen der Deutschen Akademie der Wissenschaften Berlin*1.
Strijbis, L. (2008). My midday encounter with a *Myotis welwitchii*. *African Bat Conservation News*, **17:** 3.
Strinati, P. (1951). Note sur les chauves-souris du Maroc. *Mammalia*, **15 (1):** 23 - 31. doi: 10.1515/mamm.1951.15.1.23. [Abstract]
Strinati, P. (1953). Deuxième note sur les chauves-souris du Maroc. *Mammalia*, **17:** 189 - 193. doi: 10.1515/mamm.1953.17.3.189. [Abstract]
Strinati, P. (1960). La faune actuelle de trois grottes d'Afrique équatoriale française. *Annales de Spéléologie*, **15 (3):** 533 - 538. [Abstract]
Strinati, P. and V. Aellen (1983). I. Voyage biospéologique autour du monde. *Mémoire de la Speleologie Club de Paris*, **9:** 1 - 32.
Stuart, C. T. (1975). Preliminary notes on the mammals of the Namib Desert Park. *Madoqua: Tydskrif vir natuurbewarings- en Woestynnavoring = Journal of nature conservation and desert research*, **(2) 4:** 74 - 80. [Abstract]
Stuart, C. T. and H. H. Braack (1978). Preliminary notes on the mammals of the Bontebok National Park. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **21 (1):** 111 - 117. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/966. [Abstract]
Stuart, C. (T.) and T. (D.) Stuart (2004). African White-backed vultures *Gyps africanus* feeding on Straw-coloured Fruit bats *Eidolon helvum*. *Vulture News*, **50:** 34 - 35.
Stuart, C. T., T. D. Stuart and H. H. Braack (1987). New mammal records for the Karoo National Park, with notes on several other species. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **30 (1):** 133 - 137. [Abstract]
Stuart, S. N., R. J. Adams and M. D. Jenkins (1990). *Biodiversity in Sub-Saharan Africa and its islands. Conservation, management and sustainable use.* IUCN, Gland, Switzerland: i - vi; 1 - 242.
Stutz, H. P. and M. Haffner (1984). realverlust und Bertandesrückgang der Kleinen Hufeisennase *Rhinolophus hipposideros* (Bechstein, 1800) (Mammalia: Chiroptera) in der Schweitz. *Jahresbericht der naturfurschenden Gesellschaft Graubündens*, **101:** 169 - 178.

Su, L. H. (2019). Scientists find deadly Ebola virus for first time in West African bat. The Washington Post. URL: https://www.washingtonpost.com/health/2019/01/24/scientists-find-deadly-ebola-virus-first-time-west-african-bat/?utm_term=.3d586c81ab5a.
Sudi, L., C. Mangu, T. Tarimo, N. Ntinginya and G. Shirima (2018). Hantaviruses in East and Central Africa. *American Journal of Research Communication*, **6 (6):** 1 - 14.
Sudman, P. D., L. J. Barkley and M. S. Hafner (1994). Familial affinity of *Tomopeas ravus* (Chiroptera) based on protein electrophoretic and cytochrome *B* sequence data. *Journal of Mammalogy*, **75 (2):** 365 - 377. [Abstract]
Sumibcay, L., B. Kadjo, S. H. Gu, H. J. Kang, B. K. Lim, J. A. Cook, J.-W. Song and R. Yanagihara (2012). Divergent lineage of a novel hantavirus in the banana pipistrelle (*Neoromicia nanus*) in Côte d'Ivoire. *Virology Journal*, **9 (34):** 1 - 6. doi: 10.1186/1743-422X-9-34.
Sun, K., L. Luo, R. T. Kimball, X. Wei, L. Jin, T. Jiang, G. Li and J. Feng (2013). Geographic variation in the acoustic traits of greater horseshoe bats: testing the importance of drift and ecological selection in evolutionary processes. *PLoS ONE*, **8 (8):** e70368. doi: 10.1371/journal.pone.0070368.
Sundevall, C. J. (1843). ?? Title still needs to be checked. ?? *Kongliga Svenska Vetenskaps-Akademiens Handlingar*(3) 30.
Sundevall, C. J. (1846). 7. Nya Mammalia från Sydafrika. *Öfversigt af kongligen Svenska Vetenskapsakademiens Förhandlingar, Stockholm*, **3 (4):** 118 - 121.
Sundevall, C. J. (1860). ?? Title still needs to be checked. ?? *Kongliga Svenska Vetenskaps-Akademiens Handlingar*(2) 2 (10).
Sureau, P., M. Germain, J. P. Herve, B. Geoffrey, J. P. Cornet, G. Heme and Y. Robin (1977). Isolement du virus Lagos bat en Empire Centrafricain. *Bulletin de la Société de Pathologie exotique et ses filiales*, **70:** 467 - 470.
Suu-Ire, R., L. Begeman, A. C. Banyard, A. C. Breed, C. Drosten, E. Eggerbauer, C. M. Freuling, L. Gibson, H. Goharriz, D. L. Horton, D. Jennings, I. V. Kuzmin, D. Marston, Y. Ntiamoa-Baidu, S. Riesle Sbarbaro, D. Selden, E. L. Wise, T. Kuiken, A. R. Fooks, T. Müller, J. L. N. Wood and A. A. Cunningham (2018). Pathogenesis of bat rabies in a natural reservoir: Comparative susceptibility of the straw-colored fruit bat (*Eidolon helvum*) to three strains of Lagos bat virus. *PLoS Neglected Tropical Diseases*, **12 (3):** e0006311. doi: 10.1371/journal.pntd.0006311.
Suyanto, A., M. Yoneda, I. Maryanto, Maharadatunkamsi and J. Sugardjito (2002). *Checklist of the mammals of Indonesia. 2nd Edition.* LIPI-JICA-PHKA Joint project for Biodiversity Conservation in Indonesia - National Library of Indonesia - Katalog Dalam Terbitam (KDT) - Bogor: i - vii, 1 - 63.
Swainson, W. (1827). VI. Sketch of the life and character of the late Count de Lacepede. *Zoological Journal*, **3 (9):** 73 - 76.
Swainson, W. (1835). *On the natural history and classification of quadrupeds.* .
Swanepoel, P., R. H. N. Smithers and I. L. Rautenbach (1980). A checklist and numbering system of the extant mammals of the southern African subregion. *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **32 (7):** 155 - 196. [Abstract]
Swanepoel, R. (2004). *Rabies.* In Coetzer, J. A. W. and R. C. Tustin : *Infectious diseases of livestock: with special reference to southern Africa. 2nd edition.* Oxford University Press - Cape Town: 1123 - 1182.
Swanepoel, R., P. A. Leman, F. J. Burt, N. A. Zachariades, L. E. , Ksiazek, T. G. : Rollin, P. E. : Zaki, S. R. Braack and C. J. Peters (1996). Experimental inoculation of plants and animals with Ebola virus. *Emerging Infectious Diseases*, **2:** 321 - 325.
Sweeney, R. C. H. (1959). A preliminary annotated check list of the mammals of Nyasaland. *Nyasaland Society*1 - 71.
Swynnerton, G. H. (1958). Fauna of the Serengeti National Park. *Mammalia*, **22 (3):** 435 - 450.
Swynnerton, G. H. and R. W. Hayman (1951). A checklist of the land mammals of the Tanganyika Territory and the Zanzibar Protectorate. *Journal of the East African Natural History Society and National Museum*, **20 (for 1950) (90):** 274 - 392.
Swynnerton, G. H. and R. W. Hayman (1954). Additions to the checklist of Tangayika mammals. *Journal of the East African Natural History Society and National Museum*, **23 (7) (104):** 9 - xx.
Sylla, M., X. Pourrut, M. Diatta, B. M. Diop, M. Ndiaye and J. P. Gonzalez (2015). Chiropteran and Filoviruses in Africa: Unveiling an ancient history. *African Journal of Microbiology Research*, **9 (22):** 1446 - 1472. doi: 10.5897/AJMR2015.7455.
Sylla, M., X. Pourrut, N. Faye, K. Ba, J.-P. Cornet and J.-L. Camicas (2004). Argasidae (Acari: Ixodida) parasites of wild and domestic animals in Senegal: I - Review and distribution. *Acarologia*, **44 (3-4):** 137 - 149.
Szczesniak, M., M. Yoneda, H. Sato, I. Makalowska, S. Kyuwa, S. Sugano, Y. Suzuki, W. Makalowski and C. Kai (2013). Characterization of the mitochondrial genome of *Rousettus leschenaulti*. *Mitochondrial DNA*, **25 (6):** 443 - 444 (for 2014). doi: 10.3109/19401736.2013.809451.
Szekely, P., Y. Korem, U. Moran, A. Mayo and U. Alon (2015). The mass-longevity triangle: pareto optimality and the geometry of life-history trait space. *PLoS Computational Biology*, **11 (10):** e1004524. doi: 10.1371/journal.pcbi.1004524.
Szentiványi, T., P. Christe and O. Glaizot (2019). Bat flies and their microparasites: current knowledge and distribution. *Frontiers in Veterinary Science*, **6:** 115. doi: 10.3389/fvets.2019.00115.
Szentivanyi, T., O. Vincze, O. Glaizot and P. Christe (2017). Effects of host ecology on bat fly species richness in European bats (Abstract). In Hudson, A.M. and P.H.C. Lina [Eds]: *EBRS 2017 Book of Abstracts.* 14th European Bat Research Symposium. Donostia, The Basque Country: 1 - 5 August 2017: 182. URL: http://www.ebrs2017.eus/EBRS2017_AbstractBook.pdf.
Szentkuti, S., F. Bontadina, M. Spada, M. Moretti, N. Zambelli, A. Martinoli and R. Arlettaz (2013). Factors underlying migratory bat aggregations in chestnut groves. *Endangered Species Research*, **21 (2):** 105 - 114. doi: 10.3354/esr00496.
Tabuce, R. and M. Mahboubi (1999). Contribution du gisement de Bir El Ater (Algérie) à la connaissance des petits mammifères de l'Eocène africain. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 14.
Tamsitt, J. R. and D. Valdivieso (1969). Hemoglobin electrophoresis in the systematics of bats (Microchiroptera). *Life Sciences Royal Ontario Museum, University of Toronto*, **14:** 1 - 11. [Abstract]
Tamungang, S. A., B. Mpoame and E. M. Jaff (2007). Foraging and feeding behaviour of fruit bats in Dschang, Cameroon. *African Journal of Ecology*, **46 (2):** 230 - 231 (for 2008). doi: 10.1111/j.1365-2028.2007.00825.x.
Tanshi, I. (2013). Bat Conservation Africa: a voice for our friends in the African night sky. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 152. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Tanshi, I. (2014). Bat Conservation Africa: A voice for African bats. *IUCN Bat Specialist Group Newsletter*, **1:** 3 unnumbered pp.
Tao, Y., M. Shi, C. Chommanard, K. Queen, J. Zhang, W. Markotter, I. V. Kuzmin, E. C. Holmes and S. Tong (2017). Surveillance of bat coronaviruses in Kenya identifies relatives of human coronaviruses NL63 and 229E and their recombination history. *Journal of Virology*, **91 (5):** e01953-16. doi: 10.1128/JVI.01953-16.

Tao, Y., K. Tang, M. Shi, C. Conrardy, K. S. M. Li, S. K. P. Lau, L. J. Anderson and S. Tong (2012). Genomic characterization of seven distinct bat coronaviruses in Kenya. *Virus Research*, **167 (1):** 67 - 73. doi: 10.1016/j.virusres.2012.04.007.
Tao, Y. and S. Tong (2019). Complete genome sequence of a severe acute respiratory syndrome-related coronavirus from Kenyan bats. *Microbiology Resource Announcements*, **8 (28):** e00548-19. doi: 10.1128/MRA.00548-19.
Tapanes, E., K. M. Detwiler and M. Cords (2016). Bat predation by *Cercopithecus* monkeys: Implications for zoonotic disease transmission. *EcoHealth*, **13 (2):** 405 - 409. doi: 10.1007/s10393-016-1121-0.
Tate, G. H. H. (1941a). Results of the Archbold Expeditions. Nr 36. Remarks on some Old World leaf-nose bats. *American Museum Novitates*, **1140:** 1 - 11. [Abstract]
Tate, G. H. H. (1941b). Results of the Archbold Expeditions. No. 39. A review of the genus *Myotis* (Chiroptera) of Eurasia, with special reference to species occurring in the East Indies. *Bulletin of the American Museum of Natural History*, **78 (8):** 537 - 565.
Tate, G. H. H. (1942). Results of the Archbold Expeditions. Nr 47. Review of the vespertilionine bats, with specific attention to genera and species of the Archbold collection. *Bulletin of the American Museum of Natural History*, **80 (7):** 221 - 297. [Abstract]
Taub, M., Y. Prat and Y. Yovel (2014). The role of vocal learning in the acoustic communication of the Egyptian fruit bat. *Journal of Molecular Neuroscience*, **53 (Suppl 1):** S122. doi: 10.1007/s12031-014-0252-4.
Taufflieb, R. (1962). Acariens mésostigmates actuellement connus en République du Congo (Acarina; Laelaptidae, Spinturnicidae). *Bulletin de l'institut de Recherches Scientifiques du Congo*, **1:** 109 - 113.
Taufflieb, R. (1965). Contribution à l'étude des *Trombiculidae (Acarina)* d'Angola. *Publicaçoes culturais - Companhia de Diamantes Angola. Serviços Culturais*, **??:** 21 - 36. [Abstract]
Taufflieb, R. (1972). Trois nouveaux Trombiculidae (Acarina) du Sénégal. *Acarologia*, **14 (2):** 190 - 197. [Abstract]
Taufflieb, R. and J. Mouchet (1959). Revue des Trombiculidae du Cameroun et description de huit espèces et sous-espèces nouvelles. *Acarologia*, **1 (2):** 228 - 245. [Abstract]
Taylor, E. H. (1934). Philippine Land Mammals. *Monographs of the Bureau of Science, Manila*, **30:** 1 - 548.
Taylor, G., J. P. W. Scharlemann, M. Rowcliffe, N. Kümpel, M. B. J. Harfoot, J. E. Fa, R. Melisch, E. J. Milner-Gulland, S. Bhagwat, K. A. Abernethy, A. S. Ajonina, L. Albrechtsen, S. Allebone-Webb, E. Brown, D. Brugierem, C. Clark, M. Colell, G. Cowlishaw, D. Crookes, E. De Merode, J. Dupain, T. East, D. Edderai, P. Elkan, D. Gill, E. Greengrass, C. Hodgkinson, O. Ilambu, P. Jeanmart, J. Juste, J. M. Linder, D. W, Noss, A. J. Macdonald, P. U. Okorie, V. J. J. Okouyi, S. Pailler, J. R. Poulsen, M. Riddell, J. Schleicher, B. Schulte-Herbrüggen, M. Starkey, N. van Vliet, C. Whitham, A. S. Willcox, D. S. Wilkie, J. H. Wright and L. M. Coad (2014). Synthesising bushmeat research effort in West and Central Africa: A new regional database. In Online: December 2014 - printed: January 2015 *Biological Conservation*, **181:** 199 - 205 (for 2015). doi: 10.1016/j.biocon.2014.11.001.
Taylor, M. and M. D. Tuttle (2019). *Bats: An illustrated guide to all species.* Ivy Press: 400 pp.
Taylor, P. J. (1991). First record of Welwitsch's Hairy bat (*Myotis welwitschii*) from Natal. *Durban Museum Novitates*, **16:** 35 - 36.
Taylor, P. (J.) (1998). *The smaller mammals of KwaZulu-Natal.* University of Natal Press - Pietermaritzburg: 139 pp.
Taylor, P. J. (1999a). The role of amateurs in the growth of bat conservation and research in South Africa. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **34 (1):** 19 - 26.
Taylor, P. J. (1999b). Echolocation calls of twenty southern African bat species. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **34 (3):** 114 - 124.
Taylor, P. J. (1999c). Problems with identification of southern African *Chaerephon* (Molossidae), and the possibility of a cryptic species from South Africa and Swaziland. *Acta Chiropterologica*, **1 (2):** 191 - 200.
Taylor, P. J. (2000). *Bats of Southern Africa: Guide to biology, identification, and conservation.* University of Natal Press - Pietermaritzburg: 206 pp.
Taylor, P. J. (2005). *Order Chiroptera.* In Skinner, J. D. and C. T. Chimimba : *The Mammals of the Southern African Subregion.* Cambridge University Press - Cambridge, U.K.: 256 - 352.
Taylor, P. J. (2006). Bats and Viruses: Balancing bat conservation and public health. Report back on the 8th conference of the Southern and Eastern African rabies group (SEARG), Heja Lodge, Namibia, 22-25 January 2006. *African Bat Conservation News*, **8:** 2 - 4.
Taylor, P. J. (2008). In memory of Lloyd R. Wingate (1947-2007). *African Bat Conservation News*, **17:** 2.
Taylor, P. J. (2013a). *Epomophorus angolensis Angolan Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 237 - 238.
Taylor, P. J. (2013b). *Myonycteris relicta Bergmans's Collared Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 273 - 274.
Taylor, P. J. (2013c). *Taphozous perforatus Egyptian Tomb Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 436 - 437.
Taylor, P. J., C. Cheney and C. Sapsford (1999). Roost habitat evaluation and distribution of bats (Chiroptera) in the Durban Metropolitan Region. *Durban Museum Novitates*, **24:** 62 - 71.
Taylor, P. J., L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. (R.) Richards, (M.) C. Schoeman, T. Sethusa and A. Monadjem (2016a). *A conservation assessment of Mops midas.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.
Taylor, P. J., F. P. D. Cotterill, M. van der Merwe, W. White and D. S. Jacobs (2004). New biogeographical records of five rare bat species (Chiroptera: Rhinolophidae and Vespertilionidae) from South Africa. *Durban Museum Novitates*, **29:** 104 - 109.
Taylor, P. J., C. Denys and F. P. D. Cotterill (2019). Taxonomic anarchy or an inconvenient truth for conservation? Accelerated species discovery reveals evolutionary patterns and heightened extinction threat in Afro-Malagasy small mammals. *Mammalia*, **83 (4):** 313 - 329. doi: 10.1515/mammalia-2018-0031.
Taylor, P. J., C. Geiselman, P. Kabochi, B. Agwanda and S. Turner (2005). Intraspecific variation in the calls of some African bats (Order Chiroptera). *Durban Museum Novitates*, **30:** 24 - 37.
Taylor, P. J., S. M. Goodman, M. C. Schoeman, F. H. Ratrimomanarivo and J. M. Lamb (2012a). Wing loading correlates negatively with genetic structuring of eight Afro-Malagasy bat species (Molossidae). *Acta Chiropterologica*, **14 (1):** 53 - 62. doi: 10.3161/150811012X654268.
Taylor, P. J., I. Grass, A. J. Alberts, E. Joubert and T. Tscharntke (2017a). Economic value of bat predation services - A review and new estimates from macadamia orchards. *Ecosystem Services*, **30 C:** 372 - 381 (for 2018). doi: 10.1016/j.ecoser.2017.11.015.

Taylor, P. J., D. (S.) Jacobs, L. Cohen, T. (C.) Kearney, K. (L.) MacEwan, L. (R.) Richards, (M.) C. Schoeman, T. Sethusa and A. Monadjem (2016b). *A conservation assessment of Rhinolophus smithersi.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Taylor, P. J., D. (S.) Jacobs, L. Cohen, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and A. Monadjem (2016c). *A conservation assessment of Neoromicia cf. melckorum.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Taylor, P. J., J. Lamb, D. Reddy, T. Naidoo, F. Ratrimomanarivo and S. M. Goodman (2009). Cryptic lineages of little free-tailed bats *Chaerephon pumilus* (Chiroptera: Molossidae) from southern Africa and the western Indian Ocean islands. *African Zoology*, **44 (1):** 55 - 70.

Taylor, P. J., A. MacDonald, S. M. Goodman, T. Kearney, F. P. D. Cotterill, S. Stoffberg, A. Monadjem, M. C. Schoeman, J. Guyton, P. Naskrecki and L. R. Richards (2018a). Integrative taxonomy resolves three new cryptic species of small southern African horseshoe bats (*Rhinolophus*). *Zoological Journal of the Linnean Society*, **184 (4):** 1249 - 1276. doi: 10.1093/zoolinnean/zly024.

Taylor, P. J., E. Matamba, J. N. (K.), Nangammbi, T. Steyn, M. L. Zepeda-Mendoza and K. Bohmann (2017b). Diet determined by next generation sequencing reveals pest consumption and opportunistic foraging by bats in macadamia orchards in South Africa. *Acta Chiropterologica*, **19 (2):** 239 - 254. doi: 10.3161/15081109ACC2017.19.2.003.

Taylor, P. J., D. Mkhari, T. Mukwevho, A. Monadjem, M. C. Schoeman, C. Schoeman and J. N. Steyn (2012b). Bats as potential biocontrol agents in an agricultural landscape, Levubu Valley: Diet, activity and species composition of bats in macadamia orchards and neighbouring natural habitats. *South African avocado growers' association yearbook*, **34:** 54 - 64 (for 2011).

Taylor, P. J. and A. Monadjem (2008). Maxillary shape as a diagnostic tool for identifying fruit bats, *Epomophorus crypturus* and *E. wahlbergi* from museum specimens and in the field. *South African Journal of Wildlife Research*, **38 (1):** 22 - 27. doi: 10.3957/0379-4369-38.1.22.

Taylor, P. J., A. Monadjem and J. N. Steyn (2013a). Seasonal patterns of habitat use by insectivorous bats in a subtropical African agro-ecosystem dominated by macadamia orchards. *African Journal of Ecology*, **51 (4):** 552 - 561. doi: 10.1111/aje.12066.

Taylor, P. J., G. Neef, M. Keith, S. Weier, A. Monadjem and D. M. Parker (2018b). Tapping into technology and the biodiversity informatics revolution: updated terrestrial mammal list of Angola, with new records from the Okavango Basin. *ZooKeys*, **779:** 51 - 88. doi: 10.3897/zookeys.779.25964.

Taylor, P. J., A. Rautenbach, M. C. Schoeman and X. Combrink (2007). A winter survey of the smaller mammals of the uMkuze section of the iSimangaliso Wetland Park, KwaZulu-Natal Province, South Africa. July - September 2007. Report: 13 pp. URL: http://wei.org.za/docs/p18g14mgig2b81rkf1j6j1cvp1fp53.pdf.

Taylor, P. J., L. R. Richards, J. Bayliss and F. P. D. Cotterill (2015). Rediscovery of the Transvaal free-tailed bat (*Tadarida ventralis africana*) in South Africa, with an additional record of the Malagasy free-tailed bat (*T. fulminans*) from northern Mozambique. *Durban Museum Novitates*, **38:** 50 - 55.

Taylor, P. J., L. R. Richards, Bayliss J., F. P. D. Cotterill and M. F. Child (2016d). *A conservation assessment of Tadarida ventralis.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Taylor, P. J., L. R. Richards, W. White and M. F. Child (2016e). *A conservation assessment of Scotophilus leucogaster.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Taylor, P. J., E. J. Richardson, J. Meester and L. Wingate (1994). New distribution records for six small mammal species in Natal, with notes on their taxonomy and ecology. *Durban Museum Novitates*, **19:** 59 - 66. [Abstract]

Taylor, P. J., (M.) C. Schoeman, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, L. Cohen, T. Sethusa and A. Monadjem (2016f). *A conservation assessment of Laephotis botswanae.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Taylor, P. J., S. Sowler, M. C. Schoeman and A. Monadjem (2013b). Diversity of bats in the Soutpansberg and Blouberg Mountains of northern South Africa: Complementarity of acoustic and non-acoustic survey methods. *South African Journal of Wildlife Research*, **43 (1):** 12 - 26. doi: 10.3957/056.043.0117.

Taylor, P. (J.), K. Steyn, T. Nangammbi, T. Mukwevho, C. Schoeman, K. Bohmann and T. Gilbert (2013c). Bats as biocontrol agents suppressing nocturnal flying pests in Macadamia Orchards in Limpopo Province, South Africa. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 153 - 154. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Taylor, P. J., S. Stoffberg, A. Monadjem, C. M. Schoeman and W. Cotterill (2010). Cryptic species of horseshoe bats (Rhinolophidae) of the *Rhinolophus hildebrandtii* complex in southern Africa. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 297.

Taylor, P. J., S. Stoffberg, A. Monadjem, M. C. Schoeman, J. Bayliss and F. P. D. Cotterill (2012c). Four new bat species (*Rhinolophus hildebrandtii* complex) reflect Plio-Pleistocene divergence of dwarfs and giants across an afromontane archipelago. *PLoS ONE*, **7 (9) e41744:** 1 - 23. doi: 10.1371/journal.pone.0041744.

Taylor, P. J. and M. van der Merwe (1998). Taxonomic notes on dark-winged house bats of the genus *Scotoecus* Thomas 1901, in Malawi. *Durban Museum Novitates*, **23:** 64 - 66.

Teeling, E. C., O. Madsen, W. J. Murphy, M. S. Springer and S. J. O'Brien (2003). Nuclear gene sequences confirm an ancient linkbetween New Zaland's short-tailed bat and South American noctilionid bats. *Molecular phylogenetics and evolution*, **28:** 308 - 319. doi: 10.1016/S1055-7903(03)00117-9.

Teeling, E. C., O. Madsen, R. A. Van Den Bussche, W. W. de Jong, M. J. Stanhope and M. S. Springer (2002). Microbat paraphyly and the convergent evolution of a key innovation in Old World rhinolophoid microbats. *Proceedings of the National Academy of Sciences of the USA*, **99 (3):** 1431 - 1436. doi: 10.1073/pnas.022477199.

Teeling, E. C., M. Scally, D. J. Kao, M. L. Romagnoli, M. S. Springer and M. J Stanhope (2000). Molecular evidence regarding the origin of echolocation and flight in bats. *Nature*, **403 (6766):** 188 - 192. doi: 10.1038/35003188.
Teeling, E. C., M. S. Springer, O. Madsen, P. (J. J.) Bates, S. J. O'Brien and W. J. Murphy (2005). A molecular phylogeny for bats illuminates biogeography and the fossil record. *Science*, **307 (5709):** 580 - 584. doi: 10.1126/science.1105113.
Teeling, E. C., S. C. Vernes, L. M. Dávalos, D. A. Ray, M. T. P. Gilbert, E. Myers and Bat1K Consortium (2017). Bat biology, genomes, and the Bat1K Project: to generate chromosome-level genomes for all living bat species. *Annual Review of Animal Biosciences*, **6:** 23 - 46 (for 2018). doi: 10.1146/annurev-animal-022516-022811.
Temminck, C. J. (1825). *Monographies de Mammalogie. Tome 1 (5).* Paris.
Temminck, C. J. (1826). *Monographies de Mammalogie. Tome 1 (?).* Paris.
Temminck, C. J. (1827). *Monographies de Mammalogie. Tome 1 (?).* Paris.
Temminck, C. J. (1832). *Enumerations des Mammifères Capensium.* .
Temminck, C. J. (1835). *Monographies de mammalogie ou description de quelques genres de mammifères, dont les espèces ont été observées dans les différens musées de l'Europe. Tome Seconde.* C.C Van der Hoek - Leiden & Ed. d'Ocagne et A. Bertrand - Paris (1835 à 1841): 1 - 392.
Temminck, C. J. (1837a). Rousette labiaire - *Pteropus labiatus*. *Monogr. Mamm.*, **2:** 83 - 84.
Temminck, C. J. (1837b). Monographies de mammalogie, ou description de quelques genres de mammifères, dont les espèces ont été observées dans les differentes musées de l'Europe. Van de Hoek & Dufour & d'Ocagne - Leiden: 49 - 140.
Temminck, C. J. (1838). Over de geslachten *Taphozous, Emballonura, Urocryptus* en *Diclidurus*. *Tijdschrift Natuur, Geschiedenis en Physiologie*, **5:** 1 - 34, 1 pl.
Temminck, C. J. (1840). *Treizième monographie sur les cheiroptères vespertilionides formant les genres Nyctice, Vespertilion et Furie.* 2: 141 - 272.
Temminck, C. J. (1853). *Esquisses de zoologie Côte de Guinée. 1e partie, les Mammifères.* E.J. Brill, Leiden: i - xvi; 1 - 256.
Temple, H. J. and A. Cuttelod [Eds] (2009). *The status and distribution of Mediterranean mammals.* Gland, Switzerland and Cambridge, UK : IUCN: i - vii; 1 - 32. URL: http://data.iucn.org/dbtw-wpd/edocs/2009-027.pdf.
Těšíková, J., A. Bryjová, J. Bryja, L. A. Lavrenchenko and J. de Bellocq (2017). Hantavirus strains in East Africa related to western African hantaviruses. *Vector-Borne and Zoonotic Diseases*, **17 (4):** 278 - 280. doi: 10.1089/vbz.2016.2022.
Theodor, O. (1956). On the genus *Tripselia* and the group of *Basilia bathybothyra* (Nycteribiidae, Diptera). *Parasitology*, **46:** 353 - 394. [Abstract]
Theodor, O. (1957). The Nycteribiidae of the Ethiopian region and Madagascar. *Parasitology*, **47:** 457 - 543.
Theodor, O. (1967). *An illustrated catalogue of the Rothschild collection of Nycteribiidae (Diptera) in the British Museum (Natural History).* Trustees of the British Museum (Natural History) - London: i - viii; 1 - 506, 6 plates.
Theodor, O. (1968). A revision of the Streblidae (Diptera) of the Ethiopian Region. *Transactions of the Royal Entomological Society*, **120 (16):** 313 - 373. doi: 10.1111/j.1365-2311.1968.tb00342.x. [Abstract]
Thevenot, M. and S. Aulagnier (2006). Mise à jour de la liste des mammifères sauvages du Maroc. Janvier 2006. *Go-South Bulletin*, **3:** 6 - 9.
Thewissen, J. G. M. and S. A. Etnier (1995). Adhesive devices on the thumb of Vespertilionoid bats (Chiroptera). *Journal of Mammalogy*, **76 (3):** 925 - 936. [Abstract]
Thiagavel, J., C. Cechetto, S. E. Santana, L. Jakobsen, E. J. Warrant and J. M. Ratcliffe (2018). Auditory opportunity and visual constraint enabled the evolution of echolocation in bats. *Nature Communications*, **9:** 98. doi: 10.1038/s41467-017-02532-x.
Thiagavel, J., S. E. Santana and J. M. Ratcliffe (2017). Body size predicts echolocation call peak frequency better than gape height in vespertilionid bats. *Scientific Reports*, **7:** 828. doi: 10.1038/s41598-017-00959-2.
Thiam, M., K. Bâ and J.-M. Duplantier (2008). Impacts of climatic changes on small mammal communities in the Sahel (West Africa) as evidenced by owl pellet analysis. *African Zoology*, **43 (2):** 135 - 143.
Thies, M. L. and P. J. Lewis (2015). Effects of fire on small mammals of the Koanaka Hills, northwestern Botswana. *Occasional Papers of the Museum, Texas Tech University*, **330:** 1 - 17.
Thollesson, M. and U. M. Norberg (1991). Moments of inertia of bat wings and body. *Journal of experimental biology*, **158:** 19 - 35. [Abstract]
Thomas, A. and D. S. Jacobs (2010). Factors affecting the emergence times of several sympatric insectivorous bat species. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 299.
Thomas, A. J. and D. S. Jacobs (2013). Factors influencing the emergence times of sympatric insectivorous bat species. *Acta Chiropterologica*, **15 (1):** 121 - 132. doi: 10.3161/150811013X667920.
Thomas, D. and M. Henry (2013a). *Eidolon helvum African Straw-coloured Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 232 - 234.
Thomas, D. and M. Henry (2013b). *Epomops buettikoferi Büttikofer's Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 253 - 255.
Thomas, D. and M. Henry (2013c). *Micropteropus pusillus Peters's Lesser Epauletted Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 270 - 272.
Thomas, D. and M. Henry (2013d). *Myonycteris torquata Little Collared Fruit Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 275 - 276.
Thomas, D. W. (1981a). The role of fruit bats in seed dispersal and regeneration in a Southern Guinea Savanna. Abstract. *African Small Mammal Newsletter*, **Special Number, 4:** 12. [Abstract]
Thomas, D. W. (1981b). Protein and Energy intake in frugivores: Why do fruits have little protein? Abstract. 14.
Thomas, D. W. (1982). The ecology of an African savanna fruit bat community: resource partitioning and role in seed dispersal. PhD Thesis - University of Aberdeen: 206 pp. [Abstract]
Thomas, D. W. (1983). The annual migrations of three species of West African fruit bats (Chiroptera: Pteropodidae). *Canadian journal of zoology*, **61 (10):** 2266 - 2273.
Thomas, D. W. (1984a). Moth scales in feces of fruit bats: evidence of insectivory or fruit contamination?. *Journal of Mammalogy*, **65 (3):** 484 - 485.
Thomas, D. W. (1984b). Fruit intake and energy budgets of frugivorous bats. *Physiological zoology*, **57 (4):** 457 - 467. [Abstract]
Thomas, D. W. and M. B. Fenton (1978). Notes on the dry season roosting and foraging behaviour of *Epomophorous gabianus* and *Roussettus aegyptiacus* (Chiroptera: Pteropodidae). *Journal of Zoology*, **186:** 403 - 406. [Abstract]
Thomas, D. W. and A. G. Marshall (1984). Reproduction and growth in three species of West African fruit bats. *Journal of Zoology*, **202 (2):** 265 - 281. doi: 10.1111/j.1469-7998.1984.tb05954.x. [Abstract]

Thomas, J., M. Sorourian, D. Ray, R. J. Baker and E. J. Pritham (2010). The limited distribution of *Helitrons* to vesper bats supports horizontal transfer. *Gene*, **474 (1 - 2):** 52 - 58 (for 2011). doi: 10.1016/j.gene.2010.12.007.
Thomas, N. M. (1997). A systematic review of selected Afro-Asiatic Rhinolophidae (Mammalia: Chiroptera): an evaluation of taxonomic methodologies. PhD thesis, Harrison Zoological Museum - Sevenoaks: i - v; 1 - 211. [Abstract]
Thomas, N. M., D. L. Harrison and P. J. J. Bates (1994). A study of the baculum in the genus *Nycteris* (Mammalia, Chiroptera, Nycteridae) with consideration of its taxonomic importance. *Bonner zoologische Beitrage*, **45 (1):** 17 - 31. [Abstract]
Thomas, O. (1880). XXII. On bats from Old Calabar. *Annals and Magazine of Natural History*, **ser. 5, 6 (32):** 164 - 167, 2 figs. [Abstract]
Thomas, O. (1885). 2. Report on the mammals obtained and observed by Mr. H. H. Johnston on Mount Kilima-njaro. *Proceedings of the Zoological Society of London*, **1885, II:** 219 - 222.
Thomas, O. (1886). 2. On the mammals presented by Allan O. Hume, Esq., C.B., to the Natural History Museum. *Proceedings of the Zoological Society of London*, **1886, I:** 54; 79, pls 5 - 6. [Abstract]
Thomas, O. (1888). 1. On a collection of mammals obtained by Emin Pasha in Equatorial Africa, and presented by him to the Natural History Museum. *Proceedings of the Zoological Society of London*, **1888, I:** 3; 17, pls 1 - 2. doi: 10.1111/j.1469-7998.1888.tb06674.x. [Abstract]
Thomas, O. (1889). Description of a new bat from the Gambia. *Annals and Magazine of Natural History*, **ser. 6, 3 (16):** 362 - 364, 1 fig.
Thomas, O. (1890a). 3. On a collection of mammals obtained by Dr. Emin Pasha in Central and Eastern Africa. *Proceedings of the Zoological Society of London*, **1890, III:** 443 - 450, 1 fig, pl 40. [Abstract]
Thomas, O. (1890b). Description of a new *Scotophilus* from the Gambia, with remarks on some of the allied species. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 9 (O.S. 29):** 84 - 88. [Abstract]
Thomas, O. (1891a). LXII. Descriptions of three new bats in the British Museum collection. *Annals and Magazine of Natural History*, **ser. 6, 7 (42):** 527 - 530.
Thomas, O. (1891b). 1. On a collection of small mammals made by Mr. F. J. Jackson in Eastern Africa. *Proceedings of the Zoological Society of London*, **1891, II:** 181 - 187.
Thomas, O. (1893). 3. On mammals from Nyassaland. *Proceedings of the Zoological Society of London*, **1892, IV:** 546 - .554.
Thomas, O. (1894a). 1. On the mammals of Nyasaland: third contribution. *Proceedings of the Zoological Society of London*, **1894, I:** 136 - 146. [Abstract]
Thomas, O. (1894b). 4. On some specimens of mammals from Oman, S.E. Arabia. *Proceedings of the Zoological Society of London*, **1894, III:** 448 - 455, pl 31. [Abstract]
Thomas, O. (1895). Esplorazione del Giuba e dei suoi affluenti compiuta dal cap. V. Bottego durante gli anni 1892-93 sotto gli auspicii della Società Geografica Italiana. Risultati zoologici. I. Mammiferi. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 15 (O.S. 35):** 3 - 6.
Thomas, O. (1896). On Capt. Bottego's second collection of mammals from central and southern Somaliland. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **(2) 17 (37):** 105 - 107.
Thomas, O. (1897a). 1. On the mammals of Nyasaland: fourth Notice. *Proceedings of the Zoological Society of London*, **1876, IV:** 788; 798, pls 38 - 39. [Abstract]
Thomas, O. (1897b). 6. On the genera of Rodents: An attempt to bring up to date the current arrangement of the order. *Proceedings of the Zoological Society of London*, **1876, IV:** 1012 - 1028. [Abstract]
Thomas, O. (1897c). On the mammals collected during captain Bottego's last expedition to Lake Rudolf and the Upper Sobat. *Annali del Museo civico di Storia Naturale "Giacomo Doria"*, **ser. 2, 18 (O.S. 38):** 676 - 679.
Thomas, O. (1898a). 2. On the mammals obtained by Mr. A. Whyte in Nyasaland, and presented to the British Museum by Sir H.H. Johnston, K.C.B.; being a fifth contribution to the mammal fauna of Nyasaland. *Proceedings of the Zoological Society of London*, **1897, IV:** 925 - 939, pl 54. [Abstract]
Thomas, O. (1898b). VIII. On the mammals obtained by Mr. John Whitehead during his recent Expedition to the Philippines. *Transactions of the Zoological Society of London*, **14 (6) (1):** 377; 412, pl 30 - 36. [Abstract]
Thomas, O. (1900). 2. On the mammals obtained in South-western Arabia by Messrs. Percival and Dodson. *Proceedings of the Zoological Society of London*, **1900, I:** 95 - 104. [Abstract]
Thomas, O. (1901a). Some new African bats (including one from the Azores) and a new *Galago*. *Annals and Magazine of Natural History*, **ser. 7, 7 (37):** 27 - 34.
Thomas, O. (1901b). XXXIII. A new Scotophiline bat from British East Africa, with the description of a new genus of the group. *Annals and Magazine of Natural History*, **ser. 7, 7 (39):** 263 - 265. [Abstract]
Thomas, O. (1901c). List of mammals obtained by Dr. Donaldson Smith during his recent journey from Lake Rudolf to the Upper Nile. *Proceedings of the Zoological Society of London*, **1900, IV:** 800 - 807. [Abstract]
Thomas, O. (1901d). On a new genus and species of Vespertilionine bat from East Africa. *Annals and Magazine of Natural History*, **ser. 7, 7 (41):** 460 - 462.
Thomas, O. (1901e). New species of *Macroscelides* and *Glauconycteris*. *Annals and Magazine of Natural History*, **ser. 7, 8 (55):** 255 - 257.
Thomas, O. (1901f). XXXVIII. On a collection of small mammals from the Upper Nile obtained by Mr. R.M. Hawker. *Annals and Magazine of Natural History*, **ser. 7, 8 (46):** 273 - 278. [Abstract]
Thomas, O. (1902). 1. On the mammals collected during the Whitaker Expedition to Tripoli. *Proceedings of the Zoological Society of London*, **1902, II (I):** 2 - 13. [Abstract]
Thomas, O. (1903a). 4. On a collection of mammals from Abyssinia, including some from Lake Tsana, collected by Mr. Edward Degen. *Proceedings of the Zoological Society of London*, **1902, II (2):** 308 - 316.
Thomas, O. (1903b). LXXII. On the species of the genus *Rhinopoma*. *Annals and Magazine of Natural History*, **ser. 7, 11 (65):** 496 - 499. [Abstract]
Thomas, O. (1903c). 2. On some Mammals collected by Capt. H.N. Dunn, R.A.M.C., in the Soudan. *Proceedings of the Zoological Society of London*, **1903, I (2):** 294 - 301.
Thomas, O. (1903d). Three new species of *Nyctionomus*. *Annals and Magazine of Natural History*, **ser. 7, 12 (71):** 501 - 505.
Thomas, O. (1903e). Three new bats from the Cameroons, discovered by Mr. G.L. Bates. *Annals and Magazine of Natural History*, **ser. 7, 12 (72):** 633 - 635. doi: 10.1080/00222930309487045.
Thomas, O. (1904a). XXII. New bats from British East Africa collected by Mrs. Hinde, and from the Cameroons by Mr. G.L. Bates. *Annals and Magazine of Natural History*, **ser. 7, 13 (75):** 206 - 210. [Abstract]
Thomas, O. (1904b). XLVI. Three new bats, African and Asiatic. *Annals and Magazine of Natural History*, **ser. 7, 13 (77):** 38 - 77.

Thomas, O. (1904c). XLVIII. On mammals from northern Angola collected by Dr. W.J. Ansorge. *Annals and Magazine of Natural History*, **ser. 7, 13 (77):** 405 - 421, 2 figs. [Abstract]
Thomas, O. (1904d). XXIV. On some small mammals collected by Mr. A.M. Mackilligin in the Eastern Desert of Egypt. *Annals and Magazine of Natural History*, **ser. 7, 14 (80):** 155 - 159. [Abstract]
Thomas, O. (1904e). On a new species of fruit-bat from Fernando Po. *Proceedings of the Zoological Society of London*, **1904, I (II):** 371 - 372.
Thomas, O. (1904f). XXVIII. New bats and rodents from West Africa, the Malay Peninsula, and Papuasia. *Annals and Magazine of Natural History*, **ser. 7, 14 (81):** 196 - 202.
Thomas, O. (1904g). 1. On the osteology and systematic position of the rare Malagasy Bat *Myzopoda aurita*. *Proceedings of the Zoological Society of London*, **1904, II (I):** 2 - 6.
Thomas, O. (1905a). VII. New African mammals of the Genera *Glauconycteris, Lutra, Funisciurus, Arvicanthis, Lophiomys*, and *Procavia*. *Annals and Magazine of Natural History*, **ser. 7, 15 (85):** 77 - 83.
Thomas, O. (1905b). LXV. A new genus and two new species of bats. *Annals and Magazine of Natural History*, **ser. 7, 16 (95):** 572 - 576.
Thomas, O. (1906a). New African mammals of the genera *Cercopithecus*, *Scotophilus*, *Miniopterus*, *Crocidura*, *Georychus*, and *Heliophobius*. *Annals and Magazine of Natural History*, **ser. 7, 17 (98):** 173 - 179.
Thomas, O. (1906b). A new genus of Free-tailed bat from N.E. Africa. *Annals and Magazine of Natural History*, **ser. 7, 17 (101):** 499 - 501.
Thomas, O. (1908). A new fruit-bat from Sierra Leone. *Annals and Magazine of Natural History*, **ser. 8, 2 (10):** 375 - 376.
Thomas, O. (1909a). XII. New African small mammals in the British Museum collection. *Annals and Magazine of Natural History*, **ser. 8, 4 (20):** 98 - 112.
Thomas, O. (1909b). LXX. New African Mammals. *Annals and Magazine of Natural History*, **ser. 8, 4 (24):** 542 - 549.
Thomas, O. (1910a). XXVIII. Further new African mammals. *Annals and Magazine of Natural History*, **ser. 8, 5 (26):** 191 - 202.
Thomas, O. (1910b). Ruwenzori Expedition reports. 17. Mammalia. *Transactions of the Zoological Society of London*, **19 (5):** 481 - 518.
Thomas, O. (1910c). XII. A new genus of fruit-bats and two new shrews from Africa. *Annals and Magazine of Natural History*, **ser. 8, 6 (31):** 111 - 114.
Thomas, O. (1910d). XXXVI. List of mammals from Mount Kilimandjaro, obtained by Mr. Robin Kemp, and presented to the British Museum by Mr. C.D. Rudd. *Annals and Magazine of Natural History*, **ser. 8, 6 (33):** 308 - 316. [Abstract]
Thomas, O. (1911). XIII. List of small mammals obtained by Mr. G. Fenwick Owen on the Upper Gambia and in Fouta Djallon. *Annals and Magazine of Natural History*, **ser. 8, 8 (43):** 117 - 124. [Abstract]
Thomas, O. (1912a). XXVII. Mammals of the Panyam Plateau, northern Nigeria. II. *Annals and Magazine of Natural History*, **ser. 8, 9 (50):** 269 - 274.
Thomas, O. (1912b). IV. Mammals from the Ja River, Cameroons. *Annals and Magazine of Natural History*, **ser. 8, 10 (55):** 41 - 43.
Thomas, O. (1912c). A new Vespertilionine bat from Angola. *Annals and Magazine of Natural History*, **ser. 8, 10 (56):** 204 - 206. [Abstract]
Thomas, O. (1912d). Two new West-African mammals. *Annals and Magazine of Natural History*, **ser. 8, 10 (57):** 280 - 282.
Thomas, O. (1913a). On some specimens of *Glauconycteris* from the Cameroons. *Annals and Magazine of Natural History*, **ser. 8, 11 (61):** 144 - 145. doi: 10.1080/00222931308693299. [Abstract]
Thomas, O. (1913b). On African bats and shrews. *Annals and Magazine of Natural History*, **ser. 8, 11 (63):** 314 - 321.
Thomas, O. (1915a). On three new bats obtained by Mr. Willoughby Lowe in the Sudan. *Annals and Magazine of Natural History*, **ser. 8, 15 (90):** 559 - 562. [Abstract]
Thomas, O. (1915b). Notes on bats of the genus *Coleura*. *Annals and Magazine of Natural History*, **ser. 8, 15 (90):** 576 - 579. [Abstract]
Thomas, O. (1915c). Scientific results of the mammal survey. Nr XI. A. On pipistrelles of the genera *Pipistrellus* and *Scotozous*. *Journal of the Bombay Natural History Society*, **24:** 29 - 34.
Thomas, O. (1915d). List of mammals (exclusive of Ungulata) collected on the Upper Congo by Dr. Christy for the Congo Museum, Tervueren. *Annals and Magazine of Natural History*, **ser. 8, 16 (96):** 465 - 481. [Abstract]
Thomas, O. (1916). On small mammals obtained in Sankuru, South Congo, by Mr H. Wilson. *Annals and Magazine of Natural History*, **ser. 8, 18 (104) :** 234-239. doi: 10.1080/00222931608693841.
Thomas, O. (1917). XXIII. A new bat of the genus *Scotæcus*. *Annals and Magazine of Natural History*, **ser. 8, 19 (111):** 280 - 281. [Abstract]
Thomas, O. (1919). Some new mammals from Mesopotamia. *Journal of the Bombay Natural History Society*, **26:** 745 - 749. [Abstract]
Thomas, O. (1920). A new *Taphozous* from the Sudan. *Annals and Magazine of Natural History*, **ser. 9, 5 (25):** 142 - 144. [Abstract]
Thomas, O. (1922). XXXII. The generic classification of the *Taphozous* group. *Annals and Magazine of Natural History*, **ser. 9, 9 (51):** 266 - 267. [Abstract]
Thomas, O. (1925). On the mammals (other than Ruminants) collected by Captain Angus Buchanan during his Second Saharan Expedition, and presented by him to the National Museum. *Annals and Magazine of Natural History*, **ser. 9, 16 (93):** 187 - 197. [Abstract]
Thomas, O. (1926). On mammals from Ovamboland and the Cunene river, obtained during Capt. Shortridge's third Percy Sladen and Kaffrarian Museum Expedition into South-West Africa. *Proceedings of the Zoological Society of London*, **1926, I:** 285 - 312. [Abstract]
Thomas, O. (1929). On mammals from the Kaoko-Veld, South-West Africa obtained during Captain Shortridge's Fifth Percy Sladen and Kaffrarian Museum Expedition. *Proceedings of the Zoological Society of London*99 - 111. [Abstract]
Thomas, O. and M. A. C. Hinton (1920). Captain Angus Buchanan's Aïr Expedition. I. On a series of small mammals from Kano. *Novitates Zoologicae*, **27:** 315 - 320. [Abstract]
Thomas, O. and M. A. C. Hinton (1921). Captain Angus Buchanan's Air expedition. II. On the mammals (other than ruminants) obtained during the expedition to Air (Asben). *Novitates Zoologicae*, **28:** 1 - 13.
Thomas, O. and M. A. C. Hinton (1923a). On the mammals obtained in Darfur by the Lynes-Lowe Expedition. *Proceedings of the Zoological Society of London*, **1923, II:** 247 - 271. [Abstract]
Thomas, O. and M. A. C. Hinton (1923b). 26. On mammals collected by Captain Shortridge during the Percy Sladen and Kaffrarian Museum expedition to the Orange River. *Proceedings of the Zoological Society of London*, **1923, III:** 483 - 499.

Thomas, O. and M. A. C. Hinton (1925). On mammals collected in 1923 by Captain G.C. Shortridge during the Percy Sladen and Kaffrarian Museum Expedition to South-West Africa. With field notes by the collector. *Proceedings of the Zoological Society of London*, **1925, I:** 221 - 246.

Thomas, O. and H. Schwann (1904a). 1. On a collection of mammals from British Namaqualand, presented to the National Museum by Mr. C. D. Rudd. *Proceedings of the Zoological Society of London*, **1904, I (I):** 171 - 183.

Thomas, O. and H. Schwann (1904b). 1. On mammals collected during the Uganda Boundary Commission by the late Mr. W. G. Doggett, and presented to the British Museum by Col. C. Delmé-Radcliffe. *Proceedings of the Zoological Society of London*, **1904, I (II):** 459 - 465.

Thomas, O. and H. Schwann (1905a). 3. The Rudd Exploration of South Africa. - II. List of mammals from the Wakkerstroom District, South-Eastern Transvaal. *Proceedings of the Zoological Society of London*, **1905, I (I):** 129 - 138.

Thomas, O. and H. Schwann (1905b). The Rudd exploration of South Africa. III. List of mammals obtained by Mr. Grant in Zululand. *Proceedings of the Zoological Society of London*, **1905, I (II):** 254 - 276. [Abstract]

Thomas, O. and H. Schwann (1906a). 3. The Rudd exploration of South Africa. IV. List of mammals obtained by Mr. Grant at Knysna. *Proceedings of the Zoological Society of London*, **1906, I:** 159 - 168. [Abstract]

Thomas, O. and H. Schwann (1906b). 1. The Rudd exploration of South Africa. V. List of mammals obtained by Mr. Grant in N.E. Transvaal. *Proceedings of the Zoological Society of London*, **1906, III:** 575 - 591. [Abstract]

Thomas, O. and H. Schwann (1907). 4. The Rudd exploration of South Africa. VI. List of mammals obtained by Mr. Grant in the Eastern Transvaal. *Proceedings of the Zoological Society of London*, **1906, IV:** 779 - 782. [Abstract]

Thomas, O. and R. C. Wroughton (1907). 3. The Rudd Exploration of South Africa. - VII. List of mammals obtained by Mr. Grant at Coguno, Inhambane. *Proceedings of the Zoological Society of London*, **1907, I (II):** 285 - 299.

Thomas, O. and R. C. Wroughton (1908a). The Rudd exploration of South Africa. VIII. List of mammals obtained by Mr. Grant at Beira. *Proceedings of the Zoological Society of London*, **1907, IV:** 774 - 782. [Abstract]

Thomas, O. and R. C. Wroughton (1908b). 1. The Rudd Exploration of South Africa. - IX. List of mammals obtained by Mr. Grant on the Gorongoza Mountains, Portuguese S.E. Africa. *Proceedings of the Zoological Society of London*, **1908, II:** 164 - 173.

Thomas, O. and R. C. Wroughton (1908c). The Rudd exploration of South Africa. X. List of mammals collected by Mr. Grant near Tette, Zambesia. *Proceedings of the Zoological Society of London*, **1908, III:** 535 - 553. [Abstract]

Thomas, O. and R. C. Wroughton (1910). Ruwenzori expedition reports. 17. Mammalia. *Transactions of the Zoological Society of London*, **19 (5) (63):** 481; 529, pl. 30 - 34. doi: 10.1111/j.1469-7998.1909.tb08569.x. [Abstract]

Thonglongya, K. (1973). First record of *Rhinolophus paradoxolophus* (Bourret, 1951) from Thailand, with the description of a new species of the *Rhinolophus philippinensis* group (Chiroptera, Rhinolophidae). *Mammalia*, **37 (4):** 587 - 597. [Abstract]

Thorn, E. (1988a). Re-evaluation of *Pipistrellus capensis capensis* (A. Smith, 1829) (Chiroptera, Vespertilionidae) and neighbouring subspecies in Southern Africa. *Mammalia*, **52 (2):** 199 - 211. [Abstract]

Thorn, E. (1988b). The status of *Pipistrellus capensis notius* (=*Scabrifer notius* G.M. Allen, 1908) as prior synonym for *Eptesicus melckorum* Roberts, 1919). *Mammalia*, **52 (3):** 371 - 377. [Abstract]

Thorn, E. and J. Kerbis Peterhans (2009). *Small mammals of Uganda: Bats, shrews, hedgehog, golden-moles, otter-tenrec, elephant-shrews, and hares.* Zoologisches Forschungsmuseum Alexander Koenig, Bonn. Vol. 55: 1 - 164.

Thorn, E., J. Kerbis Peterhans and J. Baranga (2009). *2. Chiroptera.* In Thorn, E. and J. Kerbis Peterhans [Eds]: *Small mammals of Uganda: Bats, shrews, hedgehog, golden-moles, otter-tenrec, elephant-shrews, and hares* Zoologisches Forschungsmuseum Alexander Koenig, Bonn. Vol. 55: 12 - 75.

Thorn, E., D. Kock and J. Cuisin (2007). Status of the African bats *Vesperugo grandidieri* Dobson 1876 and *Vesperugo flavescens* Seabra 1900 (Chiroptera, Vespertilionidae), with description of a new subgenus. *Mammalia*, **71 (1/2):** 70 - 79. doi: 10.1515/MAMM.2007.013.

Tian, L., B. Liang, K. Maeda, W. Metzner and S. Zhang (2004). Molecular studies on the classification of *Miniopterus schreibersii* (Chiroptera: Vespertilionidae) inferred from mitochondrial cytochrome *b* sequences. *Folia zoologica: International journal of vertebratology*, **53 (3):** 303 - 311.

Till, W. M. (1958). Five new species of mites (Acarina: Laelaptidae and Spinturnicidae) parasites on bats in the Ethiopian region, with a key to the species of the genus *Periglischrus*. *Revue suisse de zoologie*, **65 (4):** 241 - 258.

Till, W. M. (1960). Notes on some Mesostigmatic mites occurring on African and Australian bats. *Journal of the Entomological Society of Southern Africa*, **23 (1):** 223 - 224.

Timberlake, J. R., F. Dowsett-Lemaire, J. Bayliss, T. Alves, S. Baena, C. Bento, K. Cook, J. Francisco, T. Harris, P. Smith and C. de Sousa (2009). Mt Namuli, Mozambique: Biodiversity and Conservation. Report produced under the Darwin Initiative Award 15/036. Royal Botanic Gardens, Kew, London. 114 p. URL: http://www.kew.org/science/directory/projects/annex/Namuli_report_FINAL.pdf.

Tiunov, M. P. (1986). External structure of the male accessory gland in chiropterans and utilization of this character in their taxonomy [In Russian]. *Zoologichesky Zhurnal*, **65 (8):** 1275 - 1279.

Tiunov, M. P. (1989). *8. The taxonomic implication of different morphological systems in bats.* In Hanák, V., I. Horácek and J. Gaisler : *European Bat Research 1987.* Charles University Press, Praha: 67 - 75.

To, K. K. W., J. F. W. Chan, A. K. L. Tsang, V. C. C. Cheng and K.-Y. Yuen (2014). Ebola virus disease: a highly fatal infectious disease reemerging in West Africa. *Microbes and Infection*, **17 (2):** 84 - 97 (for 2015). doi: 10.1016/j.micinf.2014.11.007.

Tomes, R. F. (1857). 3. Descriptions of four undescribed species of bats. *Proceedings of the Zoological Society of London*, **XXV (cccxxx):** 50 - 54.

Tomes, R. F. (1858). 9. A monograph of the genus *Kerivoula*. *Proceedings of the Zoological Society of London*, **XXVI (cccIxvii):** 322 - 338.

Tomes, R. F. (1859). 5. Description of six hitherto undescribed species of bats. *Proceedings of the Zoological Society of London*, **1859, I (old XXVII):** 68 - 79.

Tomes, R. F. (1860). 1. A monograph of the genus *Epomophorus*, with the description of a new species. *Proceedings of the Zoological Society of London*, **1860 (old XXVIII):** 42 - 58.

Tomes, R. F. (1861a). 2. Additions to the monograph of the genus *Epomophorus*. *Proceedings of the Zoological Society of London*, **1861, I (old XXIX):** 11 - 12, pl. 1.

Tomes, R. F. (1861b). 1. Notes on a collection of bats made by Mr. Andersson in the Damara country, South-western Africa, with notices of some other African species. *Proceedings of the Zoological Society of London*, **1861, I (old XXIX):** 31 - 39. [Abstract]

Tong, S., C. Conrardy, S. Ruone, I. V. Kuzmin, X. Guo, Y. Tao, M. Niezgoda, L. Haynes, B. Agwanda, R. F. Breiman, L. J. Anderson and C. E. Rupprecht (2009). Detection of novel SARS-like and other Coronaviruses in bats from Kenya. *Emerging Infectious Diseases*, **15 (3):** 482 - 485. doi: 10.3201/eid1503.081013.

Tortosa, P., N. Dsouli, Y. Gomard, B. Ramasindrazana, C. W. Dick and S. M. Goodman (2013). Evolutionary history of Indian Ocean Nycteribiid bat flies mirroring the ecology of their hosts. *PLoS ONE*, **8 (9):** e75215. doi: 10.1371/journal.pone.0075215.

Toschi, A. (1954). Elenco preliminare dei mammiferi della Libia. *Riccorde di Zoologia appl. Caccia, Bologna*, **2 (7):** 241 - 273. [Abstract]

Toschi, A. (1956). Missione del prof. G. Scortecci in Somalia nel 1955. Mammiferi. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, **95:** 121 - 128. [Abstract]

Toschi, A. and B. Lanza (1959). *Fauna d'Italia: Mammalia - Generalita - Insectivora - Chiroptera.* Edizione Calderini - Bologna: 485 pp.

Toth, C. A. and S. Parsons (2013). Is lek breeding rare in bats? *Journal of Zoology*, **291 (1):** 3 - 11. doi: 10.1111/jzo.12069.

Toussaint, D. C., R. M. Brigham and A. E. McKechnie (2012). Thermoregulation in free-ranging *Nycteris thebaica* (Nycteridae) during winter: No evidence of torpor. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **78 (5):** 365 - 368 (for 2013). doi: 10.1016/j.mambio.2012.10.001.

Toussaint, D. C. and A. E. McKechnie (2012). Interspecific variation in thermoregulation among three sympatric bats inhabiting a hot, semi-arid environment. *Journal of Comparative Physiology*, **B 182 (8):** 1129 - 1140. doi: 10.1007/s00360-012-0683-6.

Toussaint, D. C., A. E. McKechnie and M. Van der Merwe (2010). Heterothermy in free-ranging male Egyptian Free-tailed bats (*Tadarida aegyptiaca*) in a subtropical climate. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **75 (5):** 466 - 470. doi: 10.1016/j.mambio.2009.06.001.

Towner, J. S., B. R. Amman and S. T. Nichol (2011). *Chapter 5. Significant zoonotic diseases identified in bats. Filoviruses.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 123 - 135. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Towner, J. S., B. R. Amman, T. K. Sealy, S. A. R. Carroll, J. A. Comer, A. Kemp, R. Swanepoel, C. D. Paddock, S. Balinandi, M. L. Khristova, P. B. H. Formenty, C. G. Albariño, D. M. Miller, Z. D. Reed, J. T. Kayiwa, J. N. Mills, D. L. Cannon, P. W. Greer, E. Byaruhanga, E. C. Farnon, P. Atimnedi, S. Okware, E. Katongole-Mbidde, R. Downing, J. W. Tappero, S. R. Zaki, T. G. Ksiazek, S. T. Nichol and P. E. Rollin (2009). Isolation of Genetically diverse Marburg viruses from Egyptian Fruit bats. *PloS Pathogens*, **5 (7):** e1000536. doi: 10.1371/journal.ppat.1000536.

Towner, J. S., X. Pourrut, C. G. Albariño, C. N. Nkogue, B. H. Bird, G. Grard, T. G. Ksiazek, J.-P. Gonzalez, S. T. Nichol and E. M. Leroy (2007). Marburg virus infection detected in a common African bat. *PLoS ONE*, **2 (8):** e764. doi: 10.1371/journal.pone.0000764.

Tranier, M. and R. de Naurois (1985). *Taphozous nudiventris* present dans l'archipel du Cap-Vert (Chiroptera, Emballonuridae). *Mammalia*, **49 (2):** 304 - 305.

Trentin, L. and F. Rovero (2011). Results of an inventory of bats in the Uzungwa Scarp Forest Reserve, Tanzania. *Journal of East African Natural History*, **100 (1 & 2):** 45 - 57. doi: 10.2982/028.100.0103.

Trewhella, W. J., P. F. Reason, K. M. Clark and S. R. T. Garrett (1998). The current status of Livingstone's flying fox (*Pteropus livingstonil*) in the Federal Islamic Republic (RFI) of the Cornores. *Phelsuma*, **6:** 32 - 40. [Abstract]

Trewhella, W. J., P. F. Reason, J. G. Davies and S. Wray (1995). Observations on the timing of reproduction in the congeneric Comoro Island fruit bats, *Pteropus livingstonii* and *P. seychellensis comorensis*. *Journal of Zoology*, **236:** 327 - 331.

Trewhella, W. J., K. M. Rodriguez-Clark, N. Corp, A. Entwistle, S. R. T. Garrett, E. Granek, K. L. Lengel, V. J. Powell, M. J. Raboude, P. F. Reason and B. J. Sewall (2004). Education, education, education! Lessons from conservation initiatives for the Critically Endangered fruit bats *Pteropus livingstonii*, *P. rodricensis* and *P.voeltzkowi* in the Western Indian Ocean, concerning locally-based bat population monitoring…. *African Bat Conservation News*, **2:** 18.

Trewhella, W. J., K. M. Rodriguez-Clark, N. Corp, A. Entwistle, S. R. T. Garrett, E. Granek, K. L. Lengel, M. J. Raboude, P. F. Reason and B. J. Sewall (2005). Environmental education as a component of multidisciplinary conservation programmes: lessons from conservation initiatives for Critically Endangered fruit bats in the Western Indian Ocean. *Conservation Biology*, **19 (1):** 75 - 85. doi: 10.1111/j.1523-1739.2005.00548.x.

Trewhella, W. J., K. M. Rodriguez-Clark, J. G. Davies, P. F. Reason and S. Wray (2001). Sympatric fruit bat species (Chiroptera: Pteropodidae) in the Comoro Islands (Western Indian Ocean): diurnality, feeding interactions and their conservation implications. *Acta Chiropterologica*, **3 (2):** 135 - 147.

Trewhella, W. J., B. J. Sewall and E. F. Granek (2002). The forgotten fruit bat: ecology and conservation of the Comoros Roussette, *Rousettus obliviosus*. *The Australasian Bat Society Newsletter*, **18:** 13.

Troudet, J., R. Vignes-Lebbe, P. Grandcolas and F. Legendre (2018). The increasing disconnection of primary biodiversity data from specimens: how does it happen and how to handle it? *Systematic Biology*, **67 (6):** 1110 - 1119. doi: 10.1093/sysbio/syy044.

Trouessart, E. L. (1895). *Cat. Mamm. Viv. Foss.* .

Trouessart, E. L. (1897). *Catalogus Mammalium tam viventium quam fossilium. Nova Editio (Prima completa). Fasc. I. Primates, Prosimiae, Chiroptera, Insectivora.* R. Friedländer & Sohn - Berlin: 218 pp.

Trouessart, E. L. (1899). *Catalogus Mammalium tam viventium quam fossilium. Nova Editio (Prima completa). Fasc. VI. Appendix (Addenda et Corrigenda). Index alphabeticus.* R. Friedländer & Sohn - Berlin: 1265 - 1469.

Trouessart, E. L. (1904). *Catalogus Mammalium tam viventium quam fossilium.* R. Friedländer & Sohn - Berlin.

Trouessart, E. L. (1905). La faune des mammifères de l'Algérie, du Maroc et de la Tunisie. *Causeries scientifiques de la Société de zoologie de la France*, **1 (10):** 353 - 410.

Trouessart, E.-L. (1907). Description de mammifères nouveau d'Afrique et du Madagacar. *Bulletin du Muséum national d'histoire naturelle de Paris*, **ser. 1, 12 (7):** 443 - 447 (for 1906).

Trouessart, E. L. (1910). *Fauna des Mammifères d'Europe.* .

Troughton, E. Le. G. (1929). A new genus and species of bat (Kerivoulinae) from the Solomons, with a review of the genera of the sub-family. *Records of the Australian Museum*, **17:** 85 - 99.

Troughton, E. Le G. (1931). Three new bats of the genera *Pteropus, Nyctimene*, and *Chaerophon* from Melanesia. *Proceedings of the Linnean Society of New South Wales*, **56:** 204 - 209.

Troughton, E. (Le G.) (1943). *Furred animals of Australia.* Angus & Robertson - Sidney - London - Melbourne - Wellington: 376 pp.

True, F. W. (1893). Description of a new species of fruit bat, *Pteropus aldabrensis*, from Aldabra Island. *Proceedings of the United States National Museums*, **16:** 533 - 534.
Trujillo, D. (1992). *Murcielagos de las Islas Canarias.* Ministerio del Agricultura, Pesca y Alimentacion - Madrid: 1 - 167. [Abstract]
Trujillo, D. (2003). *Plan de erradicación del murciélago frugivoro Rousettus aegyptiacus (Geoffroy, 1810) en Tenerife (Islas Canarias).* In Rodriguez-Luengo, J.L. [Ed]: *Control de Vertebrados Invasores en Islas de España y Portugal* Gobierno de Canarias, Santa Cruz de Tenerife. 101-109 p.
Trujillo, D. and R. Barone (1991). *La fauna de quiropteros del archipelago Canario.* In Benzal, J. and O. de Paz : *Los Murcielagos de España y Portugal.* Ministerio del Agricultura, Pesca y Alimentacion - Madrid: 93 - 111. [Abstract]
Trujillo, D., C. Ibáñez and J. Juste (2002). A new subspecies of *Barbastella barbastellus* (Mammalia: Chiroptera: Vespertilionidae) from the Canary islands. *Revue suisse de zoologie*, **109 (3):** 543 - 550.
Trujillo, R. G. (2005). Phylogenetics of the genus *Scotophilus* (Chiroptera:Vespertilionidae): perspectives from paternally and maternally inherited genomes with emphasis on African species. PhD thesis, Texas A & M University: 106 pp.
Trujillo, R. G., J. C. Patton, D. A. Schlitter and J. W. Bickham (2009). Molecular phylogenetics of the bat genus *Scotophilus* (Chiroptera: Vespertilionidae): perspectives from paternally and maternally inherited genomes. *Journal of Mammalogy*, **90 (3):** 548 - 560. doi: 10.1644/08-MAMM-A-239R2.1.
Trzcielinska-Lorych, J., H. Jackowiak, K. Skieresz-Szewczyk and S. Godynicki (2009). Morphology and morphometry of lingual papillae in adult and newborn Egyptian Fruit Bats (*Rousettus aegyptiacus*). *Anatomia Histologia Embryologia*, **38:** 370 - 376. doi: 10.1111/j.1439-0264.2009.00956.x.
Tsagkogeorga, G., S. Müller, C. Dessimoz and S. J. Rossiter (2017). Comparative genomics reveals contraction in olfactory receptor genes in bats. *Scientific Reports*, **7:** 259. doi: 10.1038/s41598-017-00132-9.
Tsagkogeorga, G., J. Parker, E. Stupka, J. A. Cotton and S. J. Rossiter (2013). Phylogenomic analyses elucidate the evolutionary relationships of bats. *Current Biology*, **23 (22):** 2262 - 2267. doi: 10.1016/j.cub.2013.09.014.
Tse, H., A. K. L. Tsang. , H.-W. Tsoi. , A. S. P. Leung, C.-C. Ho, S. K. P. Lau, P. C. Y. Woo and K.-Y. Yuen (2012). Identification of a novel bat papillomavirus by metagenomics. *PLoS ONE*, **7 (8) e43986:** 1 - 9. doi: 10.1371/journal.pone.0043986.
Tsita, J. N. (1993). Reproductive biology of the Egyptian free-tailed bat, *Tadarida aegyptiaca*. MS Thesis - Rhodes University: i - xi; 1 - 77. URL: http://eprints.ru.ac.za/3945/1/TSITA-MSc-TR94-98.pdf. [Abstract]
Tsoar, A., R. Nathan, Y. Bartan, A. Vyssotski, G. Dell'Omo and N. Ulanovsky (2011). Large-scale navigational map in a mammal. *Proceedings of the National Academy of Sciences, U.S.A.*, **108 (37):** E718 - E724. doi: 10.1073/pnas.1107365108.
Tsoar, A., N. Ulanovsky, Y. Bartan, O. Altstein, G. Dell'Omo, A. L. Vyssotski and R. Nathan (2010). Movement ecology of GPS-tracked *Rousettus aegyptiacus*: Unexpected foraging movements in a predicable heterogeneous landscape. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 300 - 301.
Turni, H. and D. Kock (2008). Type specimens of bats (Chiroptera: Mammalia) in the collections of the Museum für Naturkunde, Berlin. *Zootaxa*, **1869:** 1 - 82.
Tuttle, M. (1986). Gentle fliers of the African night. *National Geographic*, **169 (4):** 540 - 558.
Tuttle, M. D. and D. Stevenson (1982). *Growth and survival of bats.* In Kunz, T.H. [Ed]: *Ecology of bats.* Plenum Press, New York: 105 - 150. [Abstract]
Tuval, A., L. Las and Y. Shilo-Benjamini (2018). Evaluation of injectable anaesthesia with five medetomidine-midazolam based combinations in Egyptian fruit bats (*Rousettus aegyptiacus*). *Lab Animal*, **52 (5):** 515 - 525. doi: 10.1177/0023677218756456.
Tweedie, M. W. F. (1947). Orbituary Frederick Nutter Chasen. *Bulletin of the Raffles Museum, Singapore, Strait Settlements*, **18:** 170 - 176.
Twente, J. W. (1955). Some aspects of habitat selection and other behavior of cavern-dwelling bats. *Ecology*, **36 (4):** 706 - 732.
Tyshchenko, V., M. Matveev and J. Bovtunova (2005). In addition to bat fauna (Chiroptera) of Khmelnitskiy Region (in Russian with English summary). *Science Bulletin Uzhgorod University (Serie Biology)*, **17:** 173 - 183.
Uchikawa, K. (1985a). Mites of the genus *Calcarmyobia* (Acarina, Myobiidae) with information on the taxonomy of their host bats of the genus *Miniopterus* (Chiroptera, Miniopteridae). *Bulletin of the British Museum (Natural History): Zoology*, **48 (1):** 15 - 25. doi: 10.5962/bhl.part.23459. [Abstract]
Uchikawa, K. (1985b). *Calcarmyobia* from the Ethiopian region (Acarina, Myobiidae). *Bulletin of the British Museum (Natural History): Zoology*, **48 (1):** 45 - 55. [Abstract]
Uchikawa, K. (1985c). Mites of the genus *Pteracarus* (Acarina, Myobiidae) taken from the bats of the genus *Miniopterus* (Chiroptera, Miniopteridae). *Zoological Science*, **2:** 109 - 114. [Abstract]
Uchikawa, K. (1991). *Glauconyssus*: a new genus associated with African bats (Acari: Macronyssidae). *Journal of medical entomology*, **28 (3):** 446 - 449. [Abstract]
Uchikawa, W. and D. Kock (1989). Revision of the Genera *Hipposiderobia, Triaenomyobia*, and *Binunculoides* (Acarina: Myobiidae) associated mainly with the chiropteran family Hipposideridae (Mammalia). *Journal of parasitology*, **75 (6):** 875 - 891. [Abstract]
Ulanovsky, N., A. Tsoar, Y. Bartan, O. Altstein, G. Dell'Omo, A. L. Vyssotski, Y. Yovel and R. Nathan (2010). GPS tracking of *Rousettus aegyptiacus*: First evidence for large-scale navigational map in a mammal. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 302.
Ulanovsky, U. and C. F. Moss (2008). What the bat's voice tells the bat's brain. *Proceedings of the National Academy of Sciences, U.S.A.*, **105 (25):** 8491 - 8498. doi: 10.1073/pnas.0703550105.
Ulutürk, S. and Coskun Y. (2007). Contribution to the knowledge of *Pipistrellus pipistrellus* (Schreber, 1774) (Chiroptera: Vespertilionidae) from Diyarbakir Province - Turkey. *Research Journal of Biological Sciences*, **2 (6):** 639 - 642.
UNEP-WCMC, (2003). Checklist of mammals listed in the CITES appendices and in the EC Regulation 338/97. 6th edition. JNCC Report No. 342.
Urbanczyk, Z. (1994). Winter census of bats in Poland with special emphasis to large hibernaculum "Nietoperek". Symposium on Current problems of bat protection in Central and Eastern Europe. - Bonn.
Urbanowicz, R. A., C. P. McClure, A. Sakuntabhai, A. A. Sall, G. Kobinger, M. A. Müller, E. C. Holmes, F. A. Rey, E. Simon-Loriere and J. K. Ball (2016). Human adaptation of Ebola virus during the West African outbreak. *Cell*, **167(4):** 1079–1087.e5. doi: 10.1016/j.cell.2016.10.013.

Urich, F. W., H. Scott and J. Waterston (1922). 25. Note on the Dipterous bat-parasite *Cyclopodia greeffi* Karsch, and on a new Species of Himenopterous (Chalcid) parasite bred from it. *Proceedings of the Zoological Society of London*, **1922, II:** 471 - 477.

Valdivieso, D., R. L. Peterson and J. R. Tamsitt (1979). Morphology of the basisphenoid pits and related structures of the bat *Otomops martiensseni* (Chiroptera: Molossidae). *Life science contributions - Royal Ontario Museum*, **119:** 1 - 19. [Abstract]

Vallo, P. (2008). Molecular genetic studies in African leaf-nosed bats (Hipposideridae). Masaryk University - Brono. URL: http://is.muni.cz/th/108483/prif_d/Peter_Vallo_Dissertation_Thesis.pdf.

Vallo, P., P. Benda, J. Cerveny and P. Koubek (2011a). Paraphyly in small-sized house bats (*Scotophilus*, Vespertilionidae) in West Africa. XII European Bat Research Symposium - August 22-26, 2011 - Vilnius, Lithuania: 45 - 46. URL: http://www.bio.uaic.ro/cercetare/contracte/pd326-pocora/src/pdf%205.pdf.

Vallo, P., P. Benda, J. Cervený and P. Koubek (2012). Conflicting mitochondrial and nuclear paraphyly in small-sized West African house bats (Vespertilionidae). *Zoologica Scripta: an international journal of evolutionary zoology*, **42:** 1 - 12 (for 2013). doi: 10.1111/j.1463-6409.2012.00563.x.

Vallo, P., P. Benda, J. Cervený and P. Koubek (2014). Phylogenetic position of the giant house bat *Scotophilus nigrita* (Chiroptera, Vespertilionidae). *Mammalia*, **79 (2):** 225 - 231 (for 2015). doi: 10.1515/mammalia-2013-0137.

Vallo, P., P. Benda, J. Cervený, N. Martínková and P. Koubek (2007). Cryptic diversity in *Hipposideros caffer* group inferred from cytochrome *b* gene. International Bat Research Conference & 37th NASBR, Merida, Yucatan, Mexico, 19-23 August 2007: 256 - 257.

Vallo, P., P. Benda and P. Koubek (2010). What is new in systematics of the genus *Scotophilus* (Vespertilionidae) in Africa? In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference*. 15th IBRC - Prague 23 - 27 August 2010: 303.

Vallo, P., P. Benda, N. Martínková, P. Kanuch, E. K. V. Kalko, J. Cervený and P. Koubek (2011b). Morphologically uniform bats *Hipposideros* aff. *ruber* (Hipposideridae) exhibit high mitochondrial genetic diversity in southeastern Senegal. *Acta Chiropterologica*, **13 (1):** 79 - 88. doi: 10.3161/150811011X578633.

Vallo, P., P. Benda and A. Reiter (2011c). Yellow-Bellied or White-Bellied? Identity of Arabian House Bats (Vespertilionidae: Scotophilus) revealed from mitochondrial DNA and morphology. *African Zoology*, **46 (2):** 350 - 361. doi: 10.1080/15627020.2011.11407508.

Vallo, P., A. Guillen-Servent, P. Benda, D. B. Pires and P. Koubek (2009). Variation of mitochondrial DNA in the *Hipposideros caffer* complex (Chiroptera: Hipposideridae) and its taxonomic implications. *Acta Chiropterologica*, **10 (2):** 193 - 206 (for 2008). doi: 10.3161/150811008X414782.

Vallo, P., P. Motsch, P. Benda, G. D. Maganga and M. Bourgarel (2018). Mitochondrial phylogeny and morphological variation of the African sheath-tailed bat (*Coleura afra*, Emballonuridae). *Acta Chiropterologica*, **20 (1):** 73 - 84. doi: 10.3161/15081109ACC2018.20.1.005.

Vallo, P., E. E. Nkrumah, P. Tehoda, P. Benda, E. K. Badu and J. Decher (2016). Nutlet is a little nut: disclosure of the phylogenetic position of Robbins' house bat *Scotophilus nucella* (Vespertilionidae). *Folia zoologica: International journal of vertebratology*, **65 (4):** 302 - 309.

Vallo, P., D. M. Reeder, M. E. Vodzak and P. Benda (2019). Resurrection of an East African house bat species *Scotophilus altilis* Allen, 1914 (Chiroptera: Vespertilionidae). *Zootaxa*, **4577 (1):** 148 - 160. doi: 10.11646/zootaxa.4577.1.9.

Vallo, P. and V. Van Cakenberghe (2017). Advances in taxonomy of African house bats (*Scotophilus*, Vespertilionidae). *African Bat Conservation News*, **46:** 5 - 9.

Van Cakenberghe, V. (1980). Systematische en biometrische studie van de Afrikaanse vertegenwoordigers van het genus *Scotophilus* (Mammalia, Vespertlionidae). Masters thesis, University of Antwerp, Antwerp.

Van Cakenberghe, V. (1990). Notes on the systematics of the Rhinopomatidae Dobson, 1878. Abstract. Fifth European Bat Research Symposium: 20 - 25 august 1990 - Nyborg Strand, Denmark: no 34. [Abstract]

Van Cakenberghe, V. (2003). Comment on the proposed conserervation of the specific name of *Vespertilio nanus* Peters, 1852 (currently *Pipistrellus nanus*; Mammalia, Chiroptera)(Case 3240; see BZN 60: 42-44). *Bulletin of Zoological Nomenclature*, **60 (4):** 314 - 315.

Van Cakenberghe, V. and P. Benda (2013a). *Pipistrellus deserti Desert Pipistrelle*. In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 619 - 621.

Van Cakenberghe, V. and P. Benda (2013b). *Pipistrellus kuhlii Kuhl's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 633 - 635.

Van Cakenberghe, V. and F. De Vree (1985). Systematics of African *Nycteris* (Mammalia: Chiroptera). *Proceedings of the International Symposium on African Vertebrates, Bonn*53 - 90. [Abstract]

Van Cakenberghe, V. and F. De Vree (1993a). The systematic status of Southeast Asian *Nycteris* (Chiroptera: Nycteridae). *Mammalia*, **57 (2):** 227 - 244. [Abstract]

Van Cakenberghe, V. and F. De Vree (1993b). Systematics of African *Nycteris* (Mammalia: Chiroptera) Part II. The *Nycteris hispida* group. *Bonner zoologische Beitrage*, **44 (3/4):** 299 - 332. [Abstract]

Van Cakenberghe, V. and F. De Vree (1994). A revision of the Rhinopomatidae Dobson 1872, with the description of a new subspecies (Mammalia: Chiroptera). *Senckenbergiana biologica*, **73 (1/2):** 1 - 24. [Abstract]

Van Cakenberghe, V. and F. De Vree (1999a). Systematics of African *Nycteris* (Mammalia: Chiroptera) Part III. The *Nyteris thebaica* group. *Bonner zoologische Beitrage*, **48 (for 1998) (2):** 123 - 166.

Van Cakenberghe, V. and F. De Vree (1999b). The Molossid bats (Chiroptera: Molossidae) from Kikwit, Democratic Republic of Congo. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 28.

Van Cakenberghe, V., F. De Vree and H. Leirs (1999). The bats (Chiroptera) from Kikwit, Democratic Republic of Congo. Abstract. 8e symposium international sur les petits mammifères africains. 4-9 juillet 1999 - Paris: 27.

Van Cakenberghe, V., F. De Vree and H. Leirs (2000). On a collection of bats (Chiroptera) from Kikwit, Democratic Republic of the Congo. *Mammalia*, **63 (for 1999) (3):** 291 - 322. doi: 10.1515/mamm.1999.63.3.291.

Van Cakenberghe, V., G.-C. Gembu Tungaluna, P. Musaba Akawa, E. Seamark and E. Verheyen (2017). The bats of the Congo and of Rwanda and Burundi revisited (Mammalia: Chiroptera). *European Journal of Taxonomy*, **382:** 1 - 327. doi: 10.5852/ejt.2017.382.

Van Cakenberghe, V. and M. Happold (2013a). *Nycteris aurita Andersen's Slit-faced Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 444 - 445.

Van Cakenberghe, V. and M. Happold (2013b). *Genus Eptesicus Serotines.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 550 - 552.

Van Cakenberghe, V. and M. Happold (2013c). *Eptesicus bottae Botta's Serotine.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 552 - 553.
Van Cakenberghe, V. and M. Happold (2013d). *Eptesicus floweri Horn-skinned Serotine.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 554 - 555.
Van Cakenberghe, V. and M. Happold (2013e). *Eptesicus platyops Lagos Serotine.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 557 - 558.
Van Cakenberghe, V. and M. Happold (2013f). *Genus Pipistrellus Pipistrelles.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 600 - 609.
Van Cakenberghe, V. and M. Happold (2013g). *Pipistrellus aero Mt Garguez Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 608 - 610.
Van Cakenberghe, V. and M. Happold (2013h). *Pipistrellus ariel Fairy Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 611 - 612.
Van Cakenberghe, V. and M. Happold (2013i). *Pipistrellus eisentrauti Eisentraut's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 621 - 622.
Van Cakenberghe, V. and M. Happold (2013j). *Pipistrellus grandidieri Yellow Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 623 - 624.
Van Cakenberghe, V. and M. Happold (2013k). *Pipistrellus guineensis Guinean Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 624 - 625.
Van Cakenberghe, V. and M. Happold (2013l). *Pipistrellus inexspectatus Aellen's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 631 - 632.
Van Cakenberghe, V. and M. Happold (2013m). *Pipistrellus musciculus Mouse-like Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 637 - 638.
Van Cakenberghe, V. and M. Happold (2013n). *Pipistrellus nanulus Tiny Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 638 - 639.
Van Cakenberghe, V. and M. Happold (2013o). *Pipistrellus permixtus Dar-es-Salaam Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 642 - 643.
Van Cakenberghe, V. and M. Happold (2013p). *Pipistrellus rendalli Rendall's Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 645 - 647.
Van Cakenberghe, V. and M. Happold (2013q). *Pipistrellus somalicus Somali Pipistrelle.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 653 - 654.
Van Cakenberghe, V. and M. Happold (2013r). *Genus Scotophilus House Bats.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 672 - 673.
Van Cakenberghe, V. and M. Happold (2013s). *Scotophilus leucogaster White-Bellied. House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 676 - 678.
Van Cakenberghe, V. and M. Happold (2013t). *Scotophilus nucella Robbins's House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 680 - 681.
Van Cakenberghe, V. and M. Happold (2013u). *Scotophilus nux Nut-coloured House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 681 - 682.
Van Cakenberghe, V. and M. Happold (2013v). *Scotophilus viridis Green House Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 682 - 684.
Van Cakenberghe, V., A. Herrel and L. F. Aguirre (2002). *Evolutionary relationships between cranial shape and diet in bats (Mammalia: Chiroptera).* In Aerts, P., K. D'Août, A. Herrel and R. Van Damme : *Topics in Functional and Ecological Vertebrate Morphology.* Shaker Publishing - Maastricht: 205 - 236.
Van Cakenberghe, V., T. C. Kearney and E. C. J. Seamark (2006). Introducing the Africa Chiroptera Report/Database. *African Bat Conservation News*, **10:** 3 - 4.
Van Den Bussche, R. A., R. J. Baker, J. P. Huelsenbeck and D. M. Hillis (1998). Base compositional bias and phylogenetic analyses: a test of the "Flying DNA" hypothesis. *Molecular and Phylogenetic Evolution*, **13 (3):** 408 - 416. [Abstract]
Van den Bussche, R. A. and S. R. Hoofer (2004a). Phylogenetic relationships among recent chiropteran families and the importance of choosing appropriate outgroup taxa. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 8.
Van Den Bussche, R. A. and S. R. Hoofer (2004b). Phylogenetic relationships among recent chiropteran families and the importance of choosing appropriate out-group taxa. *Journal of Mammalogy*, **85 (2):** 321 - 330.
Van Den Bussche, R. A., S. R. Hoofer and E. W. Hansen (2002). Characterization and phylogenetic utility of the mammalian protamine P1 gene. *Molecular and Phylogenetic Evolution*, **22 (3):** 333 - 341. doi: 10.1006/mpev.2001.1051.
Van de Perre, F., H. Leirs and E. Verheyen (2019). Paleoclimate, ecoregion size, and degree of isolation explain regional biodiversity differences among terrestrial vertebrates within the Congo Basin. *Belgian Journal of Zoology*, **149 (1):** 23 - 42. doi: 10.26496/bjz.2019.28.
Van der Hoeven, J. (1855). *Handboek der Dierkunde. Second Edition.* C.G. Sulpke, Amsterdam.
van der Merwe, M. (1973a). Aspects of temperature and humidity in preferred hibernation sites of the Natal clinging bat *Miniopterus schreibersi natalensis* (A. Smith, 1834). *Zoologica Africana*, **8 (1):** 121 - 134. [Abstract]
van der Merwe, M. (1973b). Aspects of social behaviour of the natal clinging bat *Miniopterus schreibersi natalensis* (A. Smith, 1834). *Mammalia*, **37 (3):** 379 - 389. doi: 10.1515/mamm.1973.37.3.379. [Abstract]
van der Merwe, M. (1973c). Aspects of hibernation and winter activity of the Natal clinging bat, *Miniopterus schreibersi* A. Smih, 1834 on the Transvaal highveld. *South African Journal of Sciences*, **69:** 116 - 118.
van der Merwe, M. (1978). Equations for determining growth curves in *Miniopterus schreibersii natalensis* (A. Smith, 1834). *South African Journal of Sciences*, **74:** 147.
van der Merwe, M. (1979a). Foetal growth curves and seasonal breeding in the Natal clinging bat *Miniopterus schreibersi natalensis*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **14:** 17 - 21. [Abstract]
van der Merwe, M. (1979b). Growth of ovarian follicles in the Natal clinging bat. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **14:** 111 - 117. [Abstract]
van der Merwe, M. (1980a). Importance of *Miniopterus schreibersi natalensis* in the diet of barn owls. *South African Journal of Wildlife Research*, **10 (1):** 15 - 17. [Abstract]
van der Merwe, M. (1980b). *Delayed implantation in the Natal clinging bat Miniopterus schreibersi natalensis (A. Smith, 1834).* In Wilson, D. E. and A. L. Gardner [Eds]: *Proceedings of the 5th International Bat Research Conference.* Lubbock, Texas: 113 - 123.

van der Merwe, M. (1981). Fetal development of the bat *Miniopterus schreibersi natalensis*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **16:** 172 - 182. [Abstract]
van der Merwe, M. (1982a). Bats as vectors of rabies. *South African Journal of Sciences*, **78:** 421 - 422.
van der Merwe, M. (1982b). Histological study of implantation in the Natal clinging bat (*Miniopterus schreibersii natalensis*). *Journal of Reproduction and Fertility*, **65 (2):** 319 - 323. [Abstract]
van der Merwe, M. (1985a). Deciduous teeth and their replacement in *Miniopterus schreibersii natalensis*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **20:** 72 -76. [Abstract]
van der Merwe, M. (1985b). The vestigial teeth of *Miniopterus fraterculus* and *Miniopterus inflatus*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **20 (4):** 250 - 252. [Abstract]
van der Merwe, M. (1987a). Adaptive breeding strategies in some South African bats between 22 S and 28 S. *South African Journal of Sciences*, **83:** 607 - 609.
van der Merwe, M. (1987b). Other bat species in maternity caves occupied by *Miniopterus schreibersii natalensis*. *South African Journal of Wildlife Research*, **17 (1):** 25 - 27. [Abstract]
van der Merwe, M. (1989a). Reproduction in the Rusty Bat, *Pipistrellus rusticus* in the Northern Transvaal Bushveld, South Africa. Abstract. Eigth International Bat Research Conference, Sydney, Australia, 9 - 15 July 1989. *Macroderma*, **5:** 37 - 38. [Abstract]
van der Merwe, M. (1989b). Longevity in Schreibers' long-fingered bat. *South African Journal of Wildlife Research*, **19 (2):** 87 - 89. [Abstract]
van der Merwe, M. (1990). Polytocy in the Cape serotine bat *Eptesicus capensis* (A. Smith 1829) from the southern African subregion. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **25 (3):** 200 - 203. [Abstract]
van der Merwe, M. (1994). Reproductive biology of the Cape serotine bat, *Eptesicus capensis* in the Transvaal, South Africa. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **29 (1):** 36 - 39. [Abstract]
van der Merwe, M. (1996). Amniogenesis in Schreiber's long-fingered bat *Miniopterus schreibersii natalensis*. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **31 (3):** 154 - 157. [Abstract]
van der Merwe, M. (1997). Vestigial teeth in the genus *Scotoecus* (Mammalia: Chiroptera): adapted dental formulae for vespertilionids with vestigial teeth. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **32 (3):** 92 - 94. [Abstract]
van der Merwe, M. (2006). Amniogenesis in the African yellow bat, *Scotophilus dinganii*. *African Zoology*, **41 (2):** 234 - 239.
van der Merwe, M. and T. Mostert (2005). Ovarian activity and early embryonic development in the rusty bat, *Pipistrellus rusticus*. *African Zoology*, **40 (1):** 45 - 54.
van der Merwe, M. and I. L. Rautenbach (1986). Multiple births in Schlieffen's bat, *Nycticeius schlieffenii* (Peters, 1859) (Chiroptera: Vespertilionidae) from the southern African subregion. *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **21:** 48 - 50. [Abstract]
van der Merwe, M. and I. L. Rautenbach (1987). Reproduction in Schlieffen's bat, *Nycticeius schlieffenii*, in the eastern Transvaal lowveld, South Africa. *Journal of Reproduction and Fertility*, **81 (1):** 41 - 50. doi: 10.1530/jrf.0.0810041. [Abstract]
van der Merwe, M. and I. L. Rautenbach (1990). Reproduction in the rusty bat, *Pipistrellus rusticus*, in the northern Transvaal bushveld, South Africa. *Journal of Reproduction and Fertility*, **89 (2):** 537 - 542. [Abstract]
van der Merwe, M., I. L. Rautenbach and W. J. van der Col (1986). Reproduction in females of the little free-tailed bat, *Tadarida (Chaerephon) pumila*, in the eastern Transvaal, South Africa. *Journal of Reproduction and Fertility*, **77 (2):** 355 - 364. [Abstract]
van der Merwe, M. and R. L. Stirnemann (2007). Reproduction of the banana bat, *Neoromicia nanus*, in Mpumalanga Province, South Africa, with a discussion on sperm storage and latitudinal effects on reproductive strategies. *South African Journal of Wildlife Research*, **37 (1):** 53 - 60. doi: 10.3957/0379-4369-37.1.53.
van der Merwe, M. and R. L. Stirnemann (2009). Group composition and social events of the bannana bat, *Neoromicia nanus*, in Mpumalanga, South Africa. *South African Journal of Wildlife Research*, **39 (1):** 48 - 56.
van der Merwe, M. and R. J. van Aarde (1989a). Plasma progesterone concentrations in the female Natal Clinging Bat (*Miniopterus schreibersii natalensis*). Abstract. Eigth International Bat Research Conference, Sydney, Australia, 9 - 15 July 1989. *Macroderma*5 (38). [Abstract]
van der Merwe, M. and R. J. van Aarde (1989b). Plasma progesterone concentrations in the female Natal Clinging Bat (*Miniopterus schreibersii natalensis*). *Journal of Reproduction and Fertility*, **87 (2):** 665 - 669. [Abstract]
van der Merwe, M., N. J. van der Merwe and B. L. Penzhorn (2006). Aspects of reproduction in the seasonally breeding African yellow bat, *Scotophilus dinganii* (A. Smith, 1833). *African Zoology*, **41 (1):** 67 - 74.
van der Merwe, N. J. and I. L. Rautenbach (1988). The placenta and foetal membranes of the lesser yellow house bat, *Scotophilus borbonicus* (E. Geoffroy, 1803) (Chiroptera: Vespertilionidae). *South African Journal of Zoology / Suid-Afrikaanse tydskrif vir dierkunde*, **23 (4):** 320 - 327. [Abstract]
van der Merwe, N. J. and I. L. Rautenbach (1989). The male reproductive pattern and histology of the testes of the lesser yellow house bat, *Scotophilus borbonicus* (E Geoffroy, 1803) (Chiroptera: Vespertilionidae). *Journal of the South African Veterinary Association*, **60 (2):** 83 - 86. [Abstract]
van der Merwe, N. J., I. L. Rautenbach and B. L. Penzhorn (1988). A new pattern of early embryonic development in the seasonally breeding non-hibernating lesser yellow house bat, *Scotophilus borbonicus* (E. Geoffroy, 1803) (Chiroptera: Vespertilionidae). *Annals of the Transvaal Museum / Annale van die Transvaal museum*, **34 (24):** 551 - 556. [Abstract]
Van der Poel, W. H. M., P. H. C. Lina and J. A. Kramps (2006). Public Health Awareness of emerging zoonotic viruses of bats: A European perspective. *Vector-Borne and Zoonotic Diseases*, **6 (4):** 315 - 324.
Van der Poel, W. H. M., R. Van der Heide, G. Van Amerongen, L. J. M. Van Keulen, G. J. Wellenberg, H. Bourhy, W. Schaftenaar, J. Groen and A. D. M. E. Osterhaus (2000). Characterisation of a recently isolated lyssavirus in frugivorous zoo bats. *Archives of Virology*, **145 (9):** 1919 - 1931.
Van der Straeten, E. and F. Dieterlen (1992). Craniometrical comparison of four populations of *Praomys jacksoni* captured at different heights in Eastern Zaire (Kivu). *Mammalia*, **56 (1):** 125 - 131.
Van der Westhuyzen, J., R. C. Cantrill, F. Fernandes-Costa and J. Metz (1983). Effect of a vitamin B-12-deficient diet on lipid and fatty acid composition of spinal cord myelin in the fruit bat. *Journal of Nutrition*, **113 (3):** 531 - 537. [Abstract]
Van Deusen, H. M. (1968). Carnivorous habits of *Hypsignathus monstrosus*. *Journal of Mammalogy*, **49 (2):** 335 - 336.
Van Doremalen, N., A. Schäfer, V. D. Menachery, M. Letko, T. Bushmaker, R. J. Fischer, D. M. Figueroa, P. W. Hanley, G. Saturday, R. S. Baric and V. J. Munster (2018). SARS-like coronavirus WIV1-CoV does not replicate in Egyptian fruit bats (*Rousettus aegyptiacus*). *Viruses*, **10 (12):** 727. doi: 10.3390/v10120727.
van Eeden, C., W. Markotter and L. H. Nel (2011). Molecular phylogeny of Duvenhage virus. *South African Journal of Sciences*107 (11/12) 65 - 69. doi: 10.4102/sajs.v107i11/12.177.

Van Neer, W. (1990). *Les faunes de vertébrés quaternaires en Afrique centrale.* In Lanfranchi, R. and D. Schwartz [Eds]: *Paysages quaternaires de l'Afrique centrale atlantique.* Paris : ORSTOM: 195 - 220. [Abstract]
Van Orshoven, J. and P. J. H. Van Bree (1968). Quelques données sur six espèces de Megachiroptères de la République de Guinée. *Beaufortia*, **14 (176):** 177 - 192. [Abstract]
Van Paassen, J., M. P. Bauer, M. S. Arbous, L. G. Visser, J. Schmidt-Chanasit, S. Schilling, S. Ölschläger, T. Rieger, P. Emmerich, C. Schmetz, F. Van de Berkmortel, B. Van Hoek, N. D. Van Burgel, A. D. Osterhaus, A. C. T. M. Vossen, S. Günther and J. T. Van Dissel (2012). Acute liver failure, multiorgan failure, cerebral oedema, and activation of proangiogenic and antiangiogenic factors in a case of Marburg haemorrhagic fever. *Lancet Infectious Diseases*, **12 (9):** 635 - 642. doi: 10.1016/S1473-3099(12)70018-X.
Van Riel, J. and J. Hiernaux-L'Hoest (1948). Prospection zoologique et parasitologique des grottes du mont Hoyo. *Bulletin de l'Institut Royal Colonial Belge*, **19 (1):** 229 - 235, 2 figs.
Van Saceghem, R. (1922). Trypanosomes des chauves-souris en Afrique. *Annalen van de Belgische Vereniging voor Tropische Geneeskunde*, **2:** 231.
Van Schalkwyke, E. (2008). Correction to observation # 4: Mauritian tomb bat in the Free State Province South Africa. *African Bat Conservation News*, **17:** 3.
Van Schuylenbergh, P. (1997). La mémoire des belges en Afrique centrale inventaire des archives historiques privées du musée royal de L'afrique centrale de 1858 à nos jours. *Koninklijk Museum voor Midden Afrika. Inventaris van het Historisch Archief*, **8:** i - iii; 1 - 149.
Van Thiel, P. A. M., R. M. A. De Bie, F. Eftimov, R. Tepaske, H. L. Zaaijer, G. J. J. Van Doornum, M. Schutten, A. D. M. E. Osterhaus, C. B. L. M. Majoie, E. Aronica, C. Fehlner-Gardiner, A. L. Wandeler and P. A. Kager (2009). Fatal human rabies due to Duvenhage virus from a bat in Kenya: Failure of treatment with coma-induction, ketamine and antiviral drugs. *PLoS Neglected Tropical Diseases*, **3 (7):** e428. doi: 10.1371/journal.pntd.0000428.
van Toor, M. L., M. T. O'Mara, M. Abedi-Lartey, M. Wikelski, J. Fahr and D. K. N. Dechmann (2019). Linking colony size with quantitative estimates of ecosystem services of African fruit bats. *Current Biology*, **29 (7):** R237 - R238. doi: 10.1016/j.cub.2019.02.033.
Van Valen, L. (1979). The evolution of bats. *Evolutionary Theory*, **4:** 104 - 121.
Van Wyke, J. and I. L. Rautenbach (2005). *Lamprophis capensis* (Dumeril & Bibron, 1854) brown house snake: diet. *African Herp News*, **38:** 25 - 26.
van Zyll de Jong, C. G. (1992). A morphometric analysis of cranial variation in Holartic weasels (*Mustela nivalis*). *Zeitschrift für Säugetierkunde*, **57 (2):** 65 - 128.
Varty, N. and J. E. Hill (1988). Notes on a collection of bats from the riverine forests of the Jubba Valley, southern Somalia, including two species new to Somalia. *Mammalia*, **52 (4):** 533 - 540. [Abstract]
Vattier, G. and J. P. Adam (1966). Capture de Cératopogonidae (Diptera) dans des grottes de la république gabonaise. Brazzaville: ORSTOM: 21 pp. multigr. URL: http://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers11-04/29022.pdf. [Abstract]
Vattier-Bernard, G. (1970). Contribution à l'étude systématique et biologique des Phlébotomes cavernicoles en Afrique intertropicale. 1re partie. *Cahiers de l'ORSTOM, série Entomologie, Médicine et Parasitologie*, **8 (2):** 175 - 230. [Abstract]
Vaughan, N. (1997). The diets of British bats (Chiroptera). *Mammal Review*, **27 (2):** 77 - 94.
Vaughan, N. and J. E. Hill (1996). Bat (Chiroptera) diversity and abundance in banana plantations and rain forest, and three records for St. Vincent, Lesser Antilles. *Mammalia*, **60 (3):** 441 - 447. [Abstract]
Vaughan, N., G. Jones and S. Harris (1996). Effects of sewage effluent on the activity of bats (Chiroptera: Vespertilionidae) foraging along rivers. *Biodiversity and conservation*, **78 (3):** 337 - 343. doi: 10.1016/S0006-3207(96)00009-2. [Abstract]
Vaughan, N., G. Jones and S. Harris (1997a). Habitat use by bats (Chiroptera) assessed by means of a broad-band acoustic method. *Journal of Applied Ecology*, **34:** 716 - 730. [Abstract]
Vaughan, N., G. Jones and S. Harris (1997b). Identification of British bat species by multivariate analysis of echolocation call parameters. *Bioacoustics. The International Journal of Animal Sound and its Recording*, **7:** 189 - 207. [Abstract]
Vaughan, T. A. (1966). Morphology and flight characteristics of Molossid bats. *Journal of Mammalogy*, **47 (2):** 249 - 260. [Abstract]
Vaughan, T. A. (1976). Nocturnal behavior of the African false vampire bat (*Cardioderma cor*). *Journal of Mammalogy*, **57:** 227-248.
Vaughan, T. A. and R. P. Vaughan (1986). Seasonality and the behavior of the African yellow-winged bat. *Journal of Mammalogy*, **67 (1):** 91 - 102. doi: 10.2307/1381005. [Abstract]
Vaughan, T. A. and R. P. Vaughan (1987). Parental behavior in the African yellow-winged bat (*Lavia frons*). *Journal of Mammalogy*, **68 (2):** 217 - 223. URL: http://www.jstor.org/pss/1381460. [Abstract]
Vaughan, T. C., E. L. Cockrum and P. J. Vaughan (1977). Four Vespertilionid bats new to the fauna of Tunisia. *Mammalia*, **41 (4):** 517 - 522. [Abstract]
Vaz, H. and F. Oliveira (2007). Relatório nacional do estado geral da biodiversidade de S.Tomé e Príncipe. República democrática de S. Tomé e Príncipe - Ministério de recursos naturais e meio ambiente - Direcção geral de ambiente: 1 - 115. URL: http://www.uns.st/undp/fr/download/%DAltima%20vers%E3o%20Biodiversidade.pdf.
Veiga-Ferreira, M. C. (1948). Notas acêrca dos Megaquiropteros da Guiné Portuguesa. *Anais da Junta de Investigações Coloniais, Lisboa*, **3 (4):** 57 - 73. [Abstract]
Veiga-Ferreira, M. C. (1949). Notas acêrca dos Microquiropteros da Guiné Portuguesa. *Anais da Junta de Investigações Coloniais, Lisboa*, **4 (4):** 187 - 207. [Abstract]
Veith, M., M. Mucedda, A. Kiefer and E. Pidinchedda (2011). On the presence of pipistrelle bats (*Pipistrellus* and *Hypsugo*; Chiroptera: Vespertilionidae) in Sardinia. *Acta Chiropterologica*June 2011. doi: 10.3161/150811011X578642.
Venditti, C., A. Meade and M. Pagel (2011). Multiple routes to mammalian diversity. *Nature*, **479 (7373):** 393 - 396. doi: 10.1038/nature10516.
Verboom, B., A. M. Boonman and H. J. G. A. Limpens (1999). Acoustic perception of landscape elements by the pond bat (*Myotis dasycneme*). *Journal of Zoology*, **248 (1):** 59 - 66.
Vercammen-Grandjean, P.-H. (1964). Le genre *Trombigastia* Vercammen-Grandjean & Brennan est un synonyme de *Riedlinia* Oudemans, 1914. Révision du genre *Riedlinia* (Acarina - Trombiculidae). *Acarologia*, **6 (2):** 312 - 323.
Vercammen-Grandjean, P.-H. and A. Fain (1958). Les Trombiculidæ parasites de chiroptères. Révision du genre *Trombigastia* et description d'un ? *Myotrombicula*. *Annales de Parasitologie*, **33 (1 - 2):** 5 - 35.
Vercammen-Grandjean, P. H. and M. Nadchatram (1963). Le genre *Trombicula* et ses sous-genres (Trombiculidae-Acarina). *Acarologia*, **5:** 384 - 393.

Verheyen, R. (1972). In Memoriam: Antoon E. M. DE ROO (1936-1971). *De Giervalk: Belgisch ornithologisch tijdschrift*, **62 (1-2):** 190 - 192.
Vermeil, C. (1960). Contribution à l'étude des Nycteribiidae et des Streblidae (Diptera, Pupipara) de Tunisie. *Annales de Parasitologie*, **35 (5-6):** 737 - 743. [Abstract]
Verschuren, J. (1955). Un cas d'albinisme complet chez un cheiroptère: *Nycteris nana* (Andersen). *Koninklijk Belgisch Instituut voor Natuurwetenschappen. Mededelingen*, **31 (34):** 1 - 3.
Verschuren, J. (1957). Ecologie, biologie et systématique des cheiroptères. Mission H. De Saeger *et al.*, 1949 - 1952. *Exploration du Parc national de la Garamba*, **7:** 1 - 473.
Verschuren, J. (1965a). Exploration du Parc National de la Kagera: Cheiroptères. *Instituut der Nationale Parken van Belgisch Kongo*, **(2) 1 (2):** 67 - 75.
Verschuren, J. (1965b). Contribution à l'étude des cheiroptères du Parc National du Serengeti (Tanzanie). *Revue de zoologie et de botanique africaines*, **71 (3-4):** 371 - 375. [Abstract]
Verschuren, J. (1967). Exploration du Parc National Albert. Mission F. Bourlière et J. Verschuren (1957 - 1961). Fasc. 2. Introduction a l'écologie et la biologie des cheiroptères. *Instituut der Nationale Parken van Belgisch Kongo*25 - 65. [Abstract]
Verschuren, J. (1977). Les cheiroptères du Mont Nimba (Liberia). *Mammalia*, **40 (for 1976) (4):** 615 - 632. [Abstract]
Verschuren, J. (1980). Notes sur les cheiroptères du Burundi. *Bulletin - Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, **52 (19):** 2 - 9. [Abstract]
Verschuren, J. (1982). XXII. Note sur les cheiroptères du Sénégal, principalement dans les pars nationaux du Niokolo-Koba et du Delta du Saloum. *Mémoires de l'Institut français d'Afrique noire*, **92:** 307 - 313. [Abstract]
Verschuren, J. (1983). Quelques observations sur l'adaptation des Rongeurs et Cheiroptères à des conditions écologiques extrèmes. In Van der Straeten, E., W.N. Verheyen and F. De Vree [Eds]: *Proceedings of the Third International Colloquim on Ecology and Taxonomy of African Small Mammals. Antwerpen, July 20-24, 1981. Annalen van het Koninklijk Museum voor Midden Afrika: Zoologische Wetenschappen*, **237:** 101 - 102.
Verschuren, J. (1985). Note sur les mammifères des Seychelles. Un facteur de mortalité de la roussette endémique, *Pteropus seychellensis*. *Mammalia*, **49 (3):** 424 - 426.
Verschuren, J. (1986a). Notes d'écologie, principalement des mammifères, du Mont Nimba (Liberia). *Bulletin - Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, **56:** 27 - 43. [Abstract]
Verschuren, J. (1986b). Note sur les parcs nationaux littoraux du Sénégal et principalement leurs mammifères. *Bulletin - Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, **56:** 51 - 74.
Verschuren, J. (1988). Notes d'écologie, principalement des mammifères, du parc national de la Pendjari, Bénin. *Bulletin - Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, **58:** 185 - 206. [Abstract]
Vielliard, J. (1974). Les chiroptères du Tchad. *Revue suisse de zoologie*, **81 (4):** 975 - 991. [Abstract]
Vieth, M., S. Wulffraat, J. Kosuch, G. Hallmann, H.-W. Henkel, P. Sound, Samsu, L. Rudhimanto and D. Iskandar (2004). Amphibians of the Kayan Mentarnag National Park (East Kalimantan, Indonesia): estimating overall and local species richness. *Tropical Zoology*, **17:** 1 - 13.
Vincent, S., M. Nemoz and S. Aulagnier (2011). Activity and foraging habitats of *Miniopterus schreibersii* (Chiroptera, Miniopteridae) in southern France: implications for its conservation. *Hystrix, Italian Journal of Mammalogy*, **22 (1):** 57 - 72. doi: 10.4404/Hystrix-22.1-4524.
Vivier, L. and M. Van der Merwe (1996). Reproductive pattern in the male Angolan free-tailed bat, *Tadarida (Mops) condylura* (Microchiroptera: Molossidae) in the Eastern Transvaal, South Africa. *Journal of Zoology*, **239:** 465 - 476. [Abstract]
Vivier, L. and M. van der Merwe (2007). The incidence of torpor in winter and summer in the Angolan free-tailed bat, *Mops condylurus* (Microchiroptera: Molossidae), in a subtropical environment, Mpumulanga, South Africa. *African Zoology*, **42 (1):** 50 - 58.
Vodzak, M. and D. A. Reeder (2013). Characterization of seasonal and stress-related Immunity in Pteropodid bats. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 162. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.
Vogel, G. (2014). Are bats spreading Ebola across sub-Saharan Africa? *Science*, **344 (6180):** 140.
Vogel, P. (1977). Neue Nachweise der *Rhinopoma hardwickei* (Chiroptera) aus Westafrika. *Bonner zoologische Beitrage*, **28 (3/4):** 228 - 231. [Abstract]
Voigt, C. C., M. Helbig-Bonitz, S. K. Kramer-Schadt and E. K. V. Kalko (2013). The third dimension of bat migration: evidence for elevational movements of *Miniopterus natalensis* along the slopes of Mount Kilimanjaro. *Oecologia*, **174 (3):** 751 - 764 (for 2014). doi: 10.1007/s00442-013-2819-0.
Voigt, C. C. and T. Kingston [Eds] (2015). *Bats in the Anthropocene: Conservation of bats in a changing world.* Springer Open - Cham Heidelberg New York Dordrecht London: i - ix; 1 - 606 (for 2016). doi: 10.1007/978-3-319-25220-9.
Voigt, F. A., N. Farwig and S. D. Johnson (2011). Interactions between the invasive tree *Melia azedarach* (Meliaceae) and native frugivores in South Africa. *Journal of Tropical Ecology*, **27 (4):** 355 - 363. doi: 10.1017/S0266467410000702.
Voigt-Heucke, S. L., A. J. Thode and S. Kipper (2010). Do bats jazz? Song composition and syntax in the song of *Nyctalus noctula*. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 308.
Volleth, M. (2010). Of bats and molecules: A genomics perspective. 1. Karyotype evolution illuminated by FISH. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 308 - 309.
Volleth, M., M. Biedermann, W. Schorcht and K.-G. Heller (2013). Evidence for two karyotypic variants of the lesser horseshoe bat (*Rhinolophus hipposideros*, Chiroptera, Mammalia) in Central Europe. *Cytogenetic and Genome Research*, **140 (1):** 55 - 61. doi: 10.1159/000350693.
Volleth, M., G. Bronner, M. C. Göpfert, K.-G. Heller, O. von Helversen and H.-S. Yong (2001). Karyotype comparison and phylogenetic relationships of *Pipistrellus*-like bats (Vespertilionidae; Chiroptera; Mammalia). *Chromosome Research*, **9 (1):** 25 - 46. doi: 10.1023/A:1026787515840.
Volleth, M. and G. Eick (2012). Chromosome evolution in bats as revealed by fish: the ongoing search for the ancestral chiropteran karyotype. *Cytogenetic and Genome Research*, **137 (2-4):** 165 - 173. doi: 10.1159/000338929.
Volleth, M., H. Hameister and K. G. Heller (2004). Chiropteran phylogeny - the karyological view. Abstract from the 13th International Bat Research Conference (Poland). *African Bat Conservation News*, **2:** 10.
Volleth, M. and K.-G. Heller (1994). Phylogenetic relationships of vespertilionid genera (Mammalia: Chiroptera) as revealed by karyological analysis. *Zeitschrift für zoologischen Systematik und Evolutions-forschung*, **32 (1):** 11 - 34. doi: 10.1111/j.1439-0469.1994.tb00467.x. [Abstract]

Volleth, M. and K.-G. Heller (2008). Chromosome number reduction accompanied by extensive heterochromatin addition in the bat *Glauconycteris beatrix* (Mammalia; Chiroptera, Vespertilionidae). *Cytogenetic and Genome Research*, **119:** 245 - 247 (for 2007). doi: 10.1159/000112069.

Volleth, M., K.-G. Heller and J. Fahr (2006). Phylogenetic relationships of three "Nycticeiini" genera (Vespertilionidae, Chiroptera, Mammalia) as revealed by karyological analysis. *Mammalian biology (Zeitschrift für Säugetierkunde)*, **71 (1):** 1 - 12. doi: 10.1016/j.mambio.2005.09.001.

Volleth, M., K.-G. Heller, R. A. Pfeiffer and H. Hameister (2002). A comparative ZOO-FISH analysis in bats elucidates the phylogenetic relationships between Megachiroptera and five microchiropteran families. *Chromosome Research*, **10 (6):** 477 - 497. doi: 10.1023/A:1020992330679.

Volleth, M., F. Yang and S. Müller (2011). High-resolution chromosome painting reveals the first genetic signature for the chiropteran suborder Pteropodiformes (Mammalia: Chiroptera). *Chromosome Research*, **19 (4):** 507 - 519. doi: 10.1007/s10577-011-9196-5.

Volleth, M. and H. S. Yong (1987). *Glischropus tylopus*, the first known old-world bat with an X-autosome translocation. *Experientia*, **43:** 922 - 925.

Volpers, T. and A. Kumirai (1995). Ecological aspects of the distribution of *Epomophorus* -fruit bats (Mammal., Chiropt.) in Zimbabwe. *Verhandlungen der Gesellschaft fur Ökologie*, **24:** 89 - 92.

von Brandis, R. (2004). A summary of recent bat records from Aldabra atoll. *Phelsuma*, **12:** 133 - 135. URL: http://islandbiodiversity.com/Phelsuma%2012-7.pdf.

von Hebert, (1985). ?? Title still needs to be checked. ?? .

von Helversen, O., K. G. Heller, F. Mayer, A. Nemeth, M. Volleth and P. Gombkötö (2001). Cryptic mammalian species: a new species of whiskered bat (*Myotis alcathoe* n. sp.) in Europe. *Die Naturwissenschaften*, **88:** 217 - 223.

von Helversen, O., F. Mayer and D. Kock (2000). Comments on the proposed designation of neotypes for the nominal species *Vespertilio pipistrellus* Schreber, 1774 and *V. pygmaeus* Leach, 1825 (currently *Pipistrellus pipistrellus* and *P. pygmaeus*; Mammalia, Chiroptera) (Case 3073). (1). *Bulletin of Zoological Nomenclature*, **57 (2):** 113 - 115.

Vonhof, M. J. and M. C. Kalcounis (1999). *Lavia frons*. *Mammalian Species*, **614:** 1 - 4, 3 figs.

Vora, N. M., M. Osinubi, R. M. Wallace, A. Aman-Oloniyo, Y. H. Gbadegesin, Y. K. Sebastian, O. A. Saliman, M. Niezgoda, L. Davis and S. Recuenco (2014). Assessment of potential zoonotic disease exposure and illness related to an annual bat festival - Idanre, Nigeria. *Morbidity and Mortality Weekly Report*, **63 (15):** 334.

Voronstov, N. N. Radjabli, S. I. and V. T. Volobuev (1969). *The comparative karyology of the Vespertilionid bats, Vespertilionidae (Chiroptera)*. In Voronstov, N. N. : *The Mammals, Evolution, Karyology, Taxonomy, Fauna.* Acad. Sci. USSR, Siberian Branch: 16 - 21.

Voyron, S., A. Lazzari, M. Riccucci, M. Calvini and G. C. Varese (2011). First mycological investigation on Italian bats. *Hystrix, Italian Journal of Mammalogy*, **(n.s.) 22 (1):** 189 - 197. doi: 10.4404/Hystrix-22.1-4481.

Waddell, P. J, H. Kishino and R. Ota (2001). A phylogenetic foundation for comparative mammalian genomics. *Genome Informatics*, **12:** 141 - 154.

Waeber, P. O., C. J. Gardner, W. R. Lourenço and L. Wilmé (2017). On specimen killing in the era of conservation crisis - A quantitative case for modernizing taxonomy and biodiversity inventories. *PLoS ONE*, **12 (9):** e0183903. doi: 10.1371/journal.pone.0183903.

Wagner, J. A. (1840). *Supplementband 3.* In Schreber, J. C. D. : *Die Säugethiere in Abbildungen nach der Natur, mit Beschreibungen.* Leipzig.

Wagner, J. A. (1843). Diagnosen neuer Arten brasilischer Handflügler. *Wiegmans Archiv für Naturgeschichte München*, **9 (1):** 361 - 367.

Wagner, J. A. (1845). Diagnosen einiger neuer Arten von Nagern und Handflüglern. *Wiegmans Archiv für Naturgeschichte München*, **11 (1):** 145 - 149.

Wagner, J. A. (1855). *Supplementband 5.* In Schreber, J. C. D. : *Die Säugethiere in Abbildungen nach der Natur, mit Beschreibungen.* Leipzig: 783 pp.

Walker, A. (1969). True affinities of *Propotto leakeyi* Simpson 1967. *Nature*, **223:** 647 - 648.

Walker, E. D. (1964). *Mammals of the World. (3 volumes).* John Hopkins Press - Baltimore & London.

Walker, E. D. (1975). *Mammals of the World. (3 volumes). (Third Edition).* John Hopkins Press - Baltimore & London.

Wallace, R. G., M. Gilbert, R. Wallace, C. Pittiglio, R. Mattioli and R. Kock (2014). Did Ebola emerge in West Africa by a policy-driven phase change in agroecology? *Environment and Planning A*, **46 (11):** 2533 - 2542. doi: 10.1068/a4712com.

Wallace, R. G., R. Kock, L. Bergmann, M. Gilbert, L. Hogerwerf, C. Pittiglio, R. Mattioli and R. Wallace (2016). Did neoliberalizing West African forests produce a new niche for Ebola? *International Journal of Health Services*, **46(1):** 149 - 165. doi: 10.1177/0020731415611644.

Walldorf, V. and H. Mehlhorn (2014). *Chapter 2. Bats: A glimpse on their astonishing morphology and lifestyle.* In Klimpel, S. and H. Mehlhorn : *Bats (Chiroptera) as vectors of diseases and parasites. Facts and myths.* Parasitology Research Monographs, 5 - Springer Verlag - Berlin Heidelberg: 7 - 24. doi: 10.1007/978-3-642-39333-4_2.

Wallin, L. (1969). The Japanese bat fauna. A comparative study of chorology, species diversity and ecological differentiation. *Zoologiska Bidrag fra Uppsala*, **37:** 223 - 440. [Abstract]

Walsh, P. D., T. Breuer, C. Sanz, D. Morgan and D. Doran-Sheehy (2007). Potential for Ebola transmission between gorilla and chimpanzee social groups. *American Naturalist*, **169 (5):** 684 - 689.

Walters, C. L., R. Freeman, A. Collen, C. Dietz, M. B. Fenton, G. Jones, M. K. Obrist, S. J. Puechmaille, T. Sattler, B. Siemers, S. Parsons and K. E. Jones (2012). A continental-scale tool for acoustic identification of European bats. *Journal of Applied Ecology*, **49 (5):** 1064 - 1074. doi: 10.1111/j.1365-2664.2012.02182.x.

Wang, L.-F., I. V. Kuzmin and S. Tong (2011). *Chapter 6. Virus discovery.* In Newman, S.H., H. Field, J. Epstein and C. de Jong [Eds]: *Investigating the role of bats in emerging zoonoses: Balancing ecology, conservation and public health interest.* FAO Animal Production and Health manual. No. 12. Food and Agriculture Organization of the United Nations. Rome: 137 - 150. URL: http://www.fao.org/docrep/014/i2407e/i2407e00.pdf.

Warner, J. W., J. L. Patton, A. L. Gardner and R. J. Baker (1974). Karyotypic analyses of 21 species of molossid bats. *Canadian journal of genetics and cytology*, **16:** 165 - 176. [Abstract]

Warrell, M. (2010). Rabies and African bat lyssavirus encephalitis and its prevention. *International Journal of Antimicrobial Agents*, **36 (Supplement 1):** S47 - S52. doi: 10.1016/j.ijantimicag.2010.06.021.

Warrell, M. (2011). Author's reply to: Comment on: 'Rabies and African bat lyssavirus encephalitis and its prevention'. *International Journal of Antimicrobial Agents*, **37:** 183 - 184. doi: 10.1016/j.ijantimicag.2010.09.014.

Waruhiu, C., S. Ommeh, V. Obanda, B. Agwanda, F. Gakuya, X.-Y. Ge, X.-L. Yang, L.-J. Wu, A. Zohaib, B. Hu and Z.-L. Shi (2017). Molecular detection of viruses in Kenyan bats and discovery of novel astroviruses, caliciviruses and rotaviruses. *Virologica Sinica*, **32 (2):** 101 - 114. doi: 10.1007/s12250-016-3930-2.

Wason, A. and S. D. Misra (1981). Observations on the directional differences in homing ability of the rat-tailed bat, *Rhinopoma microphyllum* (Brunnich). *Zeitschrift für Säugetierkunde*, **46:** 331 - 332.

Wassif, K. (1950). LXXVIII. The tensor tympani muscle of bats. *Annals and Magazine of Natural History*, **ser. 12, 3 (33):** 811 - 812.

Wassif, K. (1954). On a collection of mammals from northern Sinai. *Bulletin de l'Institute du Désert de l'Egypte*, **3 (1):** 107 - 118.

Wassif, K. (1962). The serotine bat, *Eptesicus isabellinus innesi* Lataste from Egypt. *Bulletin of the Zoological Society of Egypt*, **17:** 108 - 111.

Wassif, K. and H. Hoogstraal (1953). The Mammals of South Sinai, Egypt. *Proceedings of the Egyptian Academy of Sciences*, **9:** 63 - 79.

Wassif, K. and G. Madkour (1963). Studies on the osteology of the rat-tailed bats of the genus *Rhinopoma* found in Egypt. *Bulletin of the Zoological Society of Egypt*, **18:** 56 - 80. [Abstract]

Wassif, K. and G. Madkour (1970). The structure of the hyoid bone, larynx and upper part of trachea in some Egyptian bats. *Bulletin of the Zoological Society of Egypt*, **25:** 15 - 26. [Abstract]

Wassif, K. and G. Madkour (1971). The wing skeleton in Egyptian bats (Microchiroptera). *Bulletin of the Zoological Society of Egypt*, **26:** 68 - 78. [Abstract]

Wassif, K. and G. Madkour (1972). The structure of the os penis in Egyptian bats (Microchiroptera). *Bulletin of the Zoological Society of Egypt*, **24:** 45 - 51. [Abstract]

Wassif, K., G. Madkour and S. Soliman (1984). *Fauna and Flora of Egypt. 1. On a collection of bats from Egypt*. Academy of Scientific Research and Technology - Cairo: 36 pp., 6 pls. [Abstract]

Waterhouse (1902). ?? Title still needs to be checked. ?? .

Waterhouse, G. R. (1845). Descriptions of bats collected in the Philippine Islands. *Proceedings of the Zoological Society of London*, **1845, 13 (cxliii):** 3 - 10.

Waters, D. A., G. Jones and M. Furlong (1999). Foraging ecology of Leisler's bat (*Nyctalus leisleri*) at two sites in southern Britain. *Journal of Zoology*, **249:** 173 - 180. doi: 10.1111/j.1469-7998.1999.tb00755.x.

Waters, D. A. and C. Vollrath (2002). Echolocation performance and call structure in the Megachiropteran fruit-bat *Rousettus aegyptiacus*. Abstract. IX th European Bat Research Symposium, 26 - 30 August 2002 - Le Havre: 28.

Waters, D. A. and C. Vollrath (2003). Echolocation performance and call structure in the megachiropteran fruit-bat *Rousettus aegypticacus*. *Acta Chiropterologica*, **5 (2):** 209 - 219. doi: 10.3161/001.005.0205.

Watkins, L. C. (1972). *Nycticeius humeralis*. *Mammalian Species*, **23:** 1 - 4, 2 figs.

Watkins, L. C. (1977). *Euderma maculatum*. *Mammalian Species*, **77:** 1 - 4, 3 figs.

Watson, J., A. Monadjem, L. Cohen, D. (S.) Jacobs, K. (L.) MacEwan, L. R. Richards, (M.) C. Schoeman, T. Sethusa and P. J. Taylor (2016). *A conservation assessment of Eptesicus hottentotus.* In Child, M. F., L. Roxburgh, E. Do Linh San, D. Raimondo and H. T. Davies-Mostert [Eds]: *The Red List of Mammals of South Africa, Swaziland and Lesotho* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. URL: https://www.ewt.org.za/Reddata/reddata.html.

Watson, J. M. (1951). The wild mammals of Teso and Karamoja. VI. Insectivora and Chiroptera. *Uganda Journal*, **15 (1):** 92 - 106.

Watson, J. P. (1990a). New distribution records of *Laephotis* in South Africa and Lesotho. *Navorsinge van die Nasionale Museum Bloemfontein*, **7 (4):** 61 - 70.

Watson, J. P. (1990b). Westward range extension of Temminck's hairy bat in South Africa and Lesotho. *South African Journal of Wildlife Research*, **20 (3):** 119 - 120.

Watson, J. P. (1998). New distributional records for three microchiropteran bats (Vespertilionidae, Rhinolophidae) from the Free State Province, South Africa. *South African Journal of Wildlife Research*, **28 (4):** 127 - 131. [Abstract]

Watson, J. P. (2006). Check list of the mammals of Tussen-die-Riviere Provincial Nature Reserve, Free State Province, South Africa. *Koedoe: tydskrift vir wetenskaplike navorsing in die Nasionale Parke van Die Republiek van Suid-Afrika*, **49 (1):** 111 - 117. URL: http://www.koedoe.co.za/index.php/koedoe/article/view/108.

Waylen, K. (2004). Bats as bushmeat: a survey by Fauna & Flora International. *Phelsuma*, **12:** 147 - 148. URL: http://islandbiodiversity.com/Phelsuma%2012-9.pdf.

Webala, P. (W.) (2013). Bat conservation in Kenya: challenges and opportunities. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 164. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Webala, P. (W.), C. Carugati, L. Canova and M. Fasola (2009). Bat assemblages from eastern Lake Turkana, Kenya. *Revue d'Ecologie (la Terre et la Vie)*, **64:** 85 - 91.

Webala, P. W., G. Muriuki, F. Lala and A. Bett (2006). The small mammal community of Mukogodo Forest, Kenya. *African Journal of Ecology*, **44 (3):** 363 - 370. doi: 10.1111/j.1365-2028.2006.00634.x.

Webala, P. W., S. Musila and R. Makau (2012). Population ecology, diet and movement of straw-coloured fruit bats (*Eidolon helvum*), western Kenya. Final Report - Rufford Small Grants Foundation: 23 pp. URL: http://www.ruffordsmallgrants.org/files/10078-1%20Detailed%20Final%20Report_0.pdf.

Webala, P. W., S. Musila and R. Makau (2014). Roost occupancy, roost site selection and diet of straw-coloured fruit bats (Pteropodidae: *Eidolon helvum*) in western Kenya: the need for continued public education. *Acta Chiropterologica*, **16 (1):** 85 - 94. doi: 10.3161/150811014X683291.

Webala, P. W., N. O. Oguge and A. Bekele (2004). Bat species diversity and distribution in three vegetation communities of Meru National Park, Kenya. *African Journal of Ecology*, **42 (3):** 171 - 179.

Webala, P. W., J. Rydell, C. W. Dick, S. Musila and B. D. Patterson (2019). Echolocation calls of high duty-cycle bats (Hipposideridae and Rhinonycteridae) from Kenya. *Journal of Bat Research and Conservation*, **12 (1):** 10 - 20. doi: 10.14709/BarbJ.12.1.2019.02.

Webb, N. J. and C. R. Tidemann (1996). Mobility of Australian flying-foxes, *Pteropus* spp. (Megachiroptera): evidence from genetic variation. *Proceedings of the Royal Society of London*, **B 263:** 497 - 502.

Weber, N. and J. Fahr (2006). Survey of endemic and globally threatened bat species in the Fouta Djallon Plateau for conservation priorities in Guinea. Preliminary project report - Van Tienhoven Foundation: 7 pp. URL: http://www.vantienhovenfoundation.com/uploads/Weber&Fahr_preliminary+report.pdf.

Weber, N. and J. Fahr (2007). *A rapid survey of small mammals from Atewa Range Forest Reserve, Eastern Region, Ghana.* In McCullough, J., L. E. Alonso, P. Naskrecki, H. E. Wright and Y. Osei-Owusu : *A Rapid Biological Assessment of the Atewa Range Forest Reserve, Eastern Ghana.* Conservation International - Arlington, Virginia: 90 - 98; 180.

Weber, N., L. Granjon and J. Fahr (2010). Gallery forests boost bat diversity in southern Mali, West Africa. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 311.

Weber, N., E. K. V. Kalko and J. Fahr (2009). A first assessment of home range and foraging behaviour of the African long-tongued bat *Megaloglossus woermanni* (Chiroptera: Pteropodidae) in a heterogeneous landscape within the Lama Forest Reserve, Benin. *Acta Chiropterologica*, **11 (2):** 317 - 329. doi: 10.3161/150811009X485558.

Weber, N., R. Wistuba, J. J. Astrin and J. Decher (2019). New records of bats and terrestrial small mammals from the Seli River in Sierra Leone before the construction of a hydroelectric dam. *Biodiversity Data Journal*, **7:** e34754. doi: 10.3897/BDJ.7.e34754.

Wechuli, D. B., P. W. Webala, B. D. Patterson and R. S. Ochieng (2016). Bat species diversity and distribution in a disturbed regime at the Lake Bogoria National Reserve, Kenya. *African Journal of Ecology*, **55 (4):** 465 - 476 (for 2017). doi: 10.1111/aje.12376.

Wegner, G., K. M. Howell, T. R. B. Davenport and N. D. Burgess (2009). The forgotten 'Coastal Forests' of Mtwara, Tanzania: A biologically impoverished and yet important ecosystem. *Journal of East African Natural History*, **98 (2):** 167 - 209. doi: 10.2982/028.098.0202.

Weier, S. M., I. Grass, V. M. G. Linden, T. Tscharntke and P. J. Taylor (2018). Natural vegetation and bug abundance promote insectivorous bat activity in macadamia orchards, South Africa. *Biological Conservation*, **226:** 16 - 23. doi: 10.1016/j.biocon.2018.07.017.

Weier, S. M., V. M. G. Linden, I. Gaigher, P. J. C. White and P. J. Taylor (2016). Changes of bat species composition over altitudinal gradients on northern and southern aspects of the Soutpansberg mountain range, South Africa. *Mammalia*, **81 (1):** 49 - 60 (for 2017). doi: 10.1515/mammalia-2015-0055.

Weier, S. M., V. M. G. Linden, I. Grass, T. Tscharntke and P. J. Taylor (2019a). The use of bat houses as day roosts in macadamia orchards, South Africa. *PeerJ*, **7:** e6954. doi: 10.7717/peerj.6954.

Weier, S. M., Y. Moodley, M. F. Fraser, V. M. G. Linden, I. Grass, T. Tscharntke and P. J. Taylor (2019b). Insect pest consumption by bats in macadamia orchards established by molecular diet analyses. *Global Ecology and Conservation*, **18:** e00626. doi: 10.1016/j.gecco.2019.e00626.

Weis, M., L. Behner, T. Binger, J. F. Drexler, C. Drosten and A. Maisner (2015). Fusion activity of African henipavirus F proteins with a naturally occurring start codon directly upstream of the signal peptide. *Virus Research*, **201:** 85 - 93. doi: j.virusres.2015.02.016.

Weiß, S. (2013). Identification and characterisation of emerging viruses in free-ranging bats from sub-Saharan Africa. PhD Thesis - Universität Berlin: i - ix; 1 - 109.

Weiss, S., P. W. Dabrowski, A. Kurth, S. A. J. Leendertz and F. H. Leendertz (2017). A novel Coltivirus-related virus isolated from free-tailed bats from Côte d'Ivoire is able to infect human cells in vitro. *Virology Journal*, **14:** 181. doi: 10.1186/s12985-017-0843-0.

Weiss, S., K. Nowak, J. Fahr, G. Wibbelt, J.-V. Mombouli, H.-J. Parra, N. D. Wolfe, B. S. Schneider and F. H. Leendertz (2012a). Henipavirus-related sequences in fruit bat bushmeat, Republic of Congo. *Emerging Infectious Diseases*, **18 (9):** 1536 - 1537.

Weiss, S., P. T. Witkowski, B. Auste, K. Nowak, N. Weber, J. Fahr, J.-V. Mombouli, N. D. Wolfe, J. F. Drexler, C. Drosten, B. Klempa, F. H. Leendertz and D. H. Kruger (2012b). Hantavirus in bat, Sierra Leone. *Emerging Infectious Diseases*, **18 (1):** 159 - 161. doi: 10.3201/eid1801.111026.

Welch, S. R., A. K. Chakrabarti, L. Wiggleton Guerrero, H. M. Jenks, M. K. Lo, S. T. Nichol, C. T. Spiropoulou and C. G. Albariño (2018). Development of a reverse genetics system for Sosuga virus allows rapid screening of antiviral compounds. *PLoS Neglected Tropical Diseases*, **12 (3):** e0006326. doi: 10.1371/journal.pntd.0006326.

Wellenberg, G. J., L. Audry, L. Rønsholt, W. H. M. Van der Poel, C. J. M. Bruschke and H. Bourhy (2002). Presence of European bat lyssavirus RNAs in apparently healthy *Rousettus aegyptiacus* bats. *Archives of Virology*, **147 (2):** 349 - 361.

Wesselman, H. B. (1984). The Omo micromammals: systematics and paleoecology of early man sites from Ethiopia. *Contributions to vertebrate evolution*, **7:** X + 222 p., 59 fig., 42 tab.

Wettstein, O. von (1916). Neue Affen und Fledermäuse aus Nordost-Afrika. *Anzeiger der kaiserlichen Akademie für Wissenschaften, Wien, Mathematisch-Naturwissenschaftlichen Klasse*, **53:** 189 - 192.

Wettstein, O. von (1918). Wissenschaftliche Ergebnisse der mit Unterstutzung der kaiserlichen Akademie der Wissenschaften in Wien aus der Erbschaft Treitl von F. Werner unternommenen zoologischen Expedition nach dem Anglo-Aegyptischen Sudan (Kordofan) 1914. II. Bearbeitung der…. *Denkschriften der königlichen Akademie für Wissenschaften Wien, Mathematische Naturwissenschaftlichte Klasse*, **94:** 555 - 693.

Weyeneth, N. (2010). Phylogeography of *Myotis, Miniopterus* and *Emballonura* bats from the Comoros and Madagascar. PhD Thesis - University of Geneva, no. Sc. 4267: 1 - 188. URL: http://archive-ouverte.unige.ch/unige:13094.

Weyeneth, N., S. M. Goodman, B. (R.) Appleton, R. Wood and M. Ruedi (2011). Wings or winds: Inferring bat migration in a stepping-stone archipelago. *Journal of Evolutionary Biology*, **24 (6):** 1298 - 1306. doi: 10.1111/j.1420-9101.2011.02262.x. URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1420-9101.2011.02262.x/pdf.

Weyeneth, N., S. M. Goodman and M. Ruedi (2010). Do diversification models of Madagascar's biota explain the population structure of the endemic bat *Myotis goudoti* (Chiroptera: Vespertilionidae)?. *Journal of Biogeography*, **38 (1):** 44 - 54 (for 2011). doi: 10.1111/j.1365-2699.2010.02393.x.

Weyeneth, N., S. M. Goodman, W. T. Stanley and M. Ruedi (2008). The biogeography of *Miniopterus* bats (Chiroptera: Miniopteridae) from the Comoro Archipelago inferred from mitochondrial DNA. *Molecular Ecology*, **17 (24):** 5205 - 5219.

Weyer, J., A. Grobbelaar and L. Blumberg (2015). Ebola virus disease: history, epidemiology and outbreaks. *Current Infectious Disease Report*, **17 (5):** 21. doi: 10.1007/s11908-015-0480-y.

Wheeler, A. (1988). An appraisal of the Zoology of C. S. Rafinesque. *Bulletin of Zoological Nomenclature*, **45 (1):** 6 - 12.

Whitaker, J. O. , Jr. and R. E. Mumford (1978). Foods and ectoparasites of bats from Kenya, East Africa. *Journal of Mammalogy*, **59 (3):** 632 - 634.

Whitaker, J. O. and H. Black (1976). Food habits of cave bats from Zambia, Africa. *Journal of Mammalogy*, **57 (1):** 199 - 204.

Whitaker, J. O., B. Shalom and T. Kunz (1994). Food and feeding habits of insectivorous bats from Israel. *Zeitschrift für Säugetierkunde*, **59:** 74-81.

Whiteley, S. M., D. A. Waters, G. Hayward, S. G. Pierce and I. Farr (2010a). Wireless recording of the calls of *Rousettus aegyptiacus* and their reproduction using electrastatic transducers. *Bioinspiration & Biomimetics*, **5:** 1 - 10. doi: 10.1088/1748-3182/5/2/026001.
Whiteley, S. M., D. A. Waters, G. Hayward, S. G. Pierce and I. Farr (2010b). Wireless recording of the calls of *Rousettus aegyptiacus* and their reproduction using electrastatic transducers. *Bioinspiration & Biomimetics*, **5:** 1 - 10. doi: 10.1088/1748-3182/5/2/026001.
Whiting, M. J., V. L. Williams and T. J. Hibbitts (2011). Animals traded for traditional medicine at the Faraday market in South Africa: species diversity and conservation implications. *Journal of Zoology*, **:** 1 - 13. doi: 10.1111/j.1469-7998.2010.00784.x.
Wickler, W. and U. Seibt (1976). Field studies on the African fruit bat *Epomophorus wahlbergi* (Sundevall), with special reference to male calling. *Zeitschrift für Tierpsychologie - Journal of Comparative Ethology*, **40 (4):** 345 - 376. doi: 10.1111/j.1439-0310.1976.tb00941.x. [Abstract]
Wickler, W. and D. Uhrig (1969). Verhalten und ökologische Nische der Gelbflugelfledermaus, *Lavia frons* (Geoffroy) (Chiroptera, Megadermatidae). *Zeitschrift für Tierpsychologie - Journal of Comparative Ethology*, **26 (6):** 726 - 736. doi: 10.1111/j.1439-0310.1969.tb01972.x.
Widmaier, E. P. and T. H. Kunz (1993). Basal, diurnal, and stress-induced levels of glucose and glucocorticoids in captive bats. *Journal of Experimental Zoology*, **A 265 (5):** 533 - 540. doi: 10.1002/jez.1402650509. [Abstract]
Wild, T. F. (2009). A new family of emerging Paramyxoviruses. *Pathologie Biologie*, **57 (2):** 188 - 196.
Wilkinson, D. A., O. Duron, C. Cordonin, Y. Gomard, B. Ramasindrazana, P. Mavingui, S. M. Goodman and P. Tortosa (2016). The bacteriome of bat flies (Nycteribiidae) from the Malagasy region: a community shaped by host ecology, bacterial transmission mode, and host-vector specificity. *Applied and Environmental Microbiology*, **82 (6):** 1778 - 1788. doi: 10.1128/AEM.03505-15.
Wilkinson, D. A., J. Mélade, M. Dietrich, B. Ramasindrazana, V. Soarimalala, E. Lagadec, G. le Minter, P. Tortosa, J.-M. Heraud, X. de Lamballerie, S. M. Goodman, K. Dellagi and H. Pascalis (2014). Highly diverse morbillivirus-related paramyxoviruses in wild fauna of the southwestern Indian Ocean Islands: Evidence of exchange between introduced and endemic small mammals. *Journal of Virology*, **88 (15):** 8268 - 8277. doi: 10.1128/JVI.01211-14.
Wilkinson, D. A., S. Temmam, C. Lebarbenchon, E. Erwan Lagadec, J. Chotte, J. Guillebaud, B. Ramasindrazana, J.-M. Héraud, X. de Lamballerie, S. M. Goodman, K. Dellagi and H. Pascalis (2012). Identification of novel paramyxoviruses in insectivorous bats of the Southwest Indian Ocean. *Virus Research*, **170 (1-2):** 159 - 163. doi: 10.1016/j.virusres.2012.08.022.
Wilkinson, G. S. and T. H. Fleming (1996). Migration and evolution of lesser long-nosed bats *Leptonycteris curasoae*, inferred from mitochondrial DNA. *Molecular Ecology*, **5:** 329 - 339.
Willett, F. (1988). The source and significance of the snake-winged bird in southwestern Nigeria. *Art Joural*, **47 (2):** 121 - 127.
Williams, D. F. and J. S. Findley (1979). Sexual size dimorphism in Vespertilionid bats. *The American Midland Naturalist*, **102 (1):** 113 - 126.
Williams, D. F. and M. A. Mares (1978). Karyological affinities of the South American Big-eared bat, *Histiotus montanus* (Chiroptera, Vespertilionidae). *Journal of Mammalogy*, **59:** 844-846.
Williams, J. G. (1965). Bats in Kenya. *Africana*, **2 (5):** 21.
Williams, J. G. (1966). Bats in Kenya. *Africana*, **2 (7):** 30.
Williams, J. G. (1967). *A field guide to the National Parks of East Africa.* Collins - London.
Williams, M. C., D. I. Simpson and R. C. Shepherd (1964). Studies on viruses in East African bats (Chiroptera) 2. Virus isolation. *Zoonose Research*, **3 (3):** 141 - 153.
Willig, M. R. and R. R. Hollander (1995). Secondary sexual dimorphism and phylogenetic constraints in bats: A multivariate approach. *Journal of Mammalogy*, **76 (4):** 981 - 992.
Willis, C. K. B., J. M. Psyllakis and D. J. H. Sleep (2002). *Chaerephon nigeriae*. *Mammalian Species*, **710:** 1 - 3, 3 figs.
Willoughby, A. R., K. L. Phelps and : Olival, K. J. PREDICT Consortium (2017). A comparative analysis of viral richness and viral sharing in cave-roosting bats. *Diversity*, **9 (3):** 35. doi: 10.3390/d9030035.
Wilson, D. E. and F. R. Cole (2000). *Common names of mammals of the World.* Smithsonian Institution Press - Washington, D.C. & London: 204 pp.
Wilson, D. E. and J. S. Findley (1977). *Thyroptera tricolor*. *Mammalian Species*, **71:** 1 - 3, 3 figs.
Wilson, D. E. and R. K. La Val (1974). *Myotis nigricans*. *Mammalian Species*, **39:** 1 - 3.
Wilson, L. A. B., S. J. Hand, C. López-Aguirre, M. Archer, K. H. Black, R. M. D. Beck, K. N. Armstrong and S. Wroe (2016). Cranial shape variation and phylogenetic relationships of extinct and extant Old World leaf-nosed bats. *Alcheringa*, **40 (4):** 509 - 524. doi: 10.1080/03115518.2016.1196434..
Wilson, V. J. (1975). Mammals of the Wankie National Park, Rhodesia. *Musem Memoir, Salisbury*, **5:** 147 pp. [Abstract]
Wingate, L. R. (1978). The life history and population dynamics of six species of bats inhibiting a deserted mine tunnel in Natal, South Africa. *South African Journal of Sciences*, **74 (4):** 145. [Abstract]
Wingate, L. (R.) (1983). The population status of five species of Microchiroptera in Natal. M.Sc. Thesis, University of Natal.
Wingate, L. R. and P. Swanepoel (1981). Collections of recent mammals in southern Africa. *Annals of the Cape Provincial Museums (Natural History)*, **13 (12):** 169 - 185.
Winge (1892). Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa. .
Winge, H. (1923). *Pattedyr-Slaegter. I. Monotremata, Marsupialia, Insectivora, Chiroptera, Edentata.* H. Hagerups Forlag - Copenhagen: 360 pp.
Winkelmann, J. R., F. J. Bonaccorso, E. Falk and G. Gore (2004). Roost selection and foraging movements of Peters' and Walhberg's epauletted fruit bats in Kruger National Park, South Africa. *Bat Research News*, **45 (4):** 273 - 274.
Witkowski, P. T., J. F. Drexler, R. Kallies, M. Licková, S. Bokorová, G. D. Mananga, T. Szemes, E. M. Leroy, D. H. Krüger, C. Drosten and B. Klempa (2016). Phylogenetic analysis of a newfound bat-borne hantavirus supports a laurasiatherian host association for ancestral mammalian hantaviruses. *Infection, Genetics and Evolution*, **41:** 113 - 119. doi: 10.1016/j.meegid.2016.03.036.
Witkowski, P. T., B. Klempa, N. L. Ithete, B. Auste, J. K. E. Mfune, J. Hoveka, S. Matthee, W. Preiser and D. H. Kruger (2014). Hantaviruses in Africa. *Virus Research*, **187:** 34 - 42. doi: 10.1016/j.virusres.2013.12.039.
Witsenburg, F., L. Clément, L. Dutoit, A. Lòpez Baucells, J. Palmeirim, I. Pavlinic, D. Scaravelli, M. Ševcík, A. Brelsford, J. Goudet and P. Christe (2013). How malaria gets around: the genetic structure of a parasite, vector, and host compared. 16th International Bat Research Conference & 43rd North American Symposium on Bat Research. San José, Costa Rica, 11-15 August 2013: 168 - 169. URL: www.ibrc2013.com/pdf/ibrc_2013_abstracts.pdf.

Witsenburg, F., N. Salamin and P. Christe (2012). The evolutionary host switches of *Polychromophilus*: a multi-gene phylogeny of the bat malaria genus suggests a second invasion of mammals by a haemosporidian parasite. *Malaria Journal*, **11 (53):** 1 - 10.

Wodzicki, K. and H. Felten (1981). Fruit bats of the genus *Pteropus* from the Islands Rarotonga and Mangaia, Cook Islands, Pacific Ocean (Mammalia: Chiroptera). *Senckenbergiana biologica*, **61:** 143 - 151.

Wollaston, A. F. R. (1908). *From Ruwenzori to the Congo. A naturalist's journey across Africa.* John Murray, London: i - xvii; 1 - 315. doi: 10.5962/bhl.title.25233.

Wolton, R. J., P. A. Arak, H. C. J. Godfray and R. P. Wilson (1982). Ecological and behavioural studies of the Megachiroptera at Mount Nimba, Liberia, with notes on Microchiroptera. *Mammalia*, **46 (4):** 419 - 448. [Abstract]

Wood, J. L. N., A. A. Cunningham, R. D. Suu-Ire, F. L. Jephcott and Y. Ntiamoa-Baidu (2015). Ebola, bats and evidence-based policy. Informing Ebola policy. *EcoHealth*, **13 (1):** 9 - 11 (for 2016). doi: 10.1007/s10393-015-1050-3.

Wood, J. L. N., M. Leach, L. Waldman, H. MacGregor, A. R. Fooks, K. E. Jones, O. Restif, D. Dechmann, D. T. S. Hayman, K. S. Baker, A. J. Peel, A. O. Kamins, J. Fahr, Y. Ntiamoa-Baidu, R. Suu-Ire, R. F. Breiman, J. H. Epstein, H. E. Field and A. A. Cunningham (2012). A framework for the study of zoonotic disease emergence and its drivers: spillover of bat pathogens as a case study. *Philosophical transactions of the Royal Society of London*, **B 367 (1604):** 2881 - 2892. doi: 10.1098/rstb.2012.0228.

Wood, R., N. Weyeneth and B. (R.) Appleton (2011). Development and characterisation of 20 microsatellite loci isolated from the large bent-wing bat, *Miniopterus schreibersii* (Chiroptera: Miniopteridae) and their cross-taxa utility in the family Miniopteridae. *Molecular Ecology Resources*, **11 (4):** 675 - 685. doi: 10.1111/j.1755-0998.2011.02994.x.

Wood, S., D. S. Jacobs and K. Junker (2010). Geographic distribution of parasites of the insectivorous bat, *Miniopterus natalensis* (Miniopteridae), in South Africa. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 313.

Woodman, N. (1993). The correct gender of mammalian generic names ending on *-otis*. *Journal of Mammalogy*, **74 (3):** 544 - 546. [Abstract]

World Conservation Monitoring Centre (1993). *World checklist of threatened mammals. 2nd edition.* Joint Nature Conservation Committee - Peterborough: 1 - 133.

Wright, E., D. T. S. Hayman, A. Vaughan, N. J. Temperton, J. L. N. Wood, A. A. Cunningham, R. Suu-Ire, R. A. Weiss and A. R. Fooks (2010). Virus neutralising activity of African fruit bat (*Eidolon helvum*) sera against emerging lyssaviruses. *Virology*, **408 (2):** 183 - 189. doi: 10.1016/j.virol.2010.09.014.

Wright, E. P. (1868). Notes on the bats of the Seychelles group of islands. *Annals and Magazine of Natural History*, **4(2):** 436 - 438.

Wright, G. S. (2009). *Hipposideros caffer* (Chiroptera: Hipposideridae). *Mammalian Species*, **845:** 1 - 9.

Wroughton, R. C. (1906). On some mammals collected by Mr. Robin Kemp in S. Nigeria. *Annals and Magazine of Natural History*, **ser. 7, 17 (100):** 375 - 379. [Abstract]

Wroughton, R. C. (1911). LVII. List of a collection of mammals made by Mr. A. L. Butler on the Upper Nile. *Annals and Magazine of Natural History*, **ser. 8, 8 (46):** 458 - 462.

Wroughton, R. C. (1912). Some new Indian mammals. *Journal of the Bombay Natural History Society*, **21 (3):** 767 - 773.

Wroughton, R. C. (1918). Summary of the results from the Indian mammal survey of the Bombay Natural History Society. Introduction. *Journal of the Bombay Natural History Society*, **25:** 547 - 598.

Wu, Y. , Wang, H. , Wang, H. , Feng, J. (2018). Arms race of temporal partitioning between carnivorous and herbivorous mammals. *Scientific Reports*, **8:** 1713. doi: 10.1038/s41598-018-20098-6.

Wünschmann, A., J. F. X. Jr. Wellehan, A. Armien, W. J. Bemrick, B. Barnes, G. A. Averbeck, R. Roback, M. Schwabenlander, E. D'Almeida, R. Joki, A. L. Childress, R. Cortinas, C. H. Gardiner and E. C. Greiner (2010). Renal infection by a new coccidian genus in big brown bats (*Eptesicus fuscus*). *Journal of parasitology*, **96 (1):** 178 - 183. doi: 10.1645/GE-2250.1.

Wyant, K. A. and R. A. Adams (2007). Prenatal growth and development in the Angolan free-tailed bat, *Mops condylurus* (Chiroptera: Molossidae). *Journal of Mammalogy*, **88 (5):** 1248 - 1251.

Yalden, D. W. (2013a). *Myotis morrisi Morris's Myotis.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 699 - 700.

Yalden, D. W. (2013b). *Myotis scotti Scott's Myotis.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 705 - 706.

Yalden, D. W. (2013c). *Kerivoula eriophora Heuglin's Woolly Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 729.

Yalden, D. W. and M. Happold (2013). *Otomops martienssensi Large-eared Giant Mastiff Bat.* In Happold, M. and D. Happold [Eds]: *Mammals of Africa. Volume IV. Hedgehogs, shrews and bats.* Bloomsbury Publishing, London: 480 - 482.

Yalden, D. W. and M. J. Largen (1992). The endemic mammals of Ethiopia. *Mammal Review*, **22 (3/4):** 115 - 150. [Abstract]

Yalden, D. W., M. J. Largen, D. Kock and J. C. Hillman (1996). Catalogue of the mammals of Ethiopia and Eritrea. 7. Revised checklist, zoogeography and conservation. *Tropical Zoology*, **9:** 73 - 164. [Abstract]

Yanagihara, R., S. H. Gu, S. Arai, H. J. Kang and J.-W. Song (2014). Hantaviruses: Rediscovery and new beginnings. *Virus Research*, **187:** 6 - 14. doi: 10.1016/j.virusres.2013.12.038.

Yartsev, M. M. and N. Ulanovsky (2013). Representation of three-dimensional space in the hippocampus of flying bats. *Science*, **340 (6130):** 367 - 372. doi: 10.1126/science.1235338.

Yaseen, A. E., H. A. Hassan and L. S. Kawashti (1994). Comparative study of karyotypes of two Egyptian species of bats, Taphozous perforatus and Taphozous nudiventris (Chiroptera: Mammalia). *Experientia*, **50:** 1111 - 1114.

Yassen, A. E., H. A. Hassan and L. S. Kawashti (1994). Comparative study of the karyotypes of two Egyptian species of bats, *Taphozous perforatus* and *Taphozous nudiventris* (Chiroptera: Mammalia). *Experientia*, **50 (11):** 111 - 1114.

Yeboah, S. (2007). Reproductive pattern of some megachiropteran bats in Ghana. *Ghana Journal of Science*, **47:** 117 - 122.

Yerbury and Thomas (1895). On the mammals of Aden. *Proceedings of the Zoological Society of London*542 - 555.

Yinda, C. K., N. Conceição-Neto, M. Zeller, E. Heylen, P. Maes, S. M. Ghogomu, M. Van Ranst and J. Matthijnssens (2017a). Novel highly divergent sapoviruses detected by metagenomics analysis in straw-colored fruit bats in Cameroon. *Emerging microbes & infections*, **6:** e38. doi: 10.1038/emi.2017.20.

Yinda, C. K., S. M. Ghogomu, N. Conceição-Neto, L. Beller, W. Deboutte, E. Vanhulle, P. Maes, M. Van Ranst and J. Matthijnssens (2018). Cameroonian fruit bats harbor divergent viruses, including rotavirus H, bastroviruses, and picobirnaviruses using an alternative genetic code. *Virus Evolution*, **3 (2):** vey008. doi: 10.1093/ve/vey008.

Yinda, C. K., E. Vanhulle, N. Conceição-Neto, L. Beller, W. Deboutte, C. Shi, S. M. Ghogomu, P. Maes, M. Van Ranst and J. Matthijnssens (2019). Gut virome analysis of Cameroonians reveals high diversity of enteric viruses, including potential interspecies transmitted viruses. *mSphere*, **4 (1):** e00585-18. doi: 10.1128/mSphere.00585-18.

Yinda, C. K., R. Zell, W. Deboutte, M. Zeller, N. Conceição-Neto, E. Heylen, P. Maes, N. J. Knowles, S. M. Ghogomu, M. Van Ranst and J. Matthijnssens (2017b). Highly diverse population of Picornaviridae and other members of the Picornavirales, in Cameroonian fruit bats. *BMC Genomics*, **18:** 249. doi: 10.1186/s12864-017-3632-7.

Yinda, C. K., M. Zeller, N. Conceição-Neto, P. Maes, W. Deboutte, L. Beller, E. Heylen, S. M. Ghogomu, M. Van Ranst and J. Matthijnssens (2016). Novel highly divergent reassortant bat rotaviruses in Cameroon, without evidence of zoonosis. *Scientific Reports*, **6:** 34209. doi: 10.1038/srep34209.

Yoder, A. D., L. E. Olson, C. Hanley, K. L. Heckman, R. Rasoloarison, A. L. Russell, J. Ranivo, V. Soarimalala, K. P. Karanth, A. P. Raselimanana and S. M. Goodman (2005). A multidimensional approach for detecting species patterns in Malagasy vertebrates. *Proceedings of the National Academy of Sciences of the USA*, **102 (Suppl. 1):** 6587 - 6594.

Yom-Tov, Y., M. Cohen and Z. Wollberg (1990). On the possible function of the anterior cornu in the Microchiroptera. *Mammalia*, **54 (2):** 281 - 285. [Abstract]

Yoon, M. H. and T. A. Uchida (1983a). Identification of recent bats belonging to the Vespertilionidae by the humeral characters. *Journal of the Faculty of Agriculture - Kyushi University*, **28 (1):** 31 - 50. [Abstract]

Yoon, M. H. and T. A. Uchida (1983b). Identification of recent bats belonging to the Rhinolophidae by the humeral characters. *Journal of the Faculty of Agriculture - Kyushi University*, **28 (2-3):** 135 - 146. [Abstract]

Yoshiyuki, M. (1989). *A systematic study of the Japanese Chiroptera.* National Science Museum, Tokyo: 242 pp.

Yoshiyuki, M. (1995). Two rare species of the bats *Trienopus rufus* and *Mormopterus jugularis* (Mammalia, Chiroptera) from Madagascar. *Bulletin of the National Science Museum, Tokyo*, **Ser. A (Zool.) 21 (2):** 119 - 126. [Abstract]

Yoshiyuki, M. and H. Endo (2003). *Catalogue of chiropteran specimens in spirit.* National Science Museum - Tokyo: i - vi; 1 - 153.

Young, C. C. W. and K. J. Olival (2016). Optimizing viral discovery in bats. *PLoS ONE*, **11 (2):** e0149237. doi: 10.1371/journal.pone.0149237.

Young, J. A., R. Saw, W. J. Trewhella and C. J. Cole (1993). Establishing a captive breeding programme for the endangered Livingstone's fruit bat *Pteropus livingstonii*: the 1993 capture expedition. *Dodo*, **29:** 22 - 33.

Young, R. A. (1975). Aging criteria, pelage colour polymorphism and moulting in *Rhinolophus megaphyllus* (Chiroptera) from south-eastern Queensland, Australia. *Mammalia*, **39 (1):** 75 - 111. doi: 10.1515/mamm.1975.39.1.75. [Abstract]

Yovel, Y., B. Falk, C. F. Moss and N. Ulanovsky (2010a). Optimal localization by pointing off axis. *Science*, **327:** 701 - 704. doi: 10.1126/science.1183310.

Yovel, Y., B. Falk, C. F. Moss and N. Ulanovsky (2010b). New degrees of freedom in sonar-beam control by fruit bats. In Horácek, I. and P. Benda : *15th IBRC - the Conference Manual: Programme, abstracts, list of participants. Volume of abstracts of the 15th International Bat Research Conference.* 15th IBRC - Prague 23 - 27 August 2010: 313 - 314.

Yovel, Y., B. Falk, C. F. Moss and N. Ulanovsky (2011a). Active control of acoustic field-of-view in a biosonar system. *PLoS Biology*, **9 (9) e1001150:** 1 - 10. doi: 10.1371/journal.pbio.1001150.

Yovel, Y., M. Geva-Sagiv and N. Ulanovsky (2011b). Click-based echolocation in bats: Not so primitive after all. *Journal of Comparative Physiology*, **A 197 (5):** 515 - 530. doi: 10.1007/s00359-011-0639-4.

Yu, W., Y. Wu and G. Yang (2014). Early diversification trend and Asian origin for extent bat lineages. *Journal of Evolutionary Biology*, **27 (10):** 2204 - 2218.

Zagorodniuk, I. (1998a). *Systematic review of bats from the Eastern Europe.* In Zagorodniuk, I. : *European bat night '98 in Ukraine (in Ukrainian with English summary).* Proceedings of the Theriological School, 1: 32 - 48.

Zagorodniuk, I. (1998b). *Polyspecies of bats from the Eastern Europe and their diagnostics.* In Zagorodniuk, I. : *European bat night '98 in Ukraine (in Ukrainian with English summary).* Proceedings of the Theriological School, 1: 56 - 65.

Zagorodniuk, I. (1998c). *First bat census using detector in Kyiv at 1997 - 1998.* In Zagorodniuk, I. : *European bat night '98 in Ukraine (in Ukrainian with English summary).* Proceedings of the Theriological School, 1: 128 - 133.

Zagorodniuk, I. (1998d). *Protected categories for East European bats.* In Zagorodniuk, I. : *European bat night '98 in Ukraine (in Ukrainian with English summary).* Proceedings of the Theriological School, 1: 163 - 165.

Zagorodniuk, I. (1998e). *Defining dictionary of cranial diagnostic features of bats.* In Zagorodniuk, I. : *European bat night '98 in Ukraine (in Ukrainian with English summary).* Proceedings of the Theriological School, 1: 173 - 179.

Zagorodniuk, I. (1998f). *Bibliography on bat fauna of Ukraine.* In Zagorodniuk, I. : *European bat night '98 in Ukraine (in Ukrainian with English summary).* Proceedings of the Theriological School, 1: 184 - 197.

Zagorodniuk, I. [Ed] (1999). *Mammals of Ukraine, protected by the Bern Convention.* Kyiv, 1999. - 222 pp. - (Proc. Theriol. school, issue 2).

Zagorodniuk, I. (2001a). Migration of bats: the essence of phenomenon, fundamental definitions, methods of investigation. In Zagorodniuk, I. : *Migration status of bats in Ukraine (in Ukrainian with English summary). Novitates Theriologicæ*, **6:** 8 - 20.

Zagorodniuk, I. (2001b). Checklist of bat genera and species from Ukraine. In Zagorodniuk, I. : *Checklist of bat genera and species from Ukraine. Novitates Theriologicæ*, **6:** 42 - 46.

Zagorodniuk, I. (2001c). Long-eared and barbastelle bats: *Plecotus* et *Barbastella*. In Zagorodniuk, I. : *Migration status of bats in Ukraine (in Ukrainian with English summary). Novitates Theriologicæ*, **6:** 53 - 56.

Zagorodniuk, I. (2001d). Winter records of bats from Roztochia upland. In Zagorodniuk, I. : *Migration status of bats in Ukraine (in Ukrainian with English summary). Novitates Theriologicæ*, **6:** 116.

Zagorodniuk, I. (2001e). General picture of bat fauna dymnamics in Ukraine. In Zagorodniuk, I. : *Migration status of bats in Ukraine (in Ukrainian with English summary). Novitates Theriologicæ*, **6:** 157 - 168.

Zagorodniuk, I. (2002). *Field key to small mammals of Ukraine.* Kyiv, 60 pp. (Proceedings of the Theriological School, volume 5).

Zagorodniuk, I. (2014). Changes in taxonomic diversity of Ukrainian mammals for the last three centuries: extinct, phantom, and alien species. *Proceedings of the Theriological School*, **12:** 3 - 16.

Zagorodniuk, I., B. Godovanets, V. Pokynchereda and A. Kyseliuk (1995). *Taxonomic diversity of birds and mammals in the Carpathian Biosphere Reserve: a comparison of previous and new data // Methods of monitoring of nature in the Carpathian national parks and protected areas.* Rakhiv, 1995. pp 119 - 130. (Proceed. Intern. Conf. "ACANAP-1995" 18 - 21 October 1995).

Zammarano, V. T. (1930). *Le colonie Italiane di diretto dominio. Fauna e caccia.* Ministero delle Colonie.

Zatushevskyy, A., I. Shydlovskyy and I. Tymkiv (2016). Representativeness of the Mammalian Collection of the Zoological Museum of Lviv University. *Proceedings of the Theriological School*, **14:** 41 - 48.

Zava, B. and M. Masseti (2007). First record of four species of bats from the national park of El Feidja (NW Tunisia) with a note on the non-flying mammals of the Khroumiria region. *Hystrix*, **(n.s.) 18 (1):** 83 - 90.
Zehender, G., C. Sorrentino, C. Veo, L. Fiaschi, S. Gioffrè, E. Ebranati, E. Tanzi, M. Ciccozzi, A. Lai and M. Galli (2016). Distribution of Marburg virus in Africa: An evolutionary approach. *Infection, Genetics and Evolution*, **44:** 8 - 16. doi: 10.1016/j.meegid.2016.06.014.
Zeller, U. (1984). Zur Kenntniss der Stimmapparates des Epauletten-Flughunde (Epomophorini, Pteropodidae, Megachiroptera). *Zeitschrift für Säugetierkunde*, **49:** 207 - 220. [Abstract]
Zhang, J.-S. , Han, N.-J. , Jones, G. , Lin, L.-K. , Zhang, J.-P. , Zhu, G.-J. , Huang, D.-W. , Zhang, S.-Y. (2007). A new species of *Barbastella* (Chiroptera: Vespertilionidae) from north China. *Journal of Mammalogy*, **88 (6):** 1393 - 1403.
Zhang, Y.-Z. (2014). Discovery of hantaviruses in bats and insectivores and the evolution of the genus *Hantavirus*. *Virus Research*, **187:** 15 - 21. doi: 10.1016/j.virusres.2013.12.035.
Zhao, H., S. Rossiter, E. C. Teeling, C. Li, J. A. Cotton and S. Zhang (2009). The evolution of color vision in nocturnal mammals. *Proceedings of the National Academy of Sciences, U.S.A.*, **106 (22):** 8980 - 8985. doi: 10.1073/pnas.0813201106.
Zhao, H., S. Zhang, M. Zuo and J. Zhou (2003). Correlations between call frequency and ear length in bats belonging to the families Rhinolophidae and Hipposideridae. *Journal of Zoology*, **259 (2):** 189 - 195.
Zhou, Z.-M., A. Guillén-Servent, B. K. Lim, J. L. Eger, Y.-X. Wang and X. Jiang (2009). A new species from southwestern China in the Afro-Palearctic linage of the horseshoe bats (*Rhinolophus*). *Journal of Mammalogy*, **90 (1):** 57 - 73.
Zhu, Q., M. Kosoy, K. J. Olival and K. Dittmar (2014). Horizontal transfers and gene losses in the phospholipid pathway of *Bartonella* reveal clues about early ecological niches. *Genome Biology and Evolution*, **6 (8):** 2156 - 2169. doi: 10.1093/gbe/evu169.
Zhuang, Q., X.-M. Wang, M.-X. Li, J. Mao and F.-X. Wang (2012). Noseleaf pit in Egyptian slit-faced bat as a doubly curved reflector. *Europhysics Letters*, **97 (4):** 1 - 6. doi: 10.1209/0295-5075/97/44001.
Ziegler, S., G. Nikolaus and R. Hutterer (2002). High mammalian
diversity in the newly established National Park of Upper Niger, Republic of Guinea. *Oryx*, **36 (1):** 73 - 80.
Zima, J. (1978). Chromosomal characteristics of Vespertilionidae from Czechoslovakia. *Acta scientiarum naturalium Academiae scientiarum Bohemicae - Brno*, **12:** 1 - 38.
Zima, J. (1982). Chromosomal homology in the complements of bats of the family Vespertilionidae. II. G-band karyotypes of some *Myotis*, *Eptesicus* and *Pipistrellus* species. *Folia zoologica: International journal of vertebratology*, **31 (1):** 31 - 36. [Abstract]
Zima, J. and I. Horácek (1985). Synopsis of karyotypes of Vespertilionid bats (Mammalia: Chiroptera). *Acta Universitatis Carolinae - Biologica, Prague*, **(for 1981):** 311 - 329. [Abstract]
Zima, J., M. Volleth, I. Horácek, J. Cerveny, A. Cervena, K. Prucha and M. Macholan (1992a). *Comparative karyology of rhinolophid bats (Chiroptera: Rhinolophidae).* In Horácek, I. and V. Vohralík : *Prague studies in Mammalogy*. Charles University Press - Praha: 229 - 236.
Zima, J., M. Volleth, I. Horácek, J. Cerveny and M. Macholán (1992b). *Karyotypes of two species of bats, Otonycteris hemprichi and Pipistrellus tramatus (Chiroptera, Vespertilionidae).* In Horácek, I. and V. Vohralík : *Prague studies in Mammalogy.* Charles University Press - Praha: 237 - 242. [Abstract]
Zimara, R. (1935). Säugetiere Westafrikas (gesammelt von Alfred Weidholz). *Sitzungsberichte der Akademie für Wissenschaften aus Wien, mathematisch naturwissenschaftliche Klasse*, **(1) 144:** 7 - 18. [Abstract]
Zumpt, F. (1950). Ectoparasites of bats from the Sterkfontein caves, Transvaal. *Journal of the Entomological Society of Southern Africa*, **13:** 87 - 98.
Zumpt, F. and W. Till (1954). The genus *Steatonyssus* Kolenati in the Ethiopian Region (Acarina: Laelaptidae). *Journal of the Entomological Society of Southern Africa*, **17 (1):** 47 - 57.