

SUPPLEMENTAL MATERIAL S1

Species richness patterns and functional traits of the bat fauna of arid southern Africa

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Distribution of bat species richness in sub-Saharan Africa

Methods

Study area

This study covers the entire mainland continent of Africa south of the Sahara, and includes 42 countries either fully or partially covered (Fig. 1).

Specimens

The data on which the modelling analyses were based have been taken from the literature and included 14,145 unique locality-species records for 208 species. For the southern African region we used a large dataset of 6,000 museum records of 116 species, of which almost three-quarters of the specimens were examined and verified by the authors (Monadjem *et al.*, 2010a).

Records from East Africa: Swynnerton and Hayman (1951); Aellen (1957); Hayman and Hill (1966); Verschuren (1967); Niort (1970); Anciaux de Faveaux (1972); Verschuren (1980); Kock (1981); Aggundey and Schlitter (1984); Schlitter and Aggundey (1986); Baeten *et al.* (1984); Kock and Howell (1988); Montfort (1992); Heller *et al.* (1994); Fahr *et al.* (2002); Stanley and Kock (2004); Stanley *et al.* (2005a); Stanley *et al.* (2005b); Stanley *et al.* (2005c); Stanley *et al.* (1996); Thorn *et al.* (2007); Bergmans (1997); Rovero *et al.* (2007); Stanley and Foley (2008); Stanley (2009); Kock and Stanley (2009); Kock *et al.* (2000); Thorn and Kerbis Peterhans (2009); and a visit to the Mammal Department, National Museums of Kenya, Nairobi (by AM).

Records from the Horn of Africa: Funaioli and Lanza (1968); Kock (1969); Largen *et al.* (1974); Hill (1975); Koopman (1975); McLellan (1986); Hill *et al.* (1988); Kock and Howell (1988); Varty and Hill (1988);

Duckworth *et al.* (1993); Yalden *et al.* (1996); Kruskop and Lavrenchenko (2000); Kruskop and Lavrenchenko (2006); Pearch *et al.* (2001); Fenton and Eger (2002); Benda *et al.* (2004); Lavrenchenko *et al.* (2004); Bergmans (1988).

Records from Central Africa: Hayman *et al.* (1966); Aellen (1952); Lunde and Beresford (1997); van Cakenberghe *et al.* (1999); Cotterill (2001); Eger and Schlitter (2001); Eisentraut (1956); Hill (1968); Hutterer and Joger (1982); Hutterer *et al.* (1992); Monadjem and Fahr (2007); Peterson and Smith (1973); Seamark and van Cakenberghe (2012); Thorn *et al.* (2007); Vielliard (1974); Hill (1983); Bergmans (1989); Bergmans (1990); Lunde *et al.* (2001); Schlitter *et al.* (1982); Dorst (1963); Aellen and Brosset (1968); Bergmans (1988); Brosset (1966a); Dowsett *et al.* (1991); Allen (1917); Ansell (1974); Bergmans (1997); Bergmans (1989); Fahr and Ebigbo (2003); Fahr *et al.* (2002); Gallagher and Harrison (1977); Harrison (1975); Heller *et al.* (1994); Kearney and Seamark (2005); Kock and Howell (1988); Schoutedden (1947); van Cakenberghe and de Vree (1985); Verschuren (1967); Jones (1971); Brosset (1966b); Csorba *et al.* (2003); Malbrant and Maclatchy (1949).

Records from West Africa: Robbins (1980); Green (1983); Koch-Weser (1984); Koopman *et al.* (1978); Kock (1969); Seamark and van Cakenberghe (2012); Decher and Fahr (2007); Grubb *et al.* (1998); Aellen (1956); Aellen (1963); Bergmans (1989); Eisentraut and Knorr (1957); Fahr and Ebigbo (2003); Fahr *et al.* (2002); Fahr *et al.* (2006); Konstantinov *et al.* (2000); Kock (1969); Lopes and Crawford-Cabral (1992); Monard (1939); Bergmans *et al.* (1974); Cotterill (2001a); Cotterill (2001b); de Vree (1971); Fahr and Kalko (2011); Lim and Van Coeverden De Groot (1997); Coe (1975); Hill (1982); Koopman (1989); Koopman *et al.* (1995); Monadjem *et al.* (2013); Monadjem *et al.* (2016); Denys *et al.* (2013); Kuhn (1965); Monadjem and Fahr (2007); Verschuren (1977); Wolton *et al.* (1982); Koopman (1975); Meining (2000); Sidiyene and Tranier (1990); Qumsiyeh and Schlitter (1981); Fairion (1980); Kock (1978); Poche (1975); Happold (1987); Hill *et al.* (1988); Adam and Hubert (1972); Adam and Hubert (1976); Adam *et al.* (1993); Bohme and Hutterer (1979); Poulet (1972); Decher *et al.* (2010); Weber and Fahr (2009); Kock *et al.* (2002);

Modelling distributions and analyses

We modelled the predicted suitable habitat space of species on the African continent excluding Madagascar under present climatic conditions using MaxEnt (Phillips et al. 2006). Models were run at a resolution of approximately 5 km (2.5 arc min) using all 19 Bioclimatic variables from the WorldClim database (Hijmans et al., 2005). Because the use of highly correlated layers may lead to model over-fitting, we also ran models after removing redundancy of autorrelated variables with a principal components analysis (PCA) in R version 3.0.1 (R Development Core Team, 2013) using the package FactoMineR. Occurrence data were divided into training and testing sets for a 10-fold cross-validation, testing each model on identical withheld data via the area under the receiver operating characteristic curve (AUC) test statistic. The model was set to use auto features for the analyses based on the number of records for each species (Phillips and Dudík 2008). Species richness maps were created by stacking the per-site occurrence probabilities of species (Calabrese et al. 2014) using the Raster Calculator in ESRI ArcMap™.

Species richness (number of species per cell) was rescaled to 1° resolution (Schoeman *et al.*, 2013). DIVA-GIS version 7.1.7 (<http://www.diva-gis.org>) was used to model the relationship of species richness relative to sampling effort, the latter being defined as the number of locations per 1° grid cell from which bats have been collected as well as to latitude and altitudinal roughness.

Table 1. Contribution of the first seven principal components (PC1 – PC7) derived from principal components analysis of 19 Bioclim environmental variables (values in boldface indicate variables contributing most to the components).

WorldClim variables	PC1	PC2	PC3	PC4	PC5	PC6	PC7
bio_1		0.4637					
bio_2	0.2261		0.1791	0.1345	0.5752	0.2470	0.3909
bio_3	0.2986			0.2041		0.2056	0.2792
bio_4	0.3018	0.1164	0.1963		0.1371	0.1267	0.1494
bio_5	0.2294	0.2924	0.2038		0.2488		
bio_6	0.2267	0.3306			0.2202		
bio_7	0.3146				0.3220		
bio_8		0.3950	0.1618	0.2613	0.1558		0.1538
bio_9		0.1967	0.4876	0.3403	0.2111	0.2318	0.1208
bio_10	0.1894	0.3403	0.2503		0.1180	0.1091	
bio_11	0.1962	0.3763					0.1590
bio_12	0.3134			0.1991	0.2197	0.1124	
bio_13	0.2838		0.1229	0.3876	0.2451	0.1216	
bio_14	0.2117		0.3825	0.3933	0.2263		
bio_15		0.2818	0.3398	0.1078			
bio_16	0.2868		0.1050	0.3770	0.2639	0.1253	
bio_17	0.2300		0.3784	0.3545	0.1974		0.2021
bio_18	0.2831				0.2366	0.4638	
bio_19	0.1885		0.3155	0.3278	0.1305	0.7349	0.1831
SD	2.901	2.154	1.378	1.122	0.965	0.768	0.709
Variance	0.4428	0.2442	0.0998	0.0663	0.0491	0.0311	0.0265
Cumulative variance	0.4428	0.687	0.7869	0.8532	0.9023	0.9333	0.9598

REFERENCES

- 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: 317-326.
- ADAM, F., and B. HUBERT. 1972. Chiroptères nouveaux pour le Sénégal. *Mammalia*, 36: 59-70.
- ADAM, F., and B. HUBERT. 1976. Les Nycteridae (Chiroptera) du Sénégal: Distribution, biométrie et dimorphisme sexuel. *Mammalia*, 40: 597-613.
- AELLEN, V. 1952. Contribution à l'étude des chiroptères du Cameroun. *Mémoire de la Société neuchâteloise de Sciences naturelles*, 8: 1-121.
- AELLEN, V. 1956. Speologica africana. Chiroptères des grottes de Guinée. *Bulletin de l'I.F.A.N. Sér. A*, 18(3): 884-894.
- AELLEN, V. 1957. Les Chiroptères africains du Musée zoologique de Strasbourg. *Revue suisse de zoologie*, 64: 189-214.
- AELLEN, V. 1963. La Reserve Naturelle Integrale du Mont Nimba. XXIX. Chiropteres. *Mémoires de l'Institut Français d'Afrique Noire*, 66: 629-638.
- AELLEN, V., and A. BROSSET. 1968. Chiroptères du sud du Congo (Brazzaville). *Revue suisse de zoologie*, 75: 435-458.
- AGGUNDEY, I.R., and D.A. SCHLITTER (1984). Annotated checklist of the mammals of Kenya. I. Chiroptera. *Annals of the Carnegie Museum*, 53: 119-153.
- 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: 405-496.
- ANCIAUX DE FAVEAUX, M. 1972. Répartition biogéographique et cycles annuels de Chiroptères d'Afrique centrale. Thèse de doctorat, Université de Paris.

- 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.
- 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: 183-196.
- BENDA, P., A. KIEFER, V. HANÁK, and M. VEITH. 2004. Systematic status of African populations of long-eared bats, genus *Plecotus* (Mammalia: Chiroptera). *Folia zoologica: International journal of vertebratology*, 53: 1-47.
- 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: 75-146.
- BERGMANS, W. 1989. Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 2. The genera *Micropteropus* Matschie, 1899, *Epomops* Gray, 1870, *Hypsignathus* H. Allen, 1861, *Nanonycteris* Matschie, 1899, and *Plerotes* Andersen, 1910. *Beaufortia*, 38: 89-153.
- BERGMANS, W. 1990. 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: 111-177.
- 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: 11-90.
- 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: 18-48.
- 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*, 28: 362-370.
- BROSSET, A. (1966b). Les chiroptères du Haut-Ivindo (Gabon). *Biologica Gabonica*, 2: 47-86.

- CALABRESE, J.M., G. CERTAIN, C. KRAAN, and C.F. DORMANN 2014. Stacking species distribution models and adjusting bias by linking them to macroecological models. *Global Ecology and Biogeography*, 23: 99-112.
- COE, M. 1975. Mammalian ecological studies at Mount Nimba, Liberia. *Mammalia*, 39: 523-588.
- COTTERILL, F.P.D. 2001a. The first specimen of Thomas's flat-headed bat, *Mimetillus moloneyi thomasi* (Microchiroptera: Mammalia) in Southern Africa from Mozambique. *Arnoldia Zimbabwe*, 10: 211-218.
- COTTERILL, F.P.D. 2001b. New specimens of lesser house bats (Vespertilionidae: *Scotoecus*) from Mozambique and Zambia. *Arnoldia Zimbabwe*, 10: 219-223.
- CSORBA, G., P. UJHELYI, and N. THOMAS. 2003. Horseshoe Bats of the World (Chiroptera: Rhinolophidae). Alana Books - Shropshire.
- 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., R.W. NORRIS, and J. FAHR. 2010. Small mammal survey in the upper Seli River valley, Sierra Leone. *Mammalia*, 74: 163-176.
- DENYS, C., B. KADJO, A.D. MISSOUP, A. MONADJEM, and V. ANISKINE. 2013. New records of bats (Chiroptera) and karyotypes from Guinean Mount Nimba (West Africa). *Italian Journal of Zoology*, 80: 279-290.
- DE VREE, F. 1971. Notes sur une collection de Chiroptères ouest africains, principalement de la Côte d'Ivoire. *Revue de zoologie et botanique africaines*, 83: 31-49.
- DORST, J. 1963. Présence de *Pipistrellus rüppelli* au Tchad. *Mammalia*, 27: 443.
- 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.
- 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: 278-282.

- EGER, J. L., and D. A. SCHLITTER. 2001. A new species of *Glauconycteris* from West Africa (Chiroptera: Vespertilionidae). *Acta Chiropterologica*, 3: 1-10.
- EISENTRAUT, M. 1956. Beitrag zur Chiropteren-Fauna von Kamerun (Westafrika). *Zoologische Jahrbücher: Abteilung für Systematik*, 84: 505-540.
- EISENTRAUT, M., and H. KNORR. 1957. Les chauves-souris cavernicoles de la Guinée Française. *Mammalia*, 4: 321-340.
- FAHR, J., B.A. DJOSSA, H. VIERHAUS. 2006. 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., McCullough, J., Alonso, L.E., Diallo, M.S., eds. A rapid biological assessment of three classified forests in Southeastern Guinea. Washington, DC: Conservation International, RAP Bulletin of Biological Assessment, 40: 168-180, 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: 125-141.
- 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.
- FAHR, J., and E.K.V. KALKO. 2011. Biome transitions as centres of diversity: habitat heterogeneity and diversity patterns of West African bat assemblages across spatial scales. *Ecography*, 34: 177-195.
- FENTON, M.B., and J.L. EGER. 2002. *Chaerephon chapini*. *Mammalian Species*, 692: 1-2.
- FUNAIOLI, U., and B. LANZA. 1968. On some bats from Somalia. *Monitore zoologico Italiano*, suppl. 2: 199-202.
- GALLAGHER, M.D., and D.L. HARRISON. 1977. Report on the bats (Chiroptera) obtained by the Zaire River Expedition. *Bonner zoologische Beiträge*, 28: 19-32.
- GREEN, A.A. 1983. Rodents and bats of Arli and Pendjari National Parks, Upper Volta and Benin. *Nigerian Field*, 47: 185-194.

- GRUBB, P., T.S. JONES, A.G. DAVIES, E. EDBERG, E.D. STARIN, and J.E. HILL. 1999. Mammals of Ghana, Sierra Leone, and The Gambia. The Trendine Press. Zennor, St. Ives.
- HAPPOLD, D.C.D. 1987. The mammals of Nigeria. Clarendon Press, Oxford.
- HARRISON, D.L. 1975. A new species of African Free-tailed bat (Chiroptera: Molossidae) obtained by the Zaire River Expedition. *Mammalia*, 39: 313-318.
- HAYMAN, R.W., X. MISONNE, and W.N. VERHEYEN. 1966. The bats of the Congo and of Rwanda and Burundi. *Annals Roy Mus. Afr. Centr. zool. Ser.*, 154: 1-191.
- 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: 1-8.
- HIJMANS, R.J., S.E. CAMERON, J.L. PARRA, P.G. JONES and A. JARVIS 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25: 1965-1978.
- HILL, J.E. 1968. Bats from the Cameroons, with the description of a new species of *Pipistrellus*. *Bonner Zoologische Beitrage*, 19: 43-48.
- HILL, J.E. 1975. Occurrence of *Nycteris parisii* (de Beaux, 1923) (Chiroptera: Nycteridae) in Ethiopia. *Mammalia*, 39: 506-508.
- HILL, J.E. 1982. Records of bats from Mount Nimba, Liberia. *Mammalia*, 46: 116-120.
- Hill, J.E. 1983. Further records of bats from the Central African Republic (Mammalia: Chiroptera). *Annals of the Carnegie Museum*, 52: 55-58.
- HILL, J.E., D.L. HARRISON, and T.S. JONES. 1988. New records of bats (Microchiroptera) from Nigeria. *Mammalia*, 52: 590-592.
- HUTTERER, R., and U. JOGER. 1982. Kleinsäuger aus dem Hochland von Adamaoua, Kamerun. *Bonner zoologische Beitrage*, 33: 119-132.
- 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: 393-414.

IUCN. 2013. IUCN Red List of Threatened Species. Version 2012.1. www.iucnredlist.org. Downloaded on 1 July 2013.

JONES, C. 1971. The bats of Rio Muni, West Africa. *Journal of Mammalogy*, 52: 121-140.

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*, 42: 71-87.

KOCH-WESER, S. 1984. Fledermause aus Obervolta, W-Afrika. *Senckenbergiana Biologica*, 64: 255-311.

KOCK, D. 1969. Die Fledermaus-Fauna des Sudan (Mammalia, Chiroptera). *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, 521: 1-238.

KOCK, D. 1978. Vergleichende untersuchung einiger Säugetiere im südlichen Niger (Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia). *Senckenbergiana biologica*, 58: 113-136.

KOCK, D. 1981. Zur Chiropteren-Fauna von Burundi (Mammalia). *Senckenbergiana biologica*, 61: 329-336.

KOCK, D., L. BARNETT, J. FAHR, and C. EMMS. 2002. On a collection of bats (Mammalia: Chiroptera) from The Gambia. *Acta Chiropterologica*, 4: 77-97.

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: 233-239.

KOCK, D., and K.M. HOWELL. 1988. Three bats new for mainland Tanzania (Mammalia: Chiroptera). *Senckenbergiana biologica*, 68: 223-239.

KOCK, D., and W.T. STANLEY. 2009. Mammals of Mafia Island, Tanzania. *Mammalia*, 73: 339-352.

KONSTANTINOV, O.K., A.I. PEMA, V.V. LABZIN, G.V. FARAFONOVA. 2000. Records of bats from Middle Guinea, with remarks on their natural history. *Plecotus*, 3: 129-148.

KOOPMAN, K.F. 1975. Bats of the Sudan. *Bulletin of the American Museum of Natural History*, 154: 353-444.

KOOPMAN, K.F. 1989. Systematic notes on Liberian bats. *American Museum Novitates*, 2946: 1-11.

- KOOPMAN, K.F., C.P. KOFRON, and A. CHAPMAN. 1995. The bats of Liberia: Systematics, ecology, and distribution. *American Museum Novitates*, 3148: 1-24.
- KOOPMAN, K.L., R.E. MUMFORD, J.F. HEISTERBERG. 1978. Bat records from Upper Volta, West Africa. *American Museum Novitates*, 2643: 1-6.
- KRUSKOP, S.V., and L.A. LAVRENCENKO. 2000. A new species of long-eared bat (*Plecotus*; Vespertilionidae, Mammalia) from Ethiopia. *Myotis*, 38: 5-17.
- KRUSKOP, S.V., and L.A. LAVRENCENKO. 2006. First bat records in the Simien Mountains (Northern Ethiopia). *Russian Journal of Theriology*, 5: 59-62.
- 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: 321-340.
- LARGEN, M.J., D. KOCK, and D.W. YALDEN. 1974. Catalogue of the mammals of Ethiopia. 1. Chiroptera. *Monitore zoologico Italiana*, suppl. 5: 221-298.
- LAVRENCENKO, L.A., S.V. KRUSKOP, and P.N. MOROZOV. 2004. 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: 127-147.
- 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: 261-279.
- LOPES, F.J., and J. CRAWFORD-CABRAL. 1990. Catalogo dos Chiroptera em colecao no centro de Zoologia. *Garcia de Orta*, ser. Zool., 17:1-20.
- LUNDE, D.P., and P. BERESFORD. 1997. Noteworthy records of bats from the Central African Republic. *Bat Research News*, 38: 19-20.
- 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: 535-540.
- MALBRANT, R., and A. MACLATCHY. 1949. Faune de l'Equateur Africain français. II. Mammifères. *Encyclopédie Biologique*, Paris.
- MCLELLAN, L.J. 1986. Notes on bats of Sudan. *American Museum Novitates*, 2839: 1-12.

- MONADJEM A. and J. FAHR 2007. Rapid survey of Bats of North Lorma, Gola and Grebo national forests, with notes on shrews and rodents. Conservation International, Arlington, Virginia.
- MONADJEM, A., P.J. TAYLOR, F.P.D. COTTERILL, and M.C. SCHOEMAN. 2010a. Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis. University of the Witwatersrand, Johannesburg, South Africa.
- 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. 2010b. A recent inventory of the bats of Mozambique with documentation of seven new species to the country. *Acta Chiropterologica* 12: 371-391.
- MONADJEM, A., L. RICHARDS, P.J. TAYLOR, and S. STOFFBERG. 2013. 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: 191-207.
- MONADJEM, A., L. RICHARDS, P.J. TAYLOR, C. DENYS, A. DOWER, S. STOFFBERG. 2016. Diversity of Hipposideridae in the Mount Nimba massif, West Africa, and the taxonomic status of *Hipposideros lamottei*. *Acta Chiropterologica*, 18: 359-375.
- MONARD, A. 1939. Resultats de la mission scientifique du Dr. Monard en Guinee Portugaise, 1937-1938. *Arquivos do Museu Bocage*, 10: 50-80.
- MONTFORT, A. 1992. Première liste commentée des mammifères du Rwanda. *Revue de zoologie africaine*, 106: 141-151.
- NIORT, P.L. 1970. Contribution à la connaissance des chiroptères du Burundi (Afrique Centrale). *Annalen van de Koninklijke Vereniging voor Dierkunde*, 100: 247-274.
- 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: 387-409.
- PETERSON, R.L., and D.A. SMITH. 1973. A new species of *Glauconycteris* (*Vespertilionidae*, *Chiroptera*). *Life Science Occasional Papers - Royal Ontario Museum*, 22: 1-9.
- PHILLIPS, S.J. and M. DUDÍK 2008. Modeling of species distributions with Maxent: new extensions and a comprehensive evaluation. *Ecography*, 31: 161-175.

- PHILLIPS, S.J., R.P. ANDERSON and R.E. SCHAPIRE 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modeling*, 190: 231–259.
- POULET, A.R. 1972. Recherches écologiques sur une savane sahelienne du Ferlo Septentrional, Senegal: Les mammifères. *Terre et la vie: revue d'écologie appliquée*, 26: 440-472.
- QUMSIYEH, M.B., and D.A. SCHLITTER. 1981. Bat records from Mauritania, Africa (Mammalia: Chiroptera). *Annals of the Carnegie Museum*, 50: 345-351.
- ROBBINS, C.B. 1980. Small mammals of Togo and Benin. I. Chiroptera. *Mammalia*, 44: 83-88.
- ROVERO, F., AND D.W. DE LUCA. 2007. Checklist of mammals of the Udzungwa Mountains of Tanzania. *Mammalia*, 47-55.
- 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*, 8: 167-174.
- SCHLITTER, D.A., L.W. ROBBINS, and S.A. BUCHANAN. 1982. Bats of the Central African Republic (Mammalia: Chiroptera). *Annals of the Carnegie Museum*, 51: 133-155.
- SCHOEMAN, M.C., F.P.D. COTTERILL, P.J. TAYLOR, and A. MONADJEM. 2013. Using potential distributions to explore environmental correlates of bat species richness in southern Africa: Effects of model selection and taxonomy. *Current Zoology*, 59: 279-293.
- SCHOUTEDEN, D.H. 1947. De zoogdieren van Belgisch Congo en van Ruanda-Urundi. *Ann. Mus. Congo Belge, Tervuren*, 1: 1–576.
- SEAMARK, E.C.J. and V. VAN CAKENBERGHE. 2012. African Chiroptera Report 2012. African Chiroptera Report, Pretoria. www.africanbats.org.
- STANLEY, W.T. 2009. A new species of *Mops* (Molossidae) from Pemba Island, Tanzania. *Acta Chiropterologica*, 10: 183-192.
- 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: 116-122.

- STANLEY, W.T., and D. KOCK. 2004. New records and notes on *Laephotis* Thomas, 1901 (Chiroptera: Vespertilionidae). *Mammalian biology*, 69: 173-181.
- STANLEY, W.T., J. GUNN AND P.M. KHAULE. 2005a. Results of a preliminary small mammal survey of Malundwe Mountain, Mikumi National Park, Tanzania. *Journal of East African Natural History*, 94: 213-222.
- STANLEY, W.T., A.M. NIKUNDIWE, F.A. MTURI, P.M. KHAULE, and P.D. MOEHLMAN. 2005b. Small mammals collected in the Udzungwa mountains national park, Tanzania. *Journal of East African Natural History*, 94: 203-212.
- 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: 223-230.
- 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: 196-201.
- 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: 274-392.
- THORN, E., D. KOCK, 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: 70-79.
- THORN, E., J. C. KERBIS PETERHANS, and J. BARANGA. 2009. Chiroptera, pp. 12-75. In Thorn, E., and J. C. Kerbis Peterhans, eds., *Small Mammals of Uganda*. *Bonner Zoologische Monographien* 55. Museum Alexander Koenig, Bonn.
- 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.
- VAN CAKENBERGHE, V., F. DE VREE, and H. LEIRS. 1999. On a collection of bats (Chiroptera) from Kikwit, Democratic Republic of the Congo. *Mammalia*, 63: 291-322.

- 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: 533-540.
- 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.
- VERSCHUREN J. 1977. Les chiropteres du Mont Nimba (Liberia). *Mammalia*, 40: 615-632.
- VERSCHUREN, J. 1980. Notes sur les cheiroptères du Burundi. Bulletin - Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie, 52: 2-9.
- VIELLIARD, J. 1974. Les chiroptères du Tchad. *Revue suisse de zoologie*, 81: 975-991.
- 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: 419-448.
- 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.