

BATS OF THE SUDAN

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ABSTRACT

A revision of the species of bats (Chiroptera) occurring in the Republic of the Sudan (the former Anglo-Egyptian Sudan) is presented. Sixty-six species are definitely recognized as occurring within the boundaries of the country, whereas some 38 others are known from nearby areas and may cross its borders. All eight of the widespread Old World families are represented. Most of the Sudan lies within the Ethiopian region but a relatively small area in the north is

best allocated to the arid southwestern Palearctic. The bat fauna is grouped into nine eco-geographical categories (forest, forest-savanna, savanna, east African, desert, savanna-Palearctic, desert-Palearctic, Palearctic, and unclassified), and the Sudanese distribution of the species in each category is summarized. A number of interesting taxonomic problems are discussed, but the final resolution of most of them will involve analysis outside the Sudan.

INTRODUCTION

Setzer (1956) did not mention any species of the order Chiroptera. Sixty-six species are now known, however, from within the borders of the Republic of the Sudan and a number of others may be recorded in the future, particularly from southern and eastern border areas. In the family and generic accounts below, I have tried to identify the more probable of these and to indicate the parts of the Sudan where they are most likely to occur.

More recently, Kock (1969) published a major work on the bats of the Sudan, which is based in large degree on his collections, chiefly in Kordofan Province. Kock has also garnered a great many records from the older literature and critically reviewed a number of taxonomic problems. I have studied most of the specimens that were available to him, but in addition, I have seen and measured a great many more he did not see, particularly those from the southernmost province of Equatoria.

I began my study in 1959 when I was Assistant Curator of Mammals at the Field Museum of Natural History (formerly Chicago Natural History Museum). I am indebted to Mr. Philip Hershkovitz, then chairman of the Division of Mammals, for his assistance in getting me started on the project. More recently, Dr. Joseph Curtis Moore and Dr. Luis de la Torre have made available to me specimens from the Field Museum collection. I have continued the study since joining the staff of the American Museum of Natural History. I thank my colleagues of the Depart-

ment of Mammalogy for all their help. I would like, however, to single out Dr. Guy Musser for his perceptive reading of the manuscript and Ms. Marie Lawrence for her bibliographical assistance. Ms. Frances Stiles prepared the maps.

The only other museums in the United States with any Sudan bat material, to my knowledge, are the National Museum of Natural History in Washington, D.C. and the Museum of Comparative Zoology in Cambridge, Massachusetts.

I thank Drs. David H. Johnson, Henry W. Setzer, Charles O. Handley, Jr., and Ronald H. Pine all of the National Museum of Natural History, Washington, D.C., and Dr. Barbara Lawrence and Charles Mack of the Museum of Comparative Zoology, Cambridge, Massachusetts.

The most important collection of Sudan bats in Europe, if not the world, is at the British Museum (Natural History) in London. The entire staff of the Mammal Section has been extremely helpful, but I want particularly to thank Messrs. R. W. Hayman and John E. Hill and Ms. Jean Ingles. The Sudan bat collection at the Universitets Zoologiske Museum, Copenhagen, was made available to me by Dr. F. W. Braestrup and Mr. Soren Göttke, for which I thank them. For numerous courtesies and for making available the collection of the Senckenberg-Museum, Frankfurt, I thank Dr. Heinz Felten. I am also indebted to Dr. D. Kock for providing stimulating discussion of many taxonomic problems and for other help and to Mr. Otfried Lütt for his assistance.

At the Naturhistorisches Museum, Vienna, a Sudan bat collection was made available by Dr. Kurt Bauer. For that and for other courtesies I thank him.

The following are collections containing small numbers of Sudan bats, together with the people who kindly made them available:

Zoologisches Museum der Humboldt-Universität, Berlin, Drs. H. Hackethal and R. Angermann; Staatliches Museum für Naturkunde, Stuttgart, Dr. F. Dieterlen; Rijksmuseum van Natuurlijke Historie, Leiden, Dr. A. M. Husson; Institut Royal des Sciences Naturelles de Belgique, Brussels, Dr. X. Misonne; Muséum d'Histoire Naturelle, Paris, Dr. F. Petter; Museo Civico de Storia Naturale, Genova, Dr. E. Tortonese. Important comparative material was also studied at the Museo Zoologico dell'Università di Firenze, Italy. Heartly thanks to Drs. Benedetto Lanza and Alberto Simonetta who made the collection available to me and extended many courtesies during my brief stay. I thank Dr. J. S. Owen, formerly of Tanzania National Parks, Arusha, Tanzania, for lending me his useful field notes of an extensive collection divided between the museums of Chicago and Copenhagen. Dr. C. D. Happold of the Department of Zoology, University of Ibadan, Nigeria, gave me valuable information on specimens in the Sudan Natural History Museum, Khartoum, Sudan, and also about his own collections in the British Museum (Natural History). Dr. David Harrison of Sevenoaks, Kent, England, made available specimens from his own private collection of Sudan bats and also provided much stimulating discussion.

All specimens are in the Field Museum unless otherwise indicated; most were collected by Harry Hoogstraal or J. S. Owen. To my knowledge, the only other museums in the United States containing any Sudan bats are the National Museum of Natural History, Smithsonian Institution, Washington, D.C., and the Museum of Comparative Zoology, Cambridge, Massachusetts.

ABBREVIATIONS

AMNH, the American Museum of Natural History, New York

BM, British Museum (Natural History), London

DH, Collection of David Harrison

IRSN, Institut Royal des Sciences Naturelles de Belgique, Brussels

MCZ, Museum of Comparative Zoology, Cambridge

MHNP, Muséum d'Histoire Naturelle, Paris

MNS, Staatliches Museum für Naturkunde, Stuttgart

MSNG, Museo Civico de Storia Naturale, Genova

NMW, Naturhistorisches Museum, Vienna

RML, Rijksmuseum van Natuurlijke Historie, Leiden

SMF, Senckenberg-Museum, Frankfurt

UFMZ, Museo Zoologico dell'Università di Firenze, Italy

USNM, National Museum of Natural History, Washington, D.C.

ZMB, Zoologisches Museum der Humboldt-Universität, Berlin

ZMK, Universitets Zoologiske Museum, Copenhagen

Part of my foreign travel support was provided by a National Science Foundation Grant GB-1391. Additional travel funds were provided by the Council of the Scientific Staff of the American Museum of Natural History to which I am most grateful.

I have organized the systematic section of the present paper with family accounts (under which additional genera that may occur in the Sudan are mentioned), generic accounts (under which additional species possibly occurring in the Sudan are mentioned), and species accounts. Because keys to all genera and most species of African bats were given by Hayman and Hill (1971), my keys are only for a few of the more complex genera. The keys use skull characters, wherever possible, partly because I believe these to be particularly valuable, partly because the keys of Hayman and Hill mainly use external characters. I have not figured any species, but illustrations of many may be found in Rosevear (1965). The species accounts include synonymy, specimens examined, measurements, and remarks. The measurements (in millimeters) invariably include forearm length (tip of olecranon process to distal surface of proximal carpals) and a skull length measurement (condylobasal in the Pteropodidae, Vespertilionidae, and Molossidae; condylocanine in the Rhinopomatidae, Emballonuridae, Nycteridae, Megadermatidae, and Rhinolophidae). Both of these were taken from the posterior sur-

faces of the occipital condyles to the anterior-most portions of the premaxillary bones (condylobasal) or canines (condylocanine). Additional skull and occasionally external measurements are given when these are necessary for distinguishing closely related species. These include maxillary tooth-row length (anterior edge of upper canine alveolus to posterior edge of last upper molar alveolus), interorbital width (least distance in front of postorbital processes), and braincase height (including sagittal crest but not auditory bullae). Where the number of specimens are adequate and significant geographical variation within the Sudan exists, the measurements are broken down geographically.

Both Setzer (1956, pp. 583-585) and Kock (1969, pp. 8-9) have provided gazetteers of Sudan localities, but I have seen or have records for many more not listed by them. I have therefore provided a supplementary gazetteer for these additional localities. Locality records for all species known from the Sudan are also shown on a series of maps. I do not believe that the addition of shading to indicate the probable extent of distribution would contribute anything, at least in the present state of our knowledge of the bats of the Sudan.

The Republic of the Sudan, lying between latitude 4° and 22° N and longitude 22° and 39° E, is the largest nation in Africa (967,500 square miles). Within this extensive area can be found an almost complete spectrum of tropical

African vegetation zones from small patches of lowland rain forest in the southwest and montane forest in the southeast to barren desert in the northwest. The isolated subdesert steppe of northern Kenya also extends into the southeastern corner of the Sudan.

Bats can cross narrow barriers of unfavorable habitat. It is therefore not surprising that I have found few barriers to be of importance to bat distribution in the Sudan. The only really significant barrier is the savanna between the deserts of the north and the extreme southeast, and even this is partly bridged in Ethiopia and Somalia. On the other hand, the extent of the various vegetation zones (see Keay, 1959) is of great importance. As is expected, the lowland forest bat fauna is largest, the desert bat fauna smallest, and the savanna bat fauna intermediate. The montane forest bat fauna also seems small, but is too poorly known and understood, particularly in the Sudan, for this to have much meaning.

The Sudan occupies the northeast corner of the Ethiopian region, and the desert regions of northwest Sudan are best placed in the arid southwestern portion of the Palearctic region (Saharo-Sindean Faunal Region of Ranck, 1968, p. 54). Thus, most bat species in the Sudan are clearly Ethiopian, but there are a few definite Palearctic elements and of course some that are widespread varicants. I have tried to indicate the zoogeographical affinities of the various species that have entered the Sudan.

SYSTEMATICS

ORDER CHIROPTERA

FAMILY PTEROPODIDAE

Of the 12 continental African genera recognized by Andersen (1912a), six (*Eidolon*, *Rousettus*, *Hypsignathus*, *Epomops*, *Epomophorus*, and *Micropteropus*) are known from the Sudan and are discussed in the following species accounts. The only other genus of the Pteropodidae whose range closely approaches the Sudan is *Myonycteris*, the remainder being confined to the main forest belt or to southern Africa. *Myonycteris torquata wroughtoni* (see Hayman and Hill, 1971, p. 13, for this name combination) has been recorded from Garamba National Park

(Verschuren, 1957) in northeastern Zaire and may occur along the southwestern edge of the Sudan.

Eidolon helvum (Kerr)

Vespertilio vampyrus helvus Kerr, 1792, p. 91 (no locality specified; fixed at Senegal by Andersen, 1912a, p. 12).

Pteropus stramineus E. Geoffroy, 1803, p. 48 (no locality specified; Temminck, 1837 [1835-1841], pp. 84-85, was the first to recognize that this name was based on an African bat; most of his description is based on a specimen from Senaar, which I here designate as the type locality).

Pterocyton palaceus Peters, 1862, p. 423 ("Africa"; this is a renaming of Temminck's

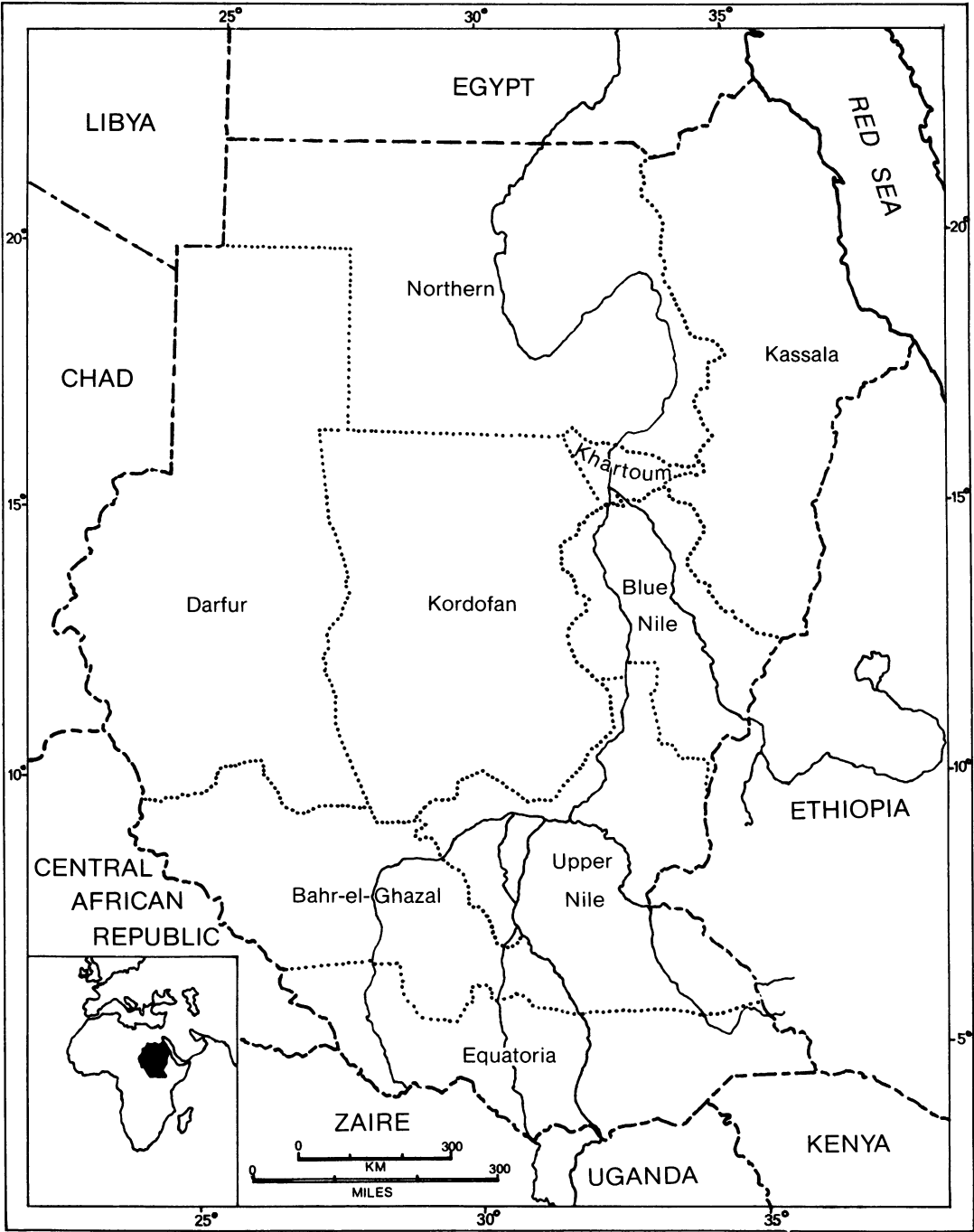


FIG. 1. Political map showing surrounding countries and provinces of the Republic of the Sudan.

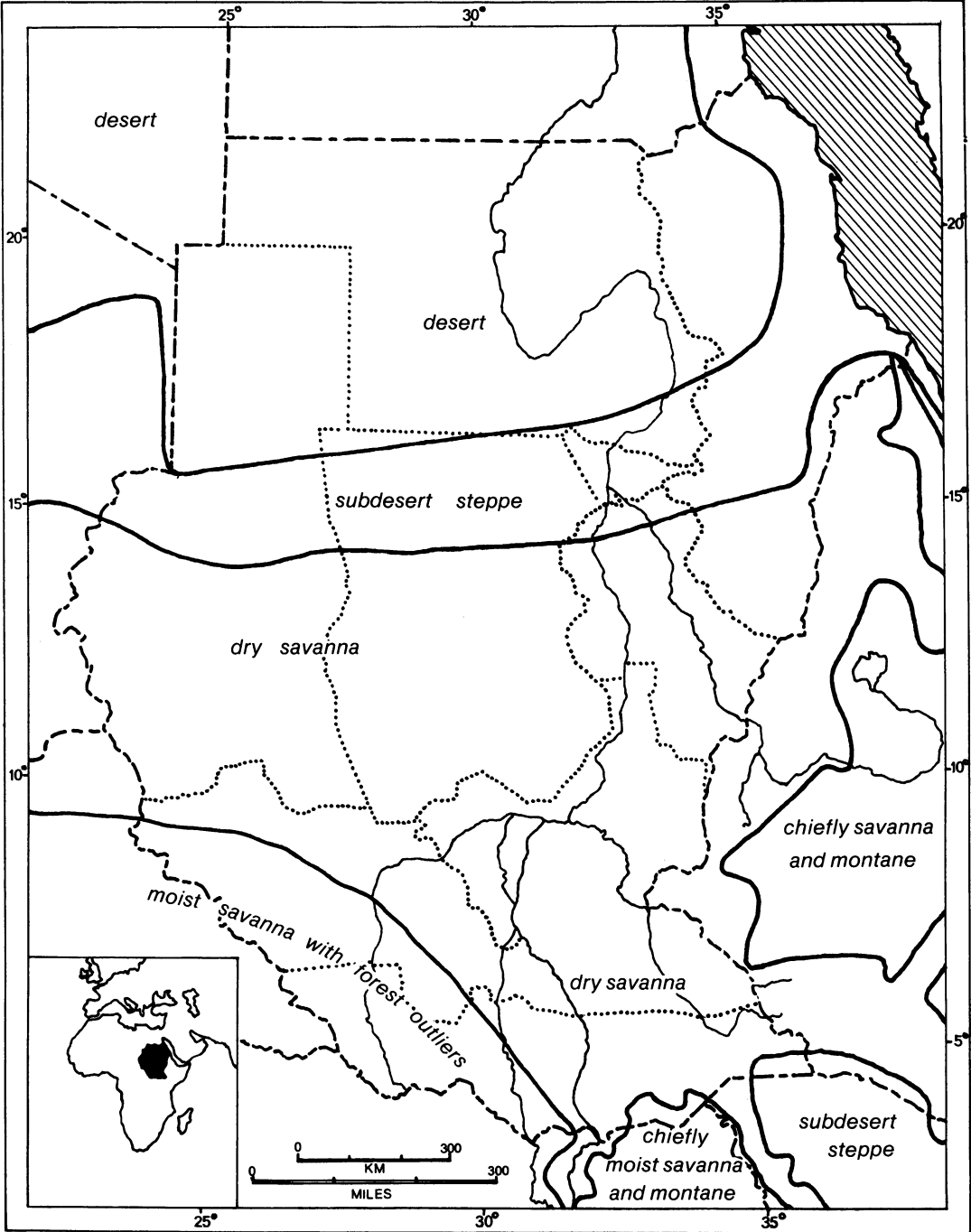


FIG. 2. Simplified vegetation map of the Sudan. Modified from Keay (1959).

stramineus; Matschie [1899] gave Senaar as the type locality).

Pteropus palmarum Heuglin, 1865, p. 34 (not seen; "Middle and upper White Nile and between Senaar and Fazogli along the Blue Nile"; I here designate Senaar as the type locality).

Xantharpyia leucomelas Fitzinger, 1866, p. 544 ("Upper Nile lands"; specimens are mentioned from Senaar, Bahr el Abiad, Bahr el Asrak, and Kordofan; Senaar is the only definite locality mentioned here, the others being rivers or provinces; Andersen, 1912a, listed a specimen in the British Museum from Senaar that came from the same series as the type; Aellen, 1957, listed a specimen in the Strassbourg Museum from Senaar collected by Kotschy, who also collected the type; I therefore fix Senaar as the type locality).

Specimens Examined. 60 from *Equatoria*: Lafon (two skins and skulls in ZMK; 13 in alcohol, one skull extracted); *Bahr-el-Ghazal*: Madâl (four skins and skulls in BM, mentioned by Wroughton, 1911, p. 458); *Upper Nile*: Tonga (seven in alcohol, two skulls only, all in NMW, mentioned in Wettstein, 1918, p. 648), 4 miles north of Malakal (one in alcohol); *Blue Nile*: Senaar (one skin and skull in BM, mentioned by Andersen, 1912a, p. 14, one skin with skull inside in RML), Rosieres (one skin only in BM, mentioned by Wroughton, 1911, p. 458); *Kordofan* (all specimens in SMF, mentioned by Kock, 1969, p. 11): Buram (two skins and skulls, five skulls only), Dilling (one skin and skull, four skulls only, three in alcohol), Kadugli (six skins and skulls, three skulls only), Tossari (one in alcohol); *Khartoum*: Khartoum (one skin and skull, one skull only, one in alcohol, all in BM, in part mentioned by Andersen, 1912a, p. 14).

Measurements. Forearm length, 14 adult males (112-126), 13 adult females (109-126); condylobasal length, seven adult males (51.0-55.2), two adult females (52.8-53.0), three adults unsexed (51.0-53.5).

Other Sudan Records. *Upper Nile*: Duk (Hinton and Kershaw, 1920). Kock (1969, p. 12) listed a number of other records.

Remarks. This is the only species of *Eidolon* as the southwestern Arabian *sabaeum* and the Malagasy *dupreanum* are now considered subspecies of *E. helvum* (Hayman and Hill, 1971, p. 11). All African mainland populations are refer-

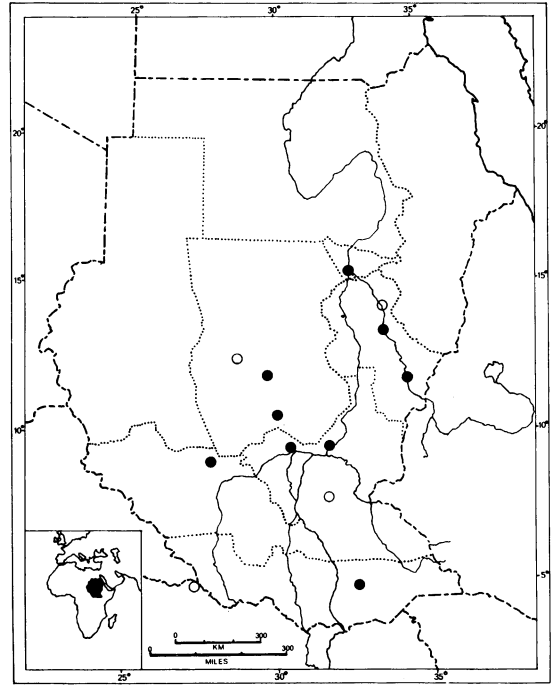


FIG. 3. Distribution of *Eidolon helvum* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

able to *E. h. helvum*, which has a very extensive distribution south of Sahara. It is probably widely distributed in the Ethiopian portion of the Sudan.

ROUSETTUS GRAY

There are three African species of this widespread Old World tropical and subtropical genus. Two are known from the Sudan and are treated below. The third, *R. (Stenonycteris) lanosus*, including *kempi*, *fide* Granvik (1924, p. 9) and Harrison (1961, p. 287), is known from a number of mountainous areas in eastern Africa, including Mt. Elgon (Kenya-Uganda border) and Shoa in Ethiopia; it may therefore occur in the mountains of the southwestern Sudan. The question of the generic allocation of *R. angolensis* is discussed under that species account.

Rousettus aegyptiacus (E. Geoffroy)

Pteropus egyptiacus E. Geoffroy, 1810a. p. 96

(misprint, corrected to *aegyptiacus* by Geoffroy, 1818, p. 134, pl. 3, fig. 2; Giza, Egypt).

Pteropus geoffroyi Temminck, 1827, p. 197 (renaming of *aegyptiacus* Geoffroy; a check of the original description indicates that this is not a new description and must therefore take the type locality of *aegyptiacus*, not Senegal as G. M. Allen, 1939, supposed).

Pteropus leachi A. Smith, 1829, p. 433 (Cape Town, South Africa; valid as a subspecies).

Specimens Examined. 22 from *Equatoria*: Jebel Goumia (21 in alcohol, two skulls extracted), Lokwi (one in alcohol).

Measurements. Forearm length, six adult males (90-98), 14 adult females (91-99); condylobasal length, one adult female (40.2); condylocanine length, one adult female (38.7).

Other Sudan Records. *Equatoria*: Torit (Aellen, 1957).

Remarks. The southern and eastern African subspecies, *R. a. leachi*, to which the above-mentioned specimens are referred, appears to

reach only the southern edge of the Sudan. Most of the republic lies within the great hiatus between the ranges of *R. a. leachi* and the Egyptian and eastern Mediterranean subspecies, *R. a. aegyptiacus*. Along the Nile, the latter is known from no farther south than Aswan in southern Egypt. However, it is to be expected in at least the northeastern Sudan, since Senna (1905, p. 256) recorded it from northern Eritrea (now part of Ethiopia).

Rousettus angolensis (Bocage)

Cynonycteris angolensis Bocage, 1898, p. 33 (Pungo Adongo, latitude 9° 40' S, longitude 15° 40' E, 1200 m., northern Angola).

Rousettus angolensis ruwenzorii Eisentraut, 1965, p. 3 (Ruwenzori East, 5000 feet, Uganda; valid as a subspecies).

Specimens Examined. 31 from *Equatoria*: Sunnat (one skin and skull), Talanga Forest (one skin only, three in alcohol), Lofi (one in alcohol), Lokwi (nine skins and skulls, two in ZMK, 11 in alcohol, three at ZMK), Isore (one skin and skull in ZMK), Logot (four in alcohol at ZMK).

Measurements. Forearm length, 12 adult males (72-82), 11 adult females (70-79); condylobasal length, one adult male (39.3), three adult females (39.0-40.7); condylocanine length, one adult male (37.7), three adult females (37.9-40.0).

Other Sudan Records. These appear to be the first records from the Sudan.

Remarks. This fairly widespread African species reaches only the southern edge of the Sudan, mostly in and around the Imatong Mountains. I follow Rosevear (1965) in regarding *crypticola* and *smithi* as subspecies of *R. angolensis*. Sudanese specimens are probably best referred to *R. a. ruwenzorii* (see Hayman and Hill, 1971, p. 12). Lawrence and Novick (1963) have maintained that *Lissonycteris*, the subgenus of which this species is now the only representative, should be raised to full generic rank and is to be regarded as more closely related to *Myonycteris* than to *Rousettus*. They also take issue with Andersen's (1912a) allocation of *Myonycteris* to the otherwise Indo-Malayan *Cynopterus* group and present a number of morphological and behavioral characters to support their position. I have checked their cranial and dental characters against specimens of *Myonycteris torquata*, *R. (Lissonycteris)*

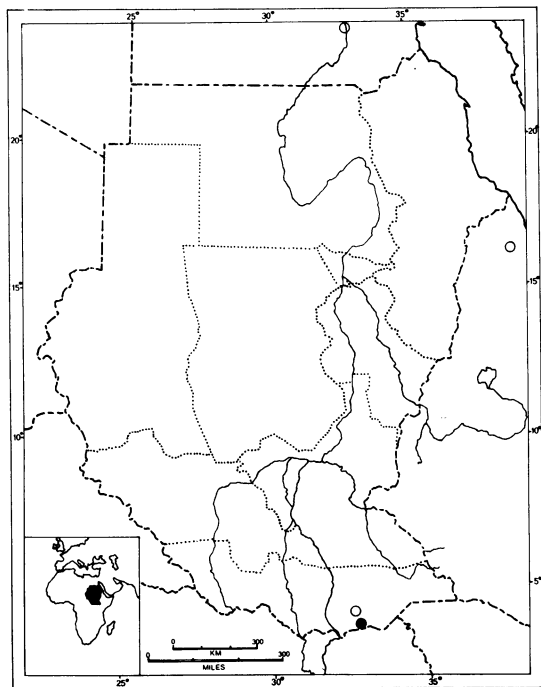


FIG. 4. Distribution of *Rousettus aegyptiacus* in the Sudan. Locality from which specimens have been examined shown solid, other records hollow.

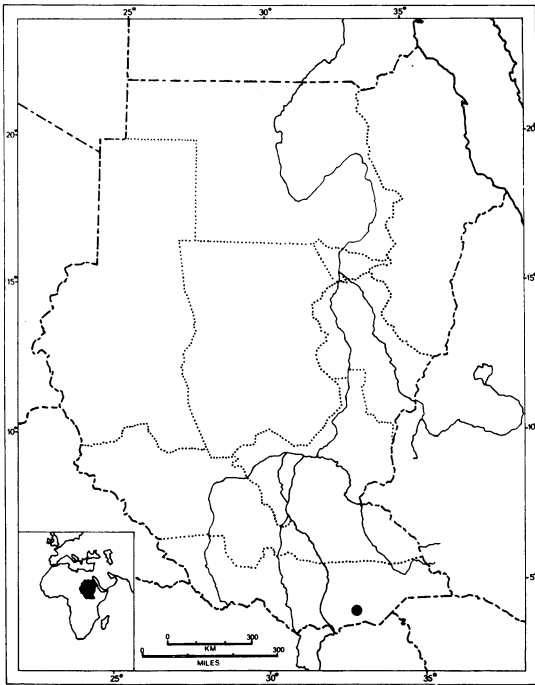


FIG. 5. Distribution of *Rousettus angolensis* in the Sudan.

angolensis, *R. (Stenonycteris) lanosus*, and all the currently recognized species of *R. (Rousettus)*, namely *aegyptiacus*, *leschenaulti*, *amplexicaudatus* (including *stresemanni*), and *celebensis*. I find myself in full agreement with Lawrence and Novick (1963) in believing that there is no close relationship between *Myonycteris* and the *Cynopterus* group. I also believe that Lawrence and Novick have demonstrated a real relationship between *Myonycteris* and *Lissonycteris*. I disagree with them in their denial of a close relationship between *Lissonycteris* and typical *Rousettus*. Of the numerous cranial and dental characters they mentioned by which *Myonycteris* and *Lissonycteris* differ from *Rousettus*, many do not appear to hold when all the species are examined. I regard only the following as reliable: (1) the dish-faced appearance of the interorbital region; (2) the larger orbit (probably functionally related to 1); (3) the orbital rim (probably functionally related to 2); (4) the relatively larger lateral frontal sinuses in relation to the medial ones (probably functionally related to 1). All these

characters may be directly or indirectly related to the larger size of the eye, which in turn may be correlated with the absence of echolocation (present in typical *Rousettus*). Furthermore, in all the above-listed cranial characters, *Lissonycteris* appears to differ less extremely from *Rousettus* than does *Myonycteris*. I am therefore inclined to retain *Lissonycteris* as a distinct subgenus of *Rousettus*. *Myonycteris* may also best be treated as a subgenus of *Rousettus* (thus returning to the arrangement of Miller, 1907), but I have studied too few adult *Myonycteris* to be confident of its generic allocation.

Hypsignathus montrosus H. Allen

Hypsignathus montrosus H. Allen, 1861, p. 157 ("West Africa"; restricted to Gabon by Andersen, 1912a).

Specimens Examined. One in USNM from Equatoria: Li Rangu (skin and skull).

Measurements. The single immature male has a forearm length of 130 mm. and a condylobasal length of 69.4 mm.

Other Sudan Records. None. This appears to be the first record from the Sudan.

Remarks. This widespread forest form, the only species of its genus, evidently only reaches the Sudan along its extreme southwestern edge.

Epomops franqueti Tomes

Epomops franqueti Tomes, 1860, p. 54 (Gabon).

Specimens Examined. None from the Sudan.

Measurements. None from the Sudan. Several series from northwestern Zaire (AMNH) yield the following: forearm length, three adult males (93-102), four adult females (88-93); condylobasal length, two adult males (50.7, 52.0), four adult females (43.7-45.3).

Other Sudan Records. Bahr-el-Ghazal: Rumbek (Kock, 1969, p. 18). The species' occurrence in the Sudan was not unexpected because it was known from both northeastern Zaire and Uganda.

Remarks. *Epomops* is chiefly a forest genus that has clearly entered the Sudan from the southwest. Of the three currently recognized species, only *E. franqueti* occurs anywhere near the Sudan. Sudanese populations are presumably referable to the widespread eastern subspecies, *E. f. franqueti*.

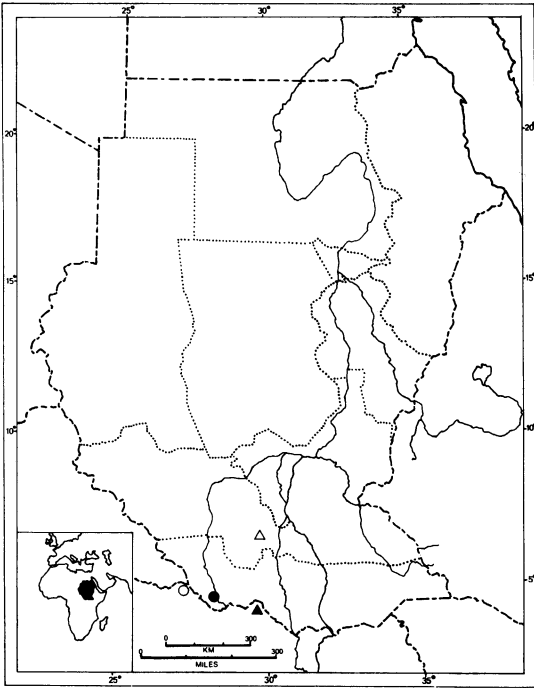


FIG. 6. Distribution of *Hypsignathus monstrosus* (circles) and *Epomops franqueti* (triangles) in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

EPOMOPHORUS BENNETT

Eight species are currently recognized in this widespread tropical African mainland genus.

Three (*angolensis*, *reii*, and *crypturus*) occur in areas well removed from the Sudan to the west or south. I have previously (Koopman, 1966) discussed the possible conspecificity of *crypturus* with more northern *anurus*, but now doubt that this is true. Three of the species (*gambianus*, *anurus*, *labiatus*) are recorded from the Sudan and treated in the following accounts, although I now agree with Kock (1969, p. 18) that *anurus* and *labiatus* are conspecific and that *E. minor* is a separate species, distinct from *E. labiatus*, as is discussed below. *Epomophorus minor* is known from central Kenya (Harrison, 1961, p. 287) and central Ethiopia (Andersen, 1912a, p. 532) and might therefore reach the southwestern Sudan. Of the other two species, *E. pousarguesi* is apparently still known only from the type specimen from central Ubangi Shari (now the Central African Republic). This form, together with its relatives *reii* and *angolensis*, is almost impossible to distinguish from *E. gambianus* unless the palatal ridges have been carefully preserved when the skulls are cleaned. In most museum specimens they have been destroyed in cleaning and can only be reconstructed by the faint traces left on the bone of the hard palate. Actually even the palate ridge differences are subtle, and it is probable that at least *reii* and *pousarguesi* are only variants of *E. gambianus*. The other species that closely approaches the Sudan is *E. wahlbergi*, which has been recorded from Semio in northeastern Zaire (Andersen, 1912a, p. 524) and from Kenya and Uganda (G. M. Allen and Lawrence, 1936, p. 45). It might therefore reach the southern edge of the Sudan.

KEY TO SKULLS OF EPOMOPHORUS EXPECTED IN THE SUDAN

- 1-Single strong transverse palatal ridge between last molars and upturned posterior edge of bony palate (bony support usually evident even if ridge cleaned off); condylobasal length 48-49 (males), 42-43 (females) *wahlbergi*
- 1A-Two weaker transverse parallel palate ridges between last molars and upturned posterior edge of bony palate (bony supports only faintly indicated if ridges cleaned off).
 - 2-Condylobasal length less than 42 (males), 38 (females) *minor*
 - 2A-Condylobasal length 42-48 (males), 39-44 (females) *labiatus*
 - 2B-Condylobasal length over 50 (males), 45 (females).
 - 3-Distance between two postdental palatal ridges about same as between anterior ridge and nearest interdental palatal ridge. *gambianus*
 - 3A-Distance between two postdental palatal ridges clearly less than between anterior ridge and nearest interdental palatal ridge *pousarguesi*

Epomophorus gambianus (Ogilby)

Pteropus gambianus Ogilby, 1835, p. 100 (Gambia).

Specimens Examined. One skin and skull from *Blue Nile*: Senaar (in SMF, mentioned by Andersen, 1912a, p. 540).

Measurements. The single male specimen has a broken forearm and skull, but a maxillary tooth-row length of 19.6. A series from Guidari in southern Chad west of Fort Archambault (AMNH) yields the following: forearm length, one adult male (92), five adult females (76-84); condylobasal length, one adult male (58.3), four adult females (49.2-51.2); maxillary tooth-row length, one adult male (20.0), six adult females (17.5-18.1).

Other Sudan Records. None.

Remarks. Ansell (1960b) described a small southern subspecies of *E. gambianus*. The Senaar specimen is referable to the large typical northern *E. g. gambianus*. Although Andersen (1912a,

p. 540) listed specimens from two localities in southwestern Ethiopia as well as those from Senaar, there are no recently collected specimens from any locality west of the above-mentioned Guidari series, with the exception of a single skull only, a female from Sidamo (140 miles south of Addis Ababa, Ethiopia). This specimen (BM 60.330) has an estimated condylobasal length of 49 and a maxillary tooth-row length of 18.0. Although the specimen has been identified as *E. anurus*, these measurements seem much too large for that species. Much better agreement is shown with the females of the Guidari series of *E. gambianus* and I am therefore inclined to allocate the Sidamo specimen to this larger species. Hill and Morris (1971, p. 29) also recorded a specimen from northwestern Ethiopia which they suspect is a young *gambianus*.

Epomophorus labiatus (Temminck)

Pteropus labiatus Temminck, 1837 [1835-1841], p. 83 (Senaar, Blue Nile, Sudan).

Pteropus schoensis Rüppell, 1842a, p. 131 (Shoa Province, Ethiopia).

Epomophorus anurus Heuglin, 1864, p. 12 (Bongo, Bahr-el-Ghazal, Sudan).

Epomophorus doriae Matschie, 1899, p. 54 (Bogos Country, now in Ethiopia).

Specimens Examined. 100 from *Equatoria*: Torit (12 skins and skulls, one skin only, 29 in alcohol), Ikoto (seven skins and skulls, two in ZMK, four in alcohol, three in ZMK), Imurok (four in alcohol, two in USNM), Kagelu (one skin and skull in AMNH), Opari (one skin and skull, two in alcohol, all in ZMK), Moimoi (one in alcohol in ZMK); *Blue Nile*: Fazogli (two skins and skulls, one in alcohol with extracted skull, all in MCZ and mentioned by G. M. Allen, 1914, p. 344), Rosieres (two in alcohol in BM, see Andersen, 1912a, p. 531), Jebel Maba (one skin and skull in BM, see Wroughton, 1911, p. 458), Senaar (one skin and skull in RML, lectotype of *labiatus*); *Kordofan* (all in SMF): Buram (seven skins and skulls, 15 in alcohol, nine extracted skulls), Kadugli (two in alcohol with extracted skulls); *Bahr-el-Ghazal*: Dad Majok (two skins and skulls in BM, mentioned by Andersen, 1912a, p. 535), Bongo (two skins and skulls, co-types of *anurus*, in MNS); *Kassala*: Telaweit (three in alcohol, two with extracted skulls).

Measurements. Forearm length, 16 adult

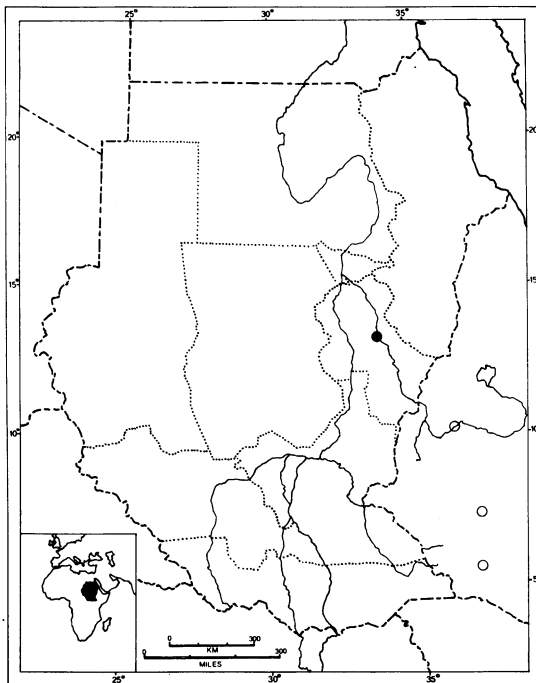


FIG. 7. Distribution of *Epomophorus gambianus* in the Sudan. Locality from which specimens have been examined shown solid, other records hollow.

males (71-75), 33 adult females (62-74); condylobasal length, nine adult males (42.4-47.0), six adult females (38.7-43.8); maxillary tooth-row length, 10 adult males (14.9-16.3), 10 adult females (13.3-15.3).

Other Sudan Records. *Kordofan:* Talodi (D. C. Happold, *in litt.*, informed me of a specimen in the Sudan Natural History Museum). *Darfur:* Zalingei and Fora (Kock, 1969, p. 24).

Remarks: Kock (1969, pp. 18-24) held that *anurus* is a synonym of *E. labiatus* but that *minor* of East Africa is a separate species. G. M. Allen and Lawrence (1936, p. 46) had previously regarded *minor* as a subspecies of *E. labiatus*. There seems no doubt that *anurus* and *minor* are specifically distinct from each other. The problem is in the status of the older name *labiatus*, which is known from few specimens in the region of the type locality. Even of these few, some are of immature individuals, others have badly broken skulls, and sexual dimorphism demands separate comparisons of males and females. After

studying the pattern of variation in the *anurus-labiatus-minor* complex, I am inclined to agree with Kock. I would therefore ally *labiatus* with *anurus* rather than with *minor*, although there is still considerable uncertainty. The relationship between *labiatus* and *minor* should become clearer when the *Epomophorus* of Ethiopia are better known, as this is where intergradation would be expected to occur, if anywhere. As here constituted, *Epomophorus labiatus* occupies most of the Sudan south of the Sahara.

Micropteropus pusillus (Peters)

Epomophorus pusillus Peters, 1868, p. 870 (fixed at Gambia by Andersen, 1912a, not Yoruba, Nigeria, as stated by G. M. Allen, 1939).

Specimens Examined. 54 from *Equatoria:* Torit (17 skins and skulls, six in alcohol), Imurok (five in alcohol), Okaru (one skin and skull, two in alcohol), Katire (two skins and skulls in ZMK,

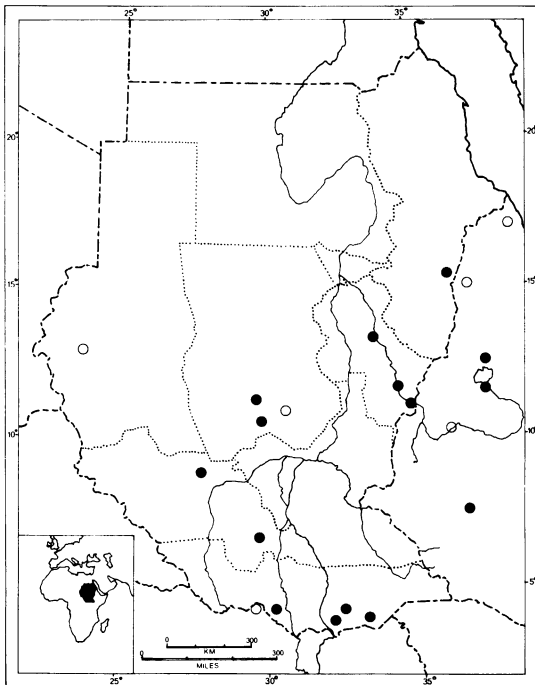


FIG. 8. Distribution of *Epomophorus labiatus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

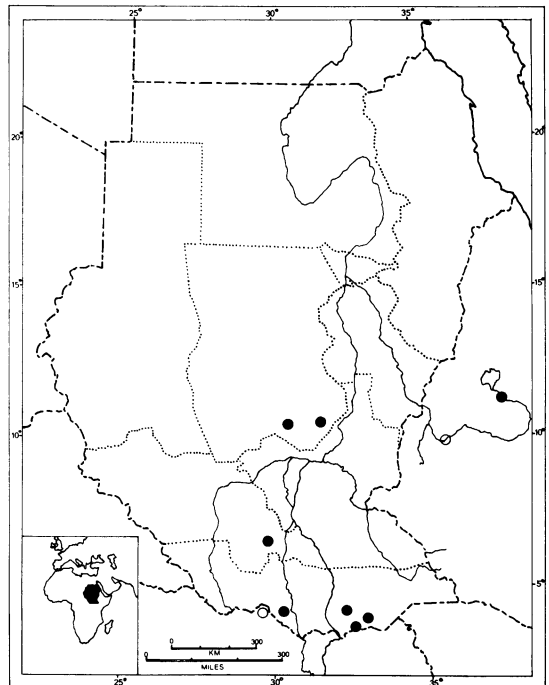


FIG. 9. Distribution of *Micropteropus pusillus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

nine in alcohol), Palwar (one in alcohol), Kagelu (one skin and skull in AMNH), Moimoi (one in alcohol in ZMK); *Bahr-el-Ghazal*: Bongo (one skin and skull in MNS, mentioned by Andersen, 1912a, p. 558); *Kordofan*: Tossari (seven in alcohol, five with extracted skulls, all in SMF and mentioned by Kock, 1969, p. 24), Jebel Kau (one in alcohol in BM).

Measurements: Forearm length, 10 adult males (50-53), 23 adult females (46-55); condylobasal length, seven adult males (28.7-30.7), three adult females (28.0-28.9).

Other Sudan Records: None.

Remarks. Of the three species currently recognized in this genus, only the widespread tropical African *pusillus* occurs anywhere near the Sudan. It has clearly entered the Sudan from the southwest.

RHINOPOMIDAE

RHINOPOMA E. GEOFFROY

The single genus of this southern Asian and northern African family has three species, two of which occur in Africa. These two species, although often confused particularly in northern Africa, are readily distinguished by smaller size, relatively longer tail, and more inflated rostral sinuses of *R. hardwickei* from *R. microphyllum* (see Hoogstraal, 1962; Wassif and Madkour, 1963).

Rhinopoma microphyllum (Brünnich)

Vespertilio microphyllus Brünnich, 1782, p. 50, pl. 6, figs. 1-4 ("Arabia and Egypt"; as Anderson and de Winton, 1902, p. 147, made clear, Brünnich's types were obtained by Hasselquist at Giza, Egypt, to which the type locality may be fixed).

Rhinopoma lepsianum Peters, 1859, p. 222 ("Blue Nile"; Kock, 1969, p. 54, designates ZMB 2578 as the lectotype, although this specimen is labeled "White Nile"; I therefore select Khartoum, the only locality on the Blue Nile and White Nile, as the further restricted type locality).

Rhinopoma microphyllum tropicalis Kock, 1969, p. 58 (Jebel Talao, 2 km. NE Kadugli, 550 m., Kordofan, Sudan; probably valid as a subspecies).

Specimens Examined. 18 from *Blue Nile*:

Arashkool (one skin only in BM); *Kordofan*: no locality (three skins with skulls inside, in BM), 2 km. NE Kadugli (three skins and skulls, including type of *tropicalis*, three in alcohol with extracted skulls, all in SMF); *Khartoum*: Jebel el Azraq (two skins and skulls in DH, one in alcohol in BM), Gebel Auli (two skins and skulls, two in alcohol, all in BM, mentioned by Thomas, 1903b, p. 497); "White Nile" (one skull only in ZMB, lectotype of *lepsianum*).

Measurements. Khartoum, Blue Nile: Forearm length, three adult males (63-65), four adult females (62-69), one adult unsexed (67); tail length, three adult males (57-64), four adult females (51-60); condylocanine length, three adult males (17.6-19.1) two adult females (18.0, 18.1); maxillary tooth-row length, three adult males (6.8-7.6), two adult females (6.8, 6.9).

Kordofan: Forearm length, five adult males (70-72), one adult female (73), two adults unsexed (60, 68); tail length, three adult males (65-73); condylocanine length, five adult males (18.9-19.5), one adult female (19.1); maxillary tooth-row length, five adult males (7.1-7.4), one adult female (7.1).

Other Sudan Records. Blue Nile: Senaar (Aellen, 1957, p. 193).

Remarks. As a result of confusion of this species with *R. hardwickei*, there is considerable doubt as to the identity of many northern African records of *Rhinopoma*. Kock (1969, pp. 41-62) allocated all from localities outside Egypt, Sudan, and Nigeria to *R. hardwickei*. Poulet (1970), however, recorded both species from the same locality in Mauretania. Although my material is not really adequate to confirm the validity of Kock's *R. m. tropicalis*, I am inclined to recognize it. I believe, however, that in the Sudan it should be restricted to Kordofan as otherwise the name *lepsianum*, although apparently based on atypical material, would probably have to be used for it. Kock (1969, p. 58) was aware of the problem, but suggested that the type was mislabeled and actually came from lower Egypt. When populations from Khartoum and Blue Nile provinces become better known, this northern Sudanese area may turn out to be an intergrade area. At the present time, however, I would allocate these northern populations to *R. m. microphyllum*.

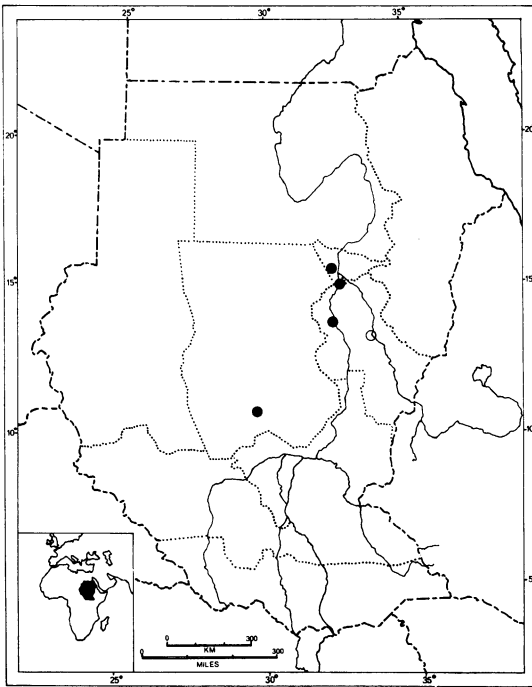


FIG. 10. Distribution of *Rhinopoma microphyllum* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Rhinopoma hardwickei Gray

Rhinopoma hardwickei Gray, 1831, p. 37 (Bengal, India).

Rhinopoma senaariense Fitzinger, 1866, p. 547 [*nomen nudum*; "Senaar and Fazogli (near Rosieres)"; Kock, 1969, p. 35, restricted the type locality to Fazogli, although he stated that the type in the Vienna Museum is marked "Senaar"].

Rhinopoma cordofanicum Heuglin, 1877 (Arashkol Mountains; this locality has been found on the west side of the White Nile at ca. latitude 14° 15' N, Blue Nile Province; valid as a subspecies).

Rhinopoma cystops Thomas, 1903b, p. 496 (Luxor, Egypt; valid as a subspecies).

Rhinopoma cystops macinnesi Hayman, 1937, p. 530 (Bat Island, near Central Island, Lake Rudolf, Kenya; valid as a subspecies).

Rhinopoma microphyllum: De Winton, 1901c, p. 398 (not *microphyllum* Brünnich; specimens from near Shendi).

Specimens Examined. 101 from *Equatoria*: Lokomarinyang (one skin and skull in DH); *Blue Nile*: Senaar (one in alcohol with extracted skull in NMW, type of *senaariensis*); *Kordofan*: Jebel Kau (three in alcohol in BM), Tadoro (four in alcohol with extracted skulls in SMF), Kadugli (two skins and skulls, six in alcohol with extracted skulls, three skulls only, all in SMF), Rheika (three skins in SMF); *Khartoum*: Jebel el Azrak (seven skins and skulls in DH, 11 in alcohol, three with extracted skulls, five in BM), Khartoum (20 in alcohol, one in BM, mentioned by Happold, 1967, 19 in alcohol in SMF, 18 with extracted skulls), Gebel Auli (one skin and skull, three in alcohol, all in BM, mentioned by Thomas, 1903b, p. 497); *Northern*: Shendi (four in alcohol, three in BM, one in USNM, mentioned by De Winton, 1901c, p. 398 and Hollister, 1918, p. 72), Merowe (two skins and skulls in BM, mentioned by Schwann, 1905, p. 1), Dongola (one skull only in ZMB).

Measurements except *Equatoria*: Forearm length, 34 adult males (53-61), 28 adult females (53-61); tail length, 31 adult males (53-78), 28 adult females (57-72); condylocanine length: 22 adult males (14.8-16.5), 22 adult females (14.4-15.9), one adult unsexed (15.6); maxillary tooth-row length, 25 adult males (5.2-6.1), 25 adult females (5.0-5.9), one adult unsexed (5.8).

Equatoria. Forearm length, one adult male (48); tail length, one adult male (61); condylocanine length, one adult male (14.6); maxillary tooth-row length, one adult male (5.6).

Other Sudan Records. None.

Remarks. Kock (1969) has demonstrated that the name *R. h. cystops* should be restricted to Upper Egyptian populations. He also referred single specimens from Air (Niger) and Hoggar (Algeria) to this form, but the material seems inadequate to establish this. All northern and central Sudan material was referred to a subspecies he called *R. h. senaariense*. As indicated above, however, this name is clearly a *nomen nudum* and is therefore not available. The earliest available name is *cordofanicum* Heuglin, 1877, and I therefore call this widespread northern African subspecies *R. h. cordofanicum*. Its southern limit corresponds roughly with the edge of subdesert scrub as shown in Keay's (1959) map, although it certainly penetrates the wooded

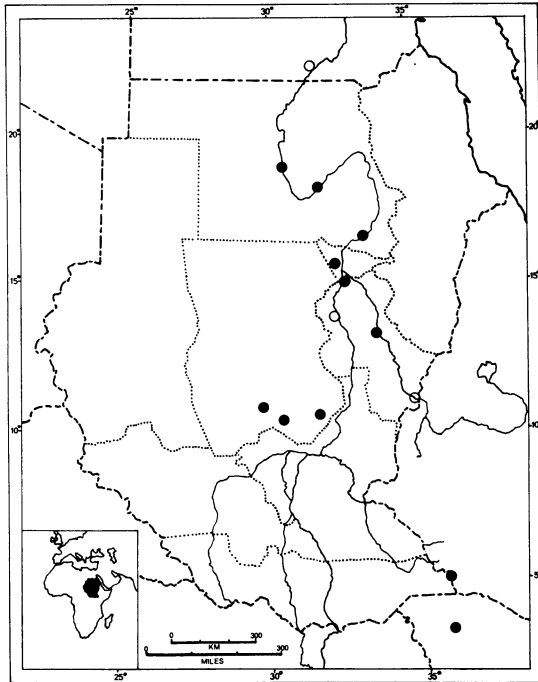


FIG. 11. Distribution of *Rhinopoma hardwickei* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

steppe in some areas. The small (forearm 45-50, condylocanine of five males 13.6-14.6) *R. h. macinnesi* originally appeared to be restricted to an isolated desert and subdesert area in northern Kenya and extreme southeastern Sudan, the Lokomarinyang specimen being referable to this form. Kock, however, has allocated specimens from Assab (northern Ethiopia) and Carim (northern Somalia) to this form, although the latter, judged by two females in the Genoa Museum from Carim, is larger (forearm 50-51, condylocanine 14.7-15.0). The true picture is more complex, however, as the Field Museum of Natural History has four adult specimens from Ali Sabiet (715 m.) in French Somaliland with forearms 56-59. The condylocanine lengths are 16.0 for a male and 15.2-15.5 for two females and therefore agree well with *R. h. cordofanicum*. In any case, however, the connection between *R. h. cordofanicum* and *R. h. macinnesi* probably is through Ethiopia or Somalia rather than directly

through the southern Sudan. In this regard Hill and Morris (1971, p. 30) have recorded what they call *Rhinopoma hardwickei sennaariense* from the dry lowland corridor that divides the Abyssinian plateau in two.

EMBALLONURIDAE

Of the three Old World genera of this pantropical family, only two, *Coleura* and *Taphozous*, occur on the African mainland. Both of these occur in the Sudan, the former having a single African mainland species.

Coleura afra (Peters)

Emballonura afra Peters, 1852, p. 51, pls. 12, 13, figs. 18, 19 (Tete, Mozambique).

Coleura gallarum Thomas, 1915c, p. 577 (Zeila, Somalia; possibly valid as a subspecies).

Coleura gallarum nilosa Thomas, 1915c, p. 577 (mouth of Bahr-el-Zeraf, Upper Nile Province, Sudan; possibly valid as a subspecies).

Specimens Examined. 159 from *Equatoria*: Imurok (six skins and skulls, nine in alcohol), Sunnat (one in alcohol), Katuluru (two in alcohol), Molongori (nine in alcohol), Lowai (one in alcohol), Torit (one skin and skull in AMNH), Kibish Wells (five skins and skulls in DH), Marunga Cave, Nagasi village, near Yambio (two in alcohol); *Upper Nile*: "Bahr el Zeraf" (three skins and skulls, including type of *nilosa*, nine in alcohol, all in BM), Jebel Zeraf (one skin and skull in BM), Tonga (one in alcohol in BM, two in alcohol in NMW, two skulls extracted, one in BM, one in NMW, mentioned by Wettstein, 1918, p. 648); *Blue Nile*: Senaar (one skin with skull inside, one skull only, in RML), Jebelein (four skins and skulls, 28 in alcohol, all in AMNH), Ingessana Hills (one in alcohol in BM), Wisco (one in alcohol in BM); *Kordofan*: Talodi (one in alcohol in NMW, mentioned by Wettstein, 1918, p. 648), Jebel Kau (seven in alcohol in BM), 2 km. NE Kadugli (11 skins and skulls, 12 skulls only, in SMF), Rheika (two skins and skulls, one skull only, one in alcohol, all in SMF); *Kassala*: Suakin (two skins and skulls, one skull only, 15 in alcohol, seven with extracted skulls in SMF, 17 in alcohol in BM, two with extracted skulls, mentioned by Thomas, 1915c, p. 577), Port Sudan (one skin and skull in BM).

Measurements. *Equatoria*: Forearm length, 15

adult males (47-52), 18 adult females (48-53); condylocanine length, five adult males (15.1-15.8), six adult females (15.1-16.1); maxillary tooth-row length, four adult males (6.5-6.8), four adult females (6.6-6.9).

Upper Nile, Kordofan, Blue Nile: Forearm length, 53 adult males (45-51), 73 adult females (40-52); condylocanine length, 16 adult males (14.3-15.7), 20 adult females (14.7-15.5); maxillary tooth-row length, 16 adult males (6.0-6.8), 20 adult females (6.3-7.0).

Kassala: Forearm length, 23 adult males (44-47), 23 adult females (46-49); condylocanine length, eight adult males (14.3-15.2), four adult females (14.7-15.3); maxillary tooth-row length, eight adult males (6.2-6.9), four adult females (6.6-6.9).

Other Sudan Records: *Upper Nile:* Taufikia (Lehmann, 1964); *Blue Nile:* Jebel Moya (Kock, 1969, p. 70).

Remarks. There appears to be a single species of *Coleura* on the mainland of Africa (Koopman, 1965, pp. 4, 5; Rosevear, 1965, p. 145), only the specimens on the Seychelles forming a second species (Hayman and Hill, 1971). Within the eastern part of the range of *C. afra* from Mozambique to northern Sudan, there appears to be a cline from large to small, the type locality of *afra* being from the southern end, those of *gallarum* and *nilosa* toward the northern end. In the northern part of the range there is another type of variation, the pelage being dark in the Nile Valley and light in the arid regions farther east. It is these two patterns of variation that are the basis for recognizing *gallarum* and *nilosa* as distinct from typical *afra*. Specimens from southeastern Equatoria and from Kassala tend to be relatively light in color, although differing in opposite directions from near topotypical *nilosa* in size; it is evident that the two patterns are discordant and the subspecies of rather dubious value. As I regard size as more important than color, I tentatively allocate all Sudan specimens to *C. a. nilosa*, although the specimens from Equatoria certainly tend toward *C. a. afra*. Thomas (1915c, p. 577) apparently allocated Suakin material to *C. a. gallarum* chiefly on the basis of color. Kock (1969, p. 69) had a map showing a different arrangement, but the subspecies are shown with very peculiar ranges.

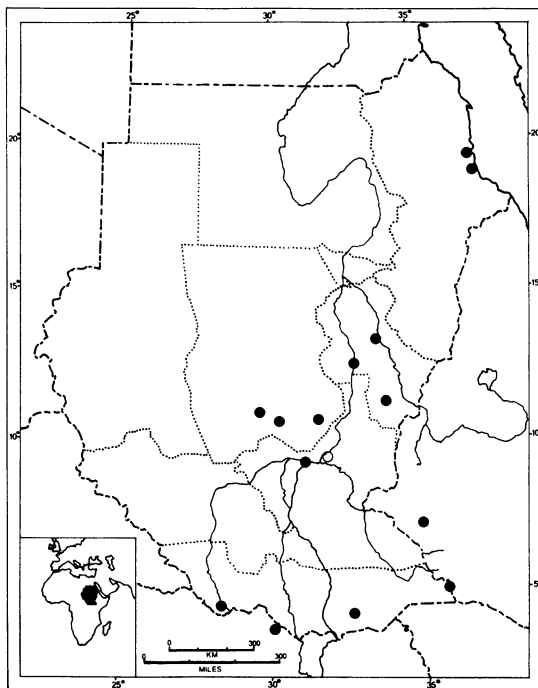


FIG. 12. Distribution of *Coleura afra* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

TAPHOZOUS E. GEOFFROY

This is a widespread Old World tropical genus with apparently six African species. Besides the four valid and one invalid species which are known from the Sudan, three additional species are recognized by G. M. Allen (1939). Of these, *senegalensis* is best regarded as a synonym or subspecies of *T. perforatus*, as Rosevear (1965, p. 151) indicated, because there is nothing in the original description to distinguish *senegalensis* Demarest, 1820, from *perforatus* E. Geoffroy, 1818. *Taphozous (Taphozous) hildegardeae* is a rather well-marked species apparently confined to Kenya. Harrison (1961) recorded this species from Chandler's Falls in central Kenya, so it may reach the southeastern Sudan. The third species, *T. (Saccolaimus) peli*, has been recorded from several localities in northeastern Zaire, including at least two (Niangara, Rungu) in the savanna

belt (Allen, 1917; Koopman, 1965). There are also specimens from Uganda in the National Museum of Natural History and Museum of Com-

parative Zoology. It may therefore reach the southwestern Sudan.

KEY TO *TAPHOZOUS* EXPECTED IN THE SUDAN

(Based mostly on skull characters.)

- 1-Tympanic bulla complete medially and sutured to anterior end of basioccipital *peli*
- 1A-Tympanic bulla incomplete medially and separated from anterior end of basioccipital.
 - 2-Forehead in profile only weakly concave.
 - 3-Condylacanine length 23 or more *nudiventris*
 - 3A-Condylacanine length less than 23 *hamiltoni*
 - 2A-Forehead in profile strongly concave.
 - 4-Underparts (behind neck) white, strongly contrasting with color of upperparts; condylacanine length usually more than 20.
 - 5-Upperparts grizzled dark gray; males with well-developed gular pouch, represented by well-defined bare area in females, no black beard *mauritanus*
 - 5A-Upper parts light brown, no gular pouch or bare area in either sex, black beard in gular area of males *hildegardae*
 - 4A-Underparts almost as dark as upperparts; condylacanine length usually less than 20 *perforatus*

Taphozous (Taphozous) perforatus E. Geoffroy

Taphozous perforatus E. Geoffroy, 1818, p. 126 (Egypt; Geoffroy mentioned two localities where this species was found, Ombos and Thebes, with no indication that specimens from either are typical; Kock, 1969, p. 74, restricted the type locality to Ombos [= Kom Ombo], between Edfu and Aswan).

Taphozous martimus Heuglin, 1877, pp. 25-26 (Suakin, Kassala Province, Sudan).

Taphozous sudani Thomas, 1915b, p. 561 (Mongalla, Equatoria Province, Sudan; probably valid as a subspecies).

Taphozous perforatus haedinus Thomas, 1915d, p. 62 (Chandler Falls, Northern Guaso Nyiro, central Kenya; probably valid as a subspecies).

Specimens Examined. 200 from *Equatoria*: Sunnat (four skins and skulls, one skin only, 20 in alcohol, two with extracted skulls), Lafon (five skins and skulls, one in ZMK, five in alcohol in ZMK), Lawudo (two in alcohol, one with extracted skull), Lofi (three skins and skulls, three in alcohol, one with extracted skull), Mongalla (three skins and skulls, type of *sudani* in alcohol with extracted skull, all in BM), Kibish Wells (seven skins and skulls in DH), Okaru (seven in alcohol), Imurok (five skins and skulls, four in alcohol), Nimule (eight skins and skulls,

two in AMNH, one in ZMK, one skin only in ZMK, 27 in alcohol, three in AMNH, five in ZMK, four with extracted skulls, one in AMNH), Longairo (two skins only in ZMK, three in alcohol, two in ZMK), Katuluru (one in alcohol), Yambio (one in alcohol with extracted skull), Murukuran (two skins and skulls, three in alcohol, all in ZMK), Isoke (two skins and skulls, two in alcohol, all in ZMK); *Bahr-el-Ghazal*: Yirol (three skins and skulls, one in AMNH); *Upper Nile*: Gebel Zeraf (one skin only in BM), Malek (three skins and skulls, one skin only, all in BM), "seven miles north of Bahr-el-Zeraf" (one in alcohol with extracted skull in BM), Khor Attar (two in alcohol with extracted skulls in NMW, mentioned by Sassi, 1908, p. 157); Lake No (one in alcohol with extracted skull in BM, mentioned by Thomas, 1915b, p. 562); *Blue Nile*: Senaar (one skin with skull inside in RML), Jebelein (two skins and skulls, one in alcohol, all in AMNH); *Khartoum*: Khartoum (three skins and skulls, 13 in alcohol, all in BM, mentioned by Thomas, 1915b, p. 562, one in alcohol in MHNP, one skull only in SMF); *Kassala*: Suakin (three in alcohol, one with extracted skull, in BM); *Northem*: Shendi (two skins and skulls, one skin only, two in alcohol, all in BM, one in alcohol in USNM, mentioned by De Winton, 1901c, p. 397,

and Hollister, 1918, p. 73), Kerma (five skins and skulls in BM, mentioned by Schwann, 1905), Nuri pyramids (three skins and skulls, five in alcohol, all in BM), Dongola (three in alcohol in NMW).

Measurements. *Northern and Kassala:* Forearm length, nine adult males (56-65), eight adult females (59-63), two adults unsexed (61, 62); hind foot length, seven adult males (13), seven adult females (12-14); condylocanine length, two adult males (19.1, 19.6), four adult females (5.4-6.0), two adults unsexed (5.5, 5.6); braincase width just behind zygomatic arches, two adult males (9.8, 9.9), three adult females (9.3-9.5), two adults unsexed (9.3, 9.4); width across mastoids, two adult males (10.5, 10.6), four adult females (10.1-10.4), two adults unsexed (10.2); braincase height, two adult males (7.6, 7.8), four adult females (7.3-7.5), two adults unsexed (7.2, 7.7).

Khartoum, Blue Nile, Kordofan, Upper Nile, Bahr-el-Ghazal: Forearm length, 7 adult males (58-66), 22 adult females (60-65), one adult unsexed (62); hind foot length, 18 adult males (12-15), 19 adult females (12-15); condylocanine length, 12 adult males (19.0-20.0), 14 adult females (18.6-19.7); interorbital width, 15 adult males (5.5-6.3), 13 adult females (5.5-5.9); braincase width just behind zygomatic arches, 14 adult males (9.4-10.3), 14 adult females (10.1-11.2); braincase height, 12 adult males (7.6-8.0), 14 adult females (7.0-7.7).

Equatoria: Forearm length, 57 adult males (59-66), 51 adult females (57-65); hind foot length, 29 adult males (11-15), 24 adult females (10-16); condylocanine length, 24 adult males (18.9-20.1), 14 adult females (18.8-19.8); interorbital width, 26 adult males (5.6-6.3), 17 adult females (5.4-6.2); braincase width just behind zygomatic arches, 22 adult males (9.1-10.4), 14 adult females (9.3-10.1); width across mastoids, 25 adult males (10.3-11.1), 14 adult females (10.3-11.1); braincase height, 22 adult males (7.3-7.9), 14 adult females (7.1-7.7).

Other Sudan Records. Kock (1969, p. 82) listed numerous records of this species from the Sudan, most of which have been listed above. The only additional localities that I have mapped are: *Northern:* Old Dongola; *Blue Nile:* Wad Medani; *Upper Nile:* Jebel Achmed Aga.

Remarks. It is still not entirely clear whether one or two species are represented by these speci-

mens. Harrison (1958, 1962, 1964b) held that *sudani* is a species distinct from *T. perforatus*. Rosevear (1965, pp. 151-154) and Kock (1969, pp. 74-82), on the other hand, believed that *sudani* could not be maintained as a separate species. During the earlier part of my study, I was inclined to agree with Harrison, but as I studied more, I came to the conclusion that the two species cannot be maintained on the basis of any character known to me, although it is still possible that two sibling species are represented. At one time several characters (larger feet, more swollen braincase, whitened wing membranes, absence of a gular pouch in males) seemed to distinguish *sudani* from *perforatus*; these have broken down with study of additional specimens. Individuals with *sudani* characters form most of the populations from Khartoum Province south to Bahr-el-Ghazal Province. North of Khartoum, in Northern and Kassala provinces, all specimens are typical of *perforatus*. In Equatoria Province

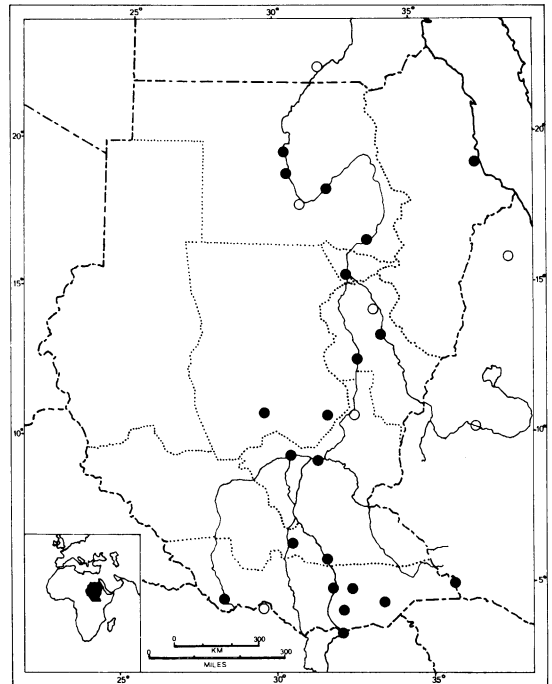


FIG. 13. Distribution of *Taphozous perforatus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

(which includes the type locality of *sudani*), both types, together with intermediates, are encountered. Tentatively, I am inclined to allocate specimens from Northern and Kassala provinces to *T. p. perforatus*, those from the rest of the Sudan to *T. p. sudani*, thus restricting *T. p. haedinus* to East Africa, south of the Sudan border. This subspecific arrangement differs in several respects from that of Kock (1969, pp. 80-82). He tentatively allocated specimens from central Sudan to *T. p. perforatus*, although he agreed that those from south of Shendi are not typical. He also allocated the Suakin material to *T. p. haedinus*, purely on the basis of color, although they seem rather isolated from other populations of that subspecies. Hill and Morris (1971, pp. 31-33), however, allocated specimens from central and northwestern Ethiopia to *T. p. haedinus*. As defined here, the species has a rather wide, albeit spotty, distribution in Africa and southwestern Asia.

Taphozous (Taphozous) mauritanus
E. Geoffroy

Taphozous mauritanus E. Geoffroy, 1818, p. 127 (Island of Mauritius).

Specimens Examined. 26 from *Equatoria*: Ikoto (one skin and skull), Torit (two skins and skulls, one in ZMK, four in alcohol, two in ZMK), Kerripi (two skins and skulls), Mbrianga cave near Yambio (one in alcohol), Opari (two skins and skulls, one in alcohol, all in ZMK), Lirangu (three in alcohol, two in USNM, one with extracted skull), Kagelu (one skin and skull in AMNH), Yei (one in alcohol with extracted skull in SMF), Nzara (two in alcohol, with extracted skulls in SMF); *Upper Nile*: Malakal (two in alcohol), Bahr-el-Zaraf kilometer 189 (one skin and skull in BM); *Kordofan*: Buram (one skin and skull, one skull only, both in SMF); *Darfur*: Kulme (one skin only in BM, mentioned by Thomas and Hinton, 1923, p. 251).

Measurements. Forearm length, five adult males (58-63), 11 adult females (59-65); condylocanine length, four adult males (19.7-20.3), eight adult females (20.3-21.1); maxillary tooth-row length, three adult males (8.0-8.4), eight adult females (8.5-9.1).

Other Sudan Records. Kock (1969, p. 72) has summarized previous records. Those not already

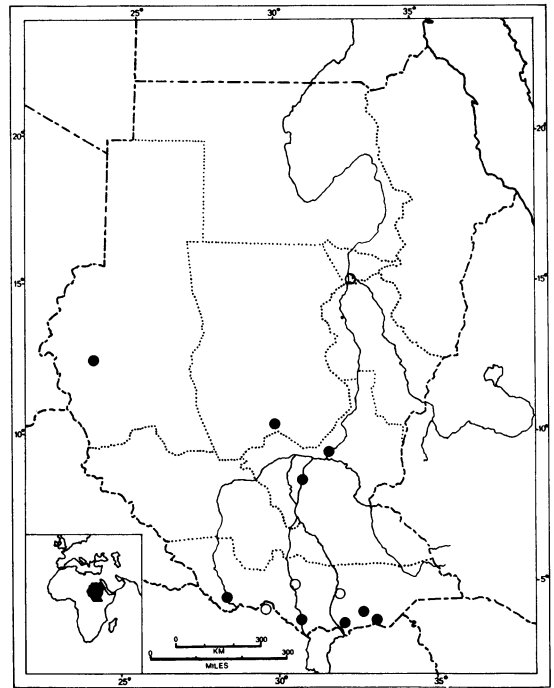


FIG. 14. Distribution of *Taphozous mauritanus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

mentioned are as follows: *Equatoria*: Gondokoro, Mundiri; *Upper Nile*: Abu Doleib, Taufikia; *Khartoum*: Khartoum. The last, an old record, is so far north as to be suspect. If the species formerly occurred there it does not now.

Remarks. *Taphozous mauritanus* contrasts with other species of the subgenus *Taphozous* in Africa in having a definite gular pouch present in both sexes, but more highly developed in males. This is a widely distributed species in tropical and southern Africa, that reaches its northern limits in the Sudan.

Taphozous (Liponycteris) hamiltoni Thomas

Taphozous hamiltoni Thomas, 1920, p. 142 (Mongalla, Equatoria Province, Sudan).

Taphozous nudiventris: St. Leger, 1937, p. 525 (not Cretzschmar; specimen from Kaitherin, Equatoria Province, Sudan).

Specimens Examined. 37 from *Equatoria*:

Lodwara (three in alcohol, one with extracted skull, two skins and skulls in ZMK), Lafon (two skins and skulls, five in alcohol, one in ZMK), Chalamani (four skins and skulls, five in alcohol, one in ZMK), Loqutor (three in alcohol), Okaru (three in alcohol, one with extracted skull), Nimule (two in alcohol, one skull extracted), Mongalla (type skin and skull in BM), Molongori (two skins and skulls, three in alcohol, all in ZMK), Kaitherin (one skin and skull in BM); *Kordofan*: Jebel Kau (one in alcohol in BM).

Measurements. Forearm length, 11 adult males (62-67), 21 adult females (61-68), one adult unsexed (63); condylocanine length, three adult males (21.4-21.6), six adult females (20.1-21.9), one adult unsexed (20.7).

Other Sudan Records. None.

Remarks. When *T. hamiltoni* is keyed out according to the arrangement given by Thomas (1922) it comes out in *Liponycteris* (currently regarded as a subgenus of *Taphozous*, see Ellerman and Morrison-Scott, 1951) near *T. (L.) nudiventris*. It differs from the latter chiefly in size,

but also tends to have a less well-developed helmet and deeper frontal depression. The hairless rump and pygal areas are also less extensive. In general, it appears to be a primitive species of the subgenus *Liponycteris*. It resembles both *T. (L.) nudiventris* and *T. (T.) mauritanus* in having a gular pouch in both sexes, but differs from both in the better relative development of the gular pouch in females. This species has a surprisingly limited known range, almost all specimens being known only from east-central Equatoria Province, Sudan. There is, however, a specimen in the Vienna Museum from Fort Archambault (southern Chad) that may belong to this species. The specimen from Kaitherin, a male, is much too small (forearm 65) to be *T. nudiventris* and agrees much better with *T. hamiltoni*.

Taphozous (Liponycteris) nudiventris
Cretzschmar

Taphozous nudiventris Cretzschmar, 1830 [1826-1830], p. 70, fig. 27b (Giza, Egypt).

Taphozous perforatus var. *assabensis* Monticelli, 1885, pp. 7, 8, pl. 7 (Assab, Eritrea, Ethiopia).

Specimens Examined. 65 from *Equatoria*: Lafon (five skins and skulls), Liwan (one skin and skull in DH), Kibish Wells (one skin and skull in DH), Chalamani (one skin only in ZMK), Murukurun (one in alcohol in ZMK); *Blue Nile*: Wad Medani (two in alcohol, one with extracted skull, one skin only in BM); *Kordofan*: Jebel Kau (five in alcohol in BM); *Khartoum*: Jebel el Azraq (one in alcohol), Jebel Auli (four skins and skulls, 12 in alcohol, all in BM, mentioned by Anderson and De Winton, 1902, p. 142), Sabaloka (four in alcohol in BM), Khartoum (23 in alcohol, 20 with extracted skulls in SMF, four skins and skulls in BM).

Measurements. Forearm length, 35 adult males (68-79), 25 adult females (66-75); condylocanine length, 17 adult males (23.2-25.2), 13 adult females (23.0-24.7).

Other Sudan Records. *Blue Nile*: Senaar (Aellen, 1957, p. 194), Sheikh el Akaba (Kock, 1969, p. 86).

Remarks. This is a widespread species ranging from Senegal to Egypt, Somalia, and Tanzania and on eastward to Malaya, chiefly in the dryer savanna areas. Its distribution in the Sudan is

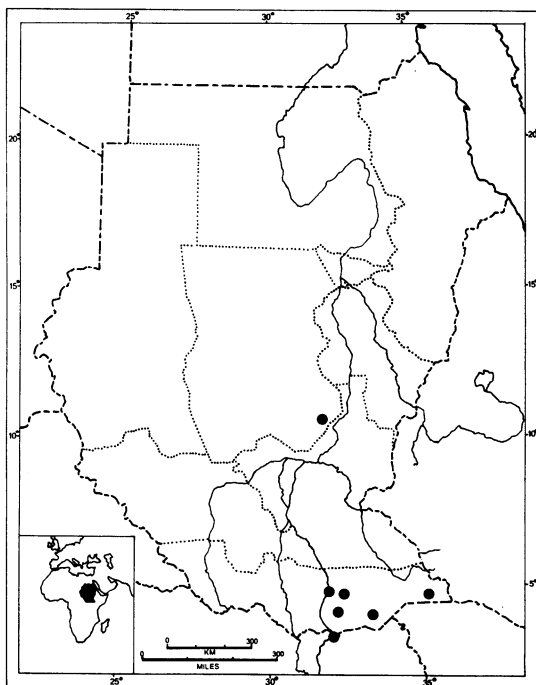


FIG. 15. Distribution of *Taphozous hamiltoni* in the Sudan.

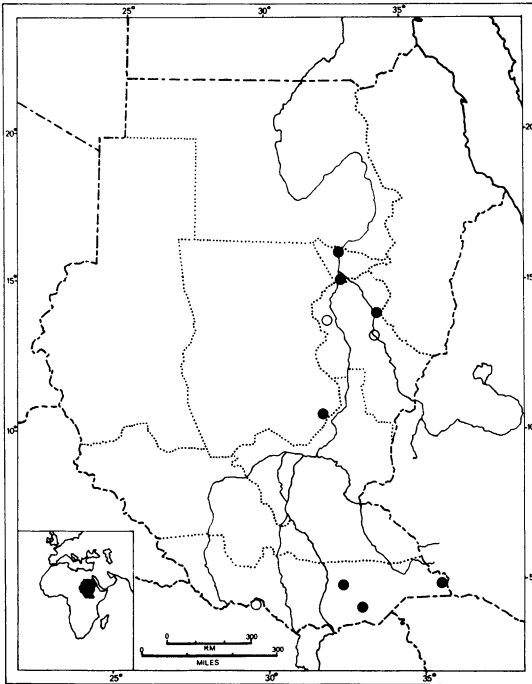


FIG. 16. Distribution of *Taphozous nudiventris* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

probably considerably more extensive than the relatively few records suggest.

NYCTERIDAE

NYCTERIS G. CUVIER AND E. GEOFFROY

This primarily African genus is the only member of its family. All the species, both African and Indomalayan, appear to fall into the four groups set up by Andersen (1912a). This arrangement was modified by Aellen (1959) who split *javanica* off from the remainder of Andersen's *javanica* group on the basis of tricuspid vs. bicuspid upper incisors. I, however cannot see the clear distinction that Aellen saw. All members of the *javanica* group (*sensu* Andersen) have a well-developed inner lobe together with an outer lobe that is often partly divided into middle and outer lobes. There is considerable individual variation, however, and the division is rarely as clear-cut as

in the *hispida* group. I can see no clear difference between *javanica* and the other members of its group in this character and am therefore using the original groups of Andersen, except that since *aethiopica* is, I believe, conspecific with *macrotis*, the latter name should be used for its group. The groups (with included species) may be characterized morphologically, distributionally, and behaviorally as follows:

- N. javanica* group—Posterior lower premolar a functional tooth, its crown rising well above cingula of anterior premolar and first molar. Upper incisors bifid or weakly trifid. Tragus more or less falcate or semilunate. Forested regions of tropical Africa and Indo-Malayan region. Roosts in hollow trees. *Nycteris nana*, *N. arge* (including *intermedia*), *N. major* (including *avakubia*), *N. tragata* (Asian), *N. javanica* (Asian).
- N. hispida* group—Posterior lower premolar reduced, its crown rising scarcely if at all above cingula of adjacent teeth. Upper incisors trifid. Tragus more or less falcate or semilunate. Forest and savanna regions of tropical Africa. Usually roosts in hollow trees (*grandis*) or under bushy vegetation (*hispida*). *Nycteris grandis* (including *marica* and *proxima*), *N. hispida* (including *aurita* and *pallida*).
- N. macrotis* group—Posterior lower premolar greatly reduced, its crown entirely below cingula of adjacent teeth. Upper incisors bifid. Tragus more or less falcate or semilunate. Forest and savanna regions of tropical Africa. Roosting places are usually burrows in the ground often made by porcupines or aardvarks. *Nycteris macrotis* (including *aethiopica*, *luteola*, and *oriana*), *N. parisi* (including *benuensis*), *N. woodi*.
- N. thebiaca* group—Posterior lower premolar greatly reduced, its crown entirely below cingula of adjacent teeth. Upper incisors bifid. Tragus pyriform (lollipop-shaped). Savanna and subdesert regions of Africa and southwestern Asia (*N. madagascariensis* of northern Madagascar apparently also belongs here). Roosts in caves and cave-like structures. Two species, at least on mainland, *N. thebiaca* (including *capensis*, *damarensis*, *gambiensis*, *revouillii*) and *N. vinsoni*. From the original description, I thought that *vinsoni* was a form of *N. macrotis*. However, I have seen the type at the University of Kansas and find that the tragus is pyriform. Kock (1969, pp. 94-97) rejected allocation of *vinsoni* to the *N. the-*

biaca group chiefly on the basis of the size of the last lower premolar. This is a vestigial tooth in both the *macrotis* and *thebiaca* groups, however, and shows considerable variation in size and form. I can see no consistent difference in the size of this tooth between the two groups and reject Kock's allocation of *vinsoni* to *N. macrotis*. *N. vinsoni* is a second mainland species of the *thebiaca* group.

Thus we see parallel trends in lower posterior premolar size, tragus form, macrohabitat, and preferred roosting sites. The picture that emerges is of a genus originally adapted to forest conditions, presumably with a continuous range from western Africa to southeastern Asia, whose original forest habitat was divided by the desiccation of eastern Africa and southwestern Asia. In Africa, however, species evolved that became progressively freed from dependence on trees for roosting sites and presumably other requirements. The genus was able to invade first savanna and eventually subdesert. The most specialized

group (*N. thebiaca*) is now almost completely absent from forest, but has invaded dry areas in northern Africa and southwestern Asia from which the genus is otherwise excluded. In other words, macrohabitats that form barriers to the primitive *javanica* group, are corridors to the specialized *thebiaca* group.

Of the 10 clearly distinct African mainland species listed above, five have been recorded from the Sudan and are treated in the accounts below. Of the remainder *N. woodi* and *N. vinsoni* are confined to southern Africa, whereas *N. major* apparently does not occur north of the main forest block. None are likely to occur in the Sudan. *Nycteris grandis* is recorded from northeastern Zaire (Verschuren, 1957) and may occur along the southwestern edge of the Sudan. The fifth species, *N. parisi*, was described from southwestern Somalia. Rosevear (1965) synonymized *benuensis*, described from northern Cameroon, with it. I have seen no material of either form, but if Rosevear is correct, it is probable that *N. parisi* occurs in the southern Sudan.

KEY TO *NYCTERIS* EXPECTED IN THE SUDAN

(Based mostly on skull characters.)

- 1-Posterior lower premolar a functional tooth, its crown rising well above cingula of anterior premolar and first molar.
 - 2-Condylacanine length less than 15 *nana*
 - 2A-Condylacanine length more than 15 *arge*
- 1A-Posterior lower premolar reduced, its crown rising scarcely, if at all, above cingula of anterior premolar and first molar.
 - 3-Upper incisors trifold.
 - 4-Condylacanine length more than 18 *grandis*
 - 4A-Condylacanine length less than 18 *hispida*
 - 3A-Upper incisors bifid.
 - 5-Tragus more or less semilunate.
 - 6-Condylacanine length less than 17 *parisi*
 - 6A-Condylacanine length more than 17 *macrotis*
 - 5A-Tragus pyriform (lollipop-shaped) *thebiaca*

Nycteris nana (Andersen)

Petalia nana Andersen, 1912b, p. 547 (Benito River, Rio Muni [Spanish Guinea]).

Nycteris nana tristis G. M. Allen and Lawrence, 1936, p. 47 (Kaimosi, Kakamega Dist., Kenya).

Specimens Examined. Two from *Equatoria*: Buluku (one in alcohol in IRSN), Meridi (one in

alcohol in IRSN), both mentioned by Verschuren, 1957, p. 243.

Measurements. Forearm length, one adult male (34), one adult female (33). Six specimens from the Yala River in southwestern Kenya (USNM and BM) yield the following: forearm length, two adult males (35), four adult females (33-35); condylacanine length, two adult males (13.7-13.9), two adult females (13.9).

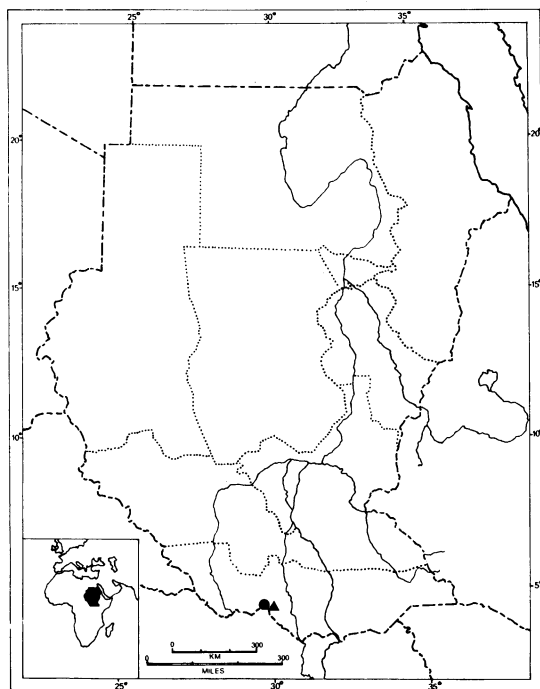


FIG. 17. Distribution of *Nycteris nana* (circle) and *N. arge* (triangle) in the Sudan.

Other Sudan Records. None.

Remarks. This widespread forest species has an extensive range from Ghana to western Kenya, but reaches the Sudan only on its southwestern edge. I follow Rosevear (1965, p. 176) in regarding *tristis* as a synonym.

Nycteris arge Thomas

Nycteris arge Thomas, 1903d, p. 633 (Efulen, Cameroon).

Specimens Examined. One from *Equatoria*: Buluku (immature in alcohol in IRSN, mentioned by Verschuren, 1957, p. 236).

Measurements. Seven specimens from north-eastern Zaire (AMNH) yield the following: forearm length, two adult males (42, 43), five adult females (41-44); condylocanine length, two adult males (16.7, 16.8), four adult females (16.9-17.8).

Other Sudan Records. None.

Remarks: This widespread forest species ex-

tends from Sierra Leone to western Kenya but barely reaches the southwestern Sudan. The specimens from Somalia identified as *arge* by De Beaux (1924) and by Funaioli and Simonetta (1966) are actually *N. macrotis luteola*.

Nycteris hispida (Schreber)

Vespertilio hispidus Schreber, 1774, pp. 169, 188, pl. 56 (Senegal).

Petalia aurita Andersen, 1912b, p. 547 (Kilifi, Kenya; valid as a subspecies, at least).

Nycteris pallida J. A. Allen, 1917, p. 425 (Faradje, Oriental Province, Zaire; possibly valid as a subspecies).

Specimens Examined. 177 from *Equatoria*: Torit (four skins and skulls, nine in alcohol, one with extracted skull, one in alcohol in ZMK), Terangole (three skins and skulls in AMNH, 15 in alcohol in AMNH), Logurun (one in alcohol), Parajok (one skin and skull, one in alcohol), Palwar (one skin and skull, six in alcohol), Kapoeta (three in alcohol, two in USNM), Nimule (six in alcohol in AMNH), Mongalla (two skins and skulls, three skins only, all in ZMK, three in alcohol in NMW, mentioned by Sassi, 1908, p. 157, one in alcohol in BM), Lafon (seven in alcohol in ZMK), Meridi (one in alcohol in IRSN, mentioned by Verschuren, 1957, p. 253); *Bahr-el-Ghazal*: 100 miles north of Wau (five in alcohol), Lake Nyibor (four skins and skulls, 13 in alcohol, all in AMNH), Tonj (one in alcohol in BM); *Upper Nile*: Kongor (six skins and skulls, four in BM, mentioned by Hinton and Kershaw, 1920, pp. 94-95), Bor (two skins and skulls and six in alcohol in USNM, mentioned by Hollister, 1918, p. 74, four in alcohol in FMNH), Tonga (one in alcohol in BM, 13 in alcohol in NMW, mentioned by Wettstein, 1918, p. 650), Khor Attar (one in alcohol with extracted skull in NMW, mentioned by Sassi, 1908, p. 157), Kaka (three skins and skulls, one skin only, two in alcohol, all in BM, mentioned by Thomas, 1901c, p. 274), Lake No (one in alcohol in BM), Renk (two skins and skulls in BM), 40 miles north of Bor (one skin and skull in BM, mentioned by Kershaw, 1924, p. 20), Malek (two skins and skulls in BM, mentioned by Kershaw, 1924, p. 20), Duk Faiwil (one skin and skull in USNM, mentioned by Hinton and Kershaw, 1920, pp. 94-95); *Blue Nile*:

Disa (two skins and skulls, one skin only, all in BM), Subeigh Forest Reserve (three in alcohol with extracted skulls in SMF and mentioned by Kock, 1969); *Kordofan* (all in SMF and mentioned by Kock, 1969): Buram (three skins and skulls, 22 in alcohol, 13 with extracted skulls), Angolo (seven skulls only); *Khartoum*: Khartoum (two in alcohol, one in MNS, one with extracted skull in BM, mentioned by Dobson, 1878, p. 163).

Measurements. Forearm length, 73 adult males (36-42), 77 adult females (36-43); ear length, 78 adult males (16-23), 80 adult females (16-24); condylocanine length, 30 adult males (13.6-14.7), 21 adult females (14.2-15.1); maxillary tooth-row length, 36 adult males (5.1-5.6), 27 adult females (5.3-5.9).

Other Sudan Records. *Upper Nile*: Duk Fadiat (Hinton and Kershaw, 1920, pp. 94-95). D. C. D. Happold (*in litt.*) informed me of the following additional locality represented by specimens in the Sudan Natural History Museum at Khartoum: *Blue Nile*: Wad Medani. He also mentioned a specimen from Khartoum collected in 1921. Kock (1969, pp. 89-90) listed a number of additional records, including one from *Bahr-el-Ghazal* (Meshra er Req), one from *Kordofan* (Dilling), one from *Darfur* (Fora) and one from *Northern* (Dongola), the validity of the latter, however, being dubious.

Remarks. All Sudan specimens are tentatively allocated to *N. h. hispida*, although I have been able to compare them with no material from nearer the type locality than Chad, more than 1500 miles away. If this subspecific identification is correct, there seems little basis for recognizing *pallida* even as a subspecies, as it is indistinguishable from Sudanese material. Braestrup (1935, p. 88) suggested a threefold subspecific division of *N. hispida* in the northern and western portions of its range. The northernmost populations from Senegal to central Sudan were identified as *N. h. hispida*, characterized by large size (as shown by forearm length) and pale coloration. *Nycteris h. martini* was suggested as a possible name for a large dark forest subspecies to the south of the Sudan. A small pale subspecies in northeastern Zaire and southern Sudan was called *N. h. pallida*. However, comparison of material from the northern parts of the range in

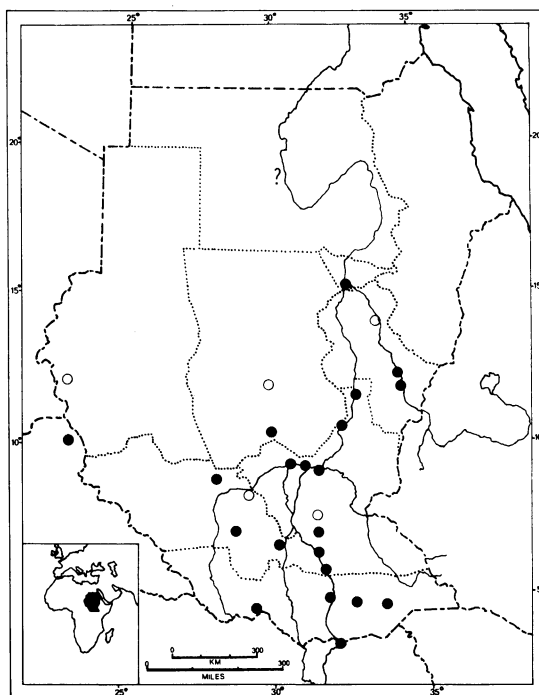


FIG. 18. Distribution of *Nycteris hispida* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

the Sudan, with more southern specimens shows virtually no size difference between the two alleged subspecies in the Sudan.

The problem of the status of *aurita* is of an entirely different nature. This form was described as a full species distinguished by longer ears and larger skull. Subsequently Hollister (1918, p. 74), also Allen and Lawrence (1936, p. 48), reported specimens from the same localities as others identified as *hispida*. On the other hand, Harrison (1957, pp. 24-26) described intergrades between the two forms in southwestern Tanzania and later (1961, p. 288) referred all Kenya material to *N. hispida aurita* remarking that both long- and short-eared forms occurred there, but he doubted that two species were involved.

I have examined a limited amount of material from Kenya and Uganda and have come to the following conclusions. Ear length is difficult to

work with in view of different methods of taking the measurement and possible difference in ear measurements of fresh material and specimens preserved in alcohol. A comparison of skull size as shown by condylocanine lengths, however, shows a definite pattern. The 13 skulls measured from the relatively mesic areas of Uganda and southwestern Kenya (25 miles north of Soroti, Moffat island, southeast slopes of the Ruwenzori, Wasa River, Kaimosi, Nairobi) seem to form a reasonably homogenous series falling within the variability of the Sudan material, although in the upper part of it. Some of these specimens are similar enough to *aurita* to be regarded as intergrades with it. The 15 specimens from the dryer areas of northern and eastern Kenya, however, fall into two well-defined groups. Eleven specimens from Kilifi (including the type of *aurita*), Ngatana, Marsabit Road, Tana River, Galma Galla, Masabubu, and Voi have condylocanine lengths of 15.2-15.9, outside the variability of Sudanese material, and clearly referable to *aurita*. Three other Tana River specimens and another from Ngatana, however (all sympatric with *aurita*), have condylocanine lengths of 13.8-14.5, thus falling well within the range of Sudanese variability, and separated from *aurita* by a pronounced gap. Although the number of specimens is small, it is difficult to escape the conclusion that two taxa coexist in the dry areas of eastern Kenya and act as good species. Analysis of more material is needed to determine if these are indeed two clearly distinct species, presumably exhibiting character displacement in the sympatric area. It is possible that *aurita* reaches the southeastern corner of the Sudan. Of the three specimens from Kapoeta, two are adults and these have ear lengths of 23 (male) and 22 (female), at the upper end of the Sudanese variation. The skulls of both specimens had been extracted, but unfortunately lost before I saw them.

Nycteris macrotis Dobson

Nycteris macrotis Dobson, 1876a, p. 80 (Sierra Leone).

Nycteris aethiopica Dobson, 1878, p. 165 (Kordofan; type was collected by Theodore Kotschy; according to Schweinfurth, 1868, Kotschy proceeded up the Nile to Mandschera,

then inland to El Obeid, which he used as a base for going to nearby mountains; I therefore restrict the type locality to Central Kordofan within a 100-mile radius of El Obeid; obviously it would be desirable to fix the type locality further, but since the only other Kordofan specimen I know of is from considerably further south, I see no safe way of doing so; valid as a subspecies).

Nycteris aethiopica luteola Thomas, 1901b, p. 30 (Ukamba, Kitui district, Kenya; possibly valid as a subspecies).

Nycteris major: J. A. Allen (not Andersen), 1917, p. 427.

Specimens Examined. 43 from *Equatoria*: Torit (two skins and skulls, two in alcohol in ZMK), Loa (three skins and skulls), Latome (one in alcohol), Gondokoro (one skin and skull, one in alcohol, both in USNM—mentioned by Hollister, 1918, p. 74), Lafon (one in alcohol), Mupoi caves near Yambio (one in alcohol); *Blue Nile*: Jebel Tozi (twelve in alcohol, two skulls only, all in BM); *Kordofan*: no locality (three skins and skulls including type of *aethiopica* in BM), Tadoro (one in alcohol with extracted skull in SMF); *Khartoum*: Khartoum (four in alcohol in NMW); *Kassala*: Gallabat (two skins and skulls in NMW); *Northern*: Shendy (two skins and skulls, five in alcohol, all in BM, mentioned by De Winton, 1901c, p. 397).

Measurements. Forearm length, 18 adult males (45-49), 12 adult females (45-51), two adult unsexed (43, 48); tibia length, 20 adult males (19-23), 13 adult females (20-23), four adults unsexed (18-23); hind foot length, 12 adult males (11-15), nine adult females (11-13), two adults unsexed (12, 13); condylocanine length, eight adult males (17.6-18.7), four adult females (17.8-18.4); maxillary tooth-row length, nine adult males (7.1-7.3), seven adult females (7.0-7.3), two adults unsexed (7.0-7.1).

Other Sudan Records. *Northern*: Meroe pyramids (de Winton, 1901c, p. 397); *Blue Nile*: Se-naar (Dobson, 1878, p. 165).

Remarks. Although Hayman and Hill (1971, pp. 18, 19) maintain *aethiopica* as a species distinct from *N. macrotis*, I see no reason to reject the conclusions of Harrison (1961, p. 288), Kulzer (1962, p. 166), and Kock (1969, pp. 93-98) that *macrotis*, *luteola*, and *aethiopica* are conspecific. I am inclined to allocate all Sudanese

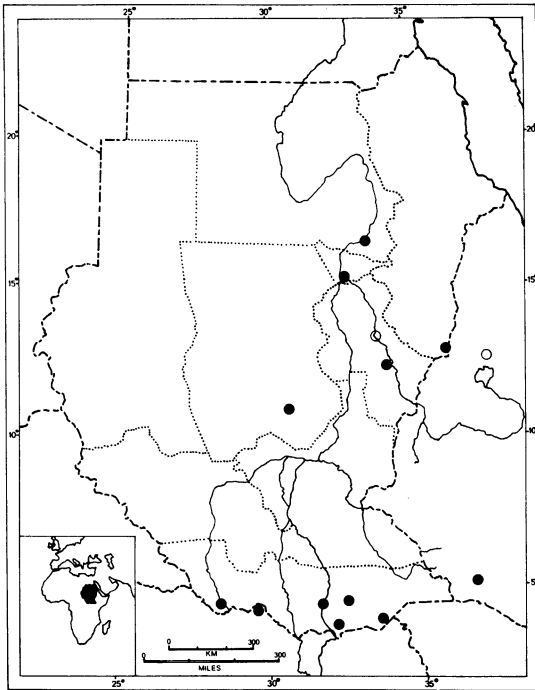


FIG. 19. Distribution of *Nycteris macrotis* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

specimens to the subspecies *aethiopica* following Hollister (1918, p. 74). The subspecies *luteola* was distinguished from *aethiopica* by Thomas largely on the basis of its longer tail, tibia, and foot. Unfortunately tail measurements are not available for northern Sudanese specimens which would appear to be typical *aethiopica*. I have compared tibia and hind foot measurements of northern Sudanese specimens, including the type of *aethiopica*, with the measurements of some 20 specimens from Kenya, including the type of *luteola*. Although there is a slight average difference in tibia and hind foot length between populations of the two regions, there is almost complete overlap, and it seems doubtful that *luteola* can be maintained as a valid subspecies. However, more material from the Sudan with comparable measurements are necessary before anything can be said with certainty. Although Rosevear (1965, p. 182) and, following him, Kock (1969, pp. 91, 98) recorded *N. (macrotis) aethio-*

pica from the former Red Sea Province of north-eastern Sudan, all specimens of *Nycteris* I have seen from that area have been *N. thebiaca* and I suspect that the specimens Rosevear and Kock referred to are the specimens of *N. thebiaca* from Erkovit listed below.

Nycteris thebiaca E. Geoffroy

Nycteris thebiaca E. Geoffroy, 1818, p. 119 (Egypt; on the basis of the name, the type locality can safely be restricted to Thebes, near Luxor; according to Andersen and De Winton, 1902, p. 108, this species had been known, in Egypt, only from the vicinity of Thebes prior to 1900).

Nycteris capensis A. Smith, 1829, p. 434 ("Interior of South Africa"; restricted to Swellenham, Cape Province, by Roberts, 1951, p. 69; valid as a subspecies).

Nycteris albiventer Wagner, 1840, p. 439 ("Nubia"; Wagner stated that the specimens on which this name is based were collected by Rüppell; the original account of the mammals collected by him is Cretschmar in Rüppell 1830 [1826-1830]; in it several bats are described, but no *Nycteris*; in the foreword to the volume, however, a brief description of the expedition is given, from which it is clear that Rüppell did not proceed south of latitude 17° N; his base of operations in Nubia is now the town of Dongola in Northern province to which I restrict the type locality; this is supported by Andersen and De Winton, 1902, p. 108, who mentioned Dongola as one of the two localities in the Upper Nile Valley where *Nycteris thebiaca* certainly occurs; synonym of *N. t. thebiaca*).

Nycteris discolor Wagner, 1840, p. 440 ("Sudspitze von Afrika"; restricted to Knysna, Cape Province, by Roberts, 1951, p. 69; synonym of *N. t. capensis*).

Nycteris labiata Heuglin, 1861, p. 5 (Keren, Bogosland, Eritrea [now part of Ethiopia]; see Moreau, Hopkins, and Hayman, 1946, p. 399; valid as a subspecies).

Nycteris revoilii Robin, 1881, p. 90 ("Somaliland" restricted by Moreau, Hopkins, and Hayman, 1946, p. 399, to Somalia north of latitude 10° N; synonym of *N. t. labiata*).

Petalia damarensis brockmani Andersen, 1912b, p. 548 (Upper Sheikh, British Somaliland [now part of Somalia]; valid as a subspecies, at least).

Petalia damarensis media Andersen, 1912b, p.

548 (Harar, Ethiopia; possibly valid as a subspecies).

Petalia (Nycteris) thebiaca aurantiaca De Beaux, 1923, p. 91 (Archer's Post, Northern Guaso Nyiro, Kenya; synonym of *N. t. labiata*).

Specimens Examined. 63 from *Equatoria*: Torit (12 skins and skulls, five in ZMK, seven in alcohol), 36 miles south of Torit (one skin and skull), Murukurun (one skin and skull), Mura (one skin and skull, three in alcohol), Loa (three skins and skulls, two in ZMK, two in alcohol), Nimule (two skins and skulls, one in AMNH, five in alcohol), Katuluru (three in alcohol), Lobira (one skin and skull in ZMK), Terangole (one in alcohol), Madial (one skin and skull in ZMK), Nagichot (one skin and skull in ZMK), Tungu (one in alcohol in IRSN, mentioned by Verschuren, 1957, p. 280), Luem (one skin and skull in ZMK), Lokwi (three in alcohol), Shukole (one skin and skull, one in alcohol), Lawudo (one in alcohol); *Bahr-el-Ghazal*: Lake Nyibor (one in alcohol in AMNH); *Blue Nile*: Senaar (one in alcohol with extracted skull in NMW); *Kordofan*: Nubbaka (one in alcohol in NMW, mentioned by Wettstein, 1918, p. 650), Jebel Toro (one in alcohol with extracted skull in SMF), no locality (two skins only in SMF); *Kassala*: Erkovit (two skins and skulls, two in alcohol, all in BM), Gallabat (two skins and skulls, in BM).

Measurements. *Erkovit*: Forearm length, four adult females (43-46); condylocanine length, one adult female (17.6); maxillary tooth-row length, two adult females (6.5, 6.7).

All other localities: Forearm length, 29 adult males (39-44), 26 adult females (41-45); condylocanine length, seven adult males (15.7-16.3), five adult females (16.4-16.7), one adult unsexed (16.2); maxillary tooth-row length, fifteen adult males (5.5-6.2), seven adult females (5.6-6.3), two adults unsexed (6.1, 6.2).

Other Sudan Records. *Northern*: Dongola (Andersen and De Winton, 1902, p. 108), Batn el Hadjar (Fitzinger, 1866, p. 547, identified as *N. discolor*). Kock (1969, pp. 102-103) mentioned several other old records, but these are rather vague and add little to the distributional picture.

Remarks. The specimens from Erkovit are indistinguishable from Egyptian material representing *N. t. thebiaca* and the same is presumably also true for the populations at Dongola and

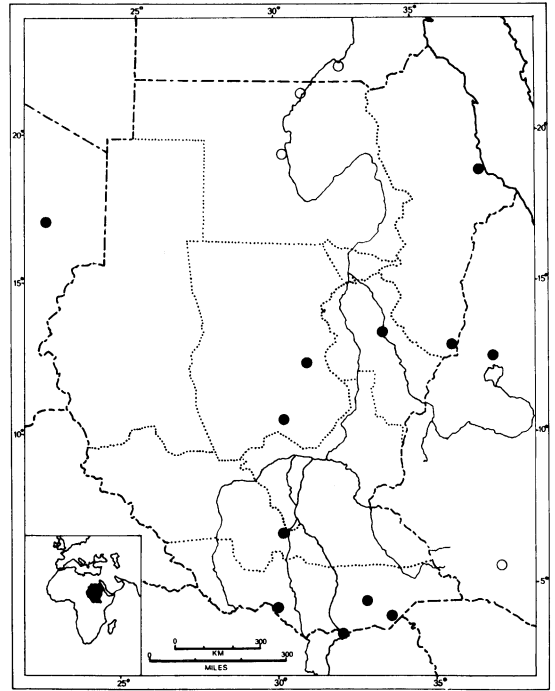


FIG. 20. Distribution of *Nycteris thebiaca* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Batn el Hadjar, and although Kock (1969) considered all Sudanese specimens to be *N. t. thebiaca*, I believe central and southern Sudanese populations are better referred to the smaller *N. t. labiata*, described from northern Ethiopia (Eritrea). The Field Museum of Natural History has a small series from near Asmara, close to the type locality and these are indistinguishable from the small forms of Somalia, Kenya, and southern Sudan to which the names *revoilii* and *aurantiaca* have been applied. Andersen (1912b, p. 550 n) suggested this for *revoilii*, but he did not use the name *labiata* for it, presumably because he had seen no near topotypes. I concur with Allen and Lawrence (1936, p. 49) in regarding this smaller form as a subspecies of *N. thebiaca*, as the differences are slight. In northern Somalia and eastern Ethiopia, a considerably larger form is found, apparently living in the same general regions as *N. t. labiata*. The names *brockmani* and *media* were applied to geographical variants of this larger

form. Actually, although Moreau, Hopkins, and Hayman (1946) restricted the type locality of *revoilii* to extreme northern Somalia, all specimens I have seen from definite localities in that area are of the larger form. All Somali specimens of the smaller form with definite locality data (Lugh, Bugle Acable, El Bur) are from southern Somalia. There is, to my knowledge, no evidence of intergradation between the two types in Somalia or Ethiopia, I, however, am inclined to regard both as subspecies of *N. thebiaca* as *N. t. adana* of southwestern Arabia is intermediate in size between *N. t. brockmani* (probably including *media*) and *N. t. thebiaca*, which occurs farther north in the Arabian peninsula (Harrison 1964a, p. 74). It is evident, however, that the pattern of geographical variation and speciation in the *thebiaca* group is far from clear. Tentatively, Sudanese material is identified as *N. t. thebiaca* (northern) and *N. t. labiata* (central and southern). I agree with Kock (1969, p. 101) that *gambianus* of far western Africa (regarded as a separate species by Hayman and Hill, 1971, p. 19) is only a subspecies of *N. thebiaca* as it is only slightly smaller than *N. t. labiata*. *Nycteris thebiaca gambiensis* is not so different from *N. t. labiata* as *N. t. brockmani* is.

MEGADERMATIDAE

There appear to be only five good species of this Old World tropical family. Two of these are African and both are known from the Sudan. These two species are each in its own genus.

Cardioderma cor (Peters)

Megaderma cor Peters, 1873, p. 194 ("Abyssinia"; although it would be desirable to restrict this rather vague type locality, I have no basis for doing so; Peters does not say who collected the type, and its distribution in Ethiopia is poorly known, although scattered specimens in a number of museums suggest a wide distribution, at least in the lowlands of that country).

Specimens Examined. 33 from *Equatoria*: Lodwara (one skin and skull in ZMK, four in alcohol), Mura (two skins and skulls), Murukurun (two skins and skulls, two in alcohol), Talanga Forest (one in alcohol), Loelli (eight in alcohol),

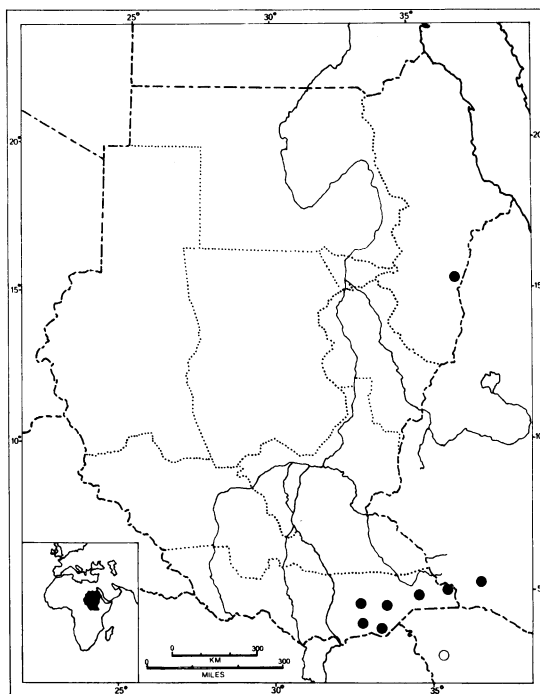


FIG. 21. Distribution of *Cardioderma cor* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Kapoeta (one in alcohol), Torit district (one in alcohol in AMNH), Teretainia (one skin and skull, four in alcohol, all in ZMK), Lobira (one skin and skull, one in alcohol, both in ZMK), Lokomarinyang (two skins and skulls in DH); *Kassala*: Telaweit (one in alcohol).

Measurements. Forearm length, eight adult males (51-55), 14 adult females (53-57); condylocanine length, one adult male (21.3), four adult females (21.5-23.0).

Other Sudan Records. None.

Remarks. *Cardioderma* has a rather restricted distribution from northern Ethiopia and north-eastern Sudan to northern Tanzania. The records from the Sudan are all from near the eastern edge.

Lavia frons (E. Geoffroy)

Megaderma frons E. Geoffroy, 1810b, p. 192 (Senegal).

Lavia rex Miller, 1905, p. 227 (Taveta, Kenya; probably valid as a subspecies).

Lavia frons affinis Andersen and Wroughton, 1907, p. 140 (Kaka, Upper Nile Province, Sudan; probably valid as a subspecies).

Specimens Examined. 178 from *Equatoria*: Meridi (one skin and skull at BM), Torit (four skins and skulls, 38 in alcohol), Sim Sima (two in alcohol at AMNH), Mnyouri Jardin (one skull only at USNM, mentioned by Hollister, 1918, p. 80), Nimule (two in alcohol at USNM, mentioned by Hollister, *ibid.*), Gondokoro (one in alcohol at USNM, mentioned by Hollister, *ibid.*, five in alcohol and one skull only at NMW, mentioned by Sassi, 1908, p. 157), Gemeiza (two in alcohol at USNM), Terraka (one in alcohol in USNM), Tori (two in alcohol at IRSN, mentioned by Verschuren, 1957, p. 288), Kojali (three skins and skulls at BM, mentioned by Wroughton, 1911, p. 458), Mongalla (six skins and skulls, five at BM, mentioned by Wroughton, 1911, p. 457, one at USNM), Yei (one in alcohol at BM); *Bahr-el-Ghazal*: Lake Nyibor (eight in alcohol at AMNH), Shambe (two in alcohol at USNM, mentioned by Hollister, *ibid.*), Abukika (three in alcohol at USNM); *Upper Nile*: White Nile below Lake No (two in alcohol at USNM, mentioned by Hollister, *ibid.*), Renk (two in alcohol at USNM, mentioned by Hollister, *ibid.*), 7 miles south of Kaka (one skin only, three in alcohol, all at USNM, one skin and skull in BM), Umbarbit (four in alcohol at USNM), Akona (four skins and skulls at AMNH), Lake No (one skin and skull at BM), 10 miles south of Renk (one skin and skull, one skin only, both at BM), 8 miles south of Tonga (one in alcohol at BM), Malek (one skin and skull at BM, mentioned by Kershaw, 1924, p. 21), Fashoda (one in alcohol at BM), Duk (one skin and skull in BM, mentioned by Hinton and Kershaw, 1920, p. 95), Jebel Ahmed Agha (one in alcohol at BM); *Blue Nile*: Singa (two skins and skulls in MCZ, mentioned by G. M. Allen, 1914, p. 345, one skin and skull in BM), Abu Zor (one skin and skull in MCZ, mentioned by G. M. Allen, 1914, p. 345), "White Nile district" (five skins only in AMNH), north end Musran Island (eight skins and skulls, eight in alcohol, all at AMNH), Senaar (five skins only, two in BM, three at SMF), Rosieres (two skins and skulls in BM, mentioned by De Winton, 1900, p. 80), Goz Abu Gomer

(three skins and skulls in BM, mentioned by Thomas, 1901c, p. 274), Wad Medani (one skin in BM, mentioned by Thomas, 1903a, p. 295), Abu Haraz (two in alcohol at BM), Kamisa (one skin and skull, three in alcohol, all at BM), Abu Tiga (eight in alcohol with extracted skulls at SMF), El Gueisi (one skin and skull, three in alcohol with extracted skulls, all at SMF), Sabun Reservat (two skins and skulls, one skull only, nine in alcohol with extracted skulls, all at SMF), Ronga (one skin and skull, one in alcohol with extracted skull, both at SMF), Subeigh (one in alcohol with extracted skull at SMF), Karshawal (one in alcohol at NMW, mentioned by Wettstein, 1918, p. 650); *Khartoum*: Khartoum (one skin and skull in BM, mentioned by Andersen and De Winton, 1902, p. 111); *Kassala*: Telaweit (two in alcohol); *Province not determined*: Dula-ba (one in alcohol at USNM).

Measurements. Forearm length, 70 adult males (49-59), 57 adult females (54-61); condy-

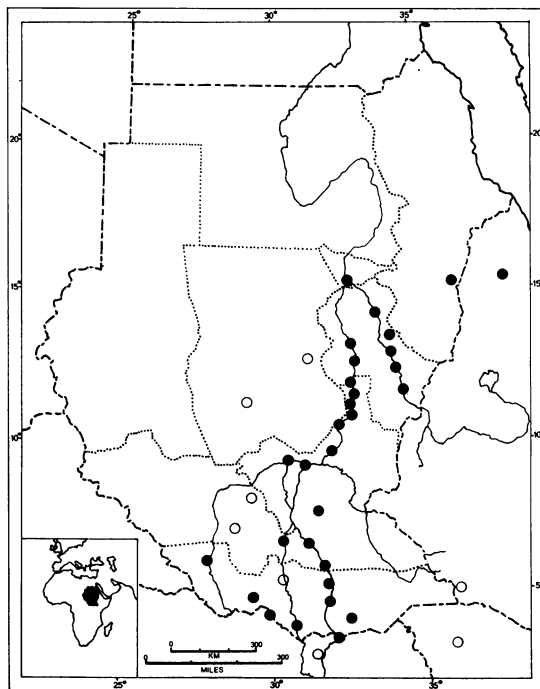


FIG. 22. Distribution of *Lavia frons* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

locanine length, 26 adult males (19.4-21.4), 23 adult females (19.9-22.1), four adults unsexed (20.9-21.9).

Other Sudan Records. Numerous additional records of this common bat from various parts of the Sudan are listed by Kock (1969, pp. 110-111) and there is no need to repeat them here. The only range extensions are to *Kordofan* (including Sherkeila and El Lagowa) and possibly *Northern Province*. Three additional localities in *Bahr-el-Ghazal* (Meshra er Req, Tonj) and *Equatoria* (Amadi) are mapped.

Remarks. I have previously (Koopman, 1965, p. 7) discussed the basic problem of the two eastern African subspecies (*affinis* and *rex*). It is still unclear which the typical *L. f. frons* of Senegal is most like. Pending study of skulls of Senegal specimens, it seems desirable to recognize the two eastern subspecies. On the basis of specimens and published records, the boundary between them probably passes from Lake Victoria to the northern end of Lake Rudolf and on across Ethiopia. Thus all Sudanese material seems referable to *L. f. affinis*.

RHINOLOPHIDAE

I follow Ellerman and Morrison-Scott (1951, p. 109) in merging the Hipposideridae with the Rhinolophidae. So constituted, the family includes five African genera. Three of these occur in the Sudan and are treated below. *Cloeotis*, represented by a single species, ranges from Swaziland and Botswana to southeastern Kenya, but probably does not reach the Sudan. The single mainland species of *Triaenops* on the other hand (*T. persicus*), with a range from Iran to Mozambique, is now known from northwestern Uganda (Hayman and Hill, 1971) and eastern Ethiopia (Hill and Morris, 1971, p. 41) and may reach the southern or eastern edges of the Sudan.

RHINOLOPHUS LACÉPÉDE

This large, widespread Old World genus is represented by some 22 valid species in Africa. The best synopsis of African *Rhinolophus* is by Andersen (1905b), although now out of date. An updated version of Andersen's arrangement with necessary taxonomic additions and corrections,

but retaining Andersen's grouping would be as follows:

R. ferrumequinum group—*simulator* (including *alticolus*), *adami*, *denti*, *swinyi*, *capensis*, *clivosus* (including *acrotis* and *augur*), *ferrumequinum*, *darlingi*, *silvestris*, and *deckeni*
R. pusillus group—*blasii* (including *empusa* and *andreinii*), *landeri* (including *lobatus*, *dobsoni*, and *angolensis*), *alcyone*, *euryale*, and *mehelyi*
R. hipposideros group—*hipposideros*
R. luctus group—*maclaudi*, *ruwenzorii*, and *hilli*
R. macrotis group—*fumigatus* (including *aethiops*), *eloquens*, and *hildebrandti*

Tate (1943) has combined the *luctus* and *macrotis* groups on the basis of their Indo-Malayan members, but the African forms of the two groups seem quite distinct from each other. I have some reservations concerning the desirability of uniting *simulator*, *adami*, *denti*, *swinyi*, and *capensis* on one hand with *clivosus*, *ferrumequinum*, *darlingi*, *silvestris*, and *deckeni* on the other. The first group to me shows greater resemblance to the *pusillus* group and the second to the *macrotis* group than they do to each other. However, any taxonomic decision should be based on a revision of the entire genus, not just the African species. Besides the eight species discussed in the accounts below, most of the *Rhinolophus* of the Ethiopian region (therefore excluding *ferrumequinum*, *euryale*, and *mehelyi* from the above list) are either southern (including southern East) African or else confined to the main forest block. *Rhinolophus blasii* (including *andreinii*, *brockmani*, and *empusa* types of all three forms studied), the only real exception, has two subspecies in Africa south of the Sahara, *R. b. andreinii* (= *brockmani*) in Ethiopia and northern Somalia and *R. b. empusa* from southeastern Zaire to Transvaal. The species may occur along the eastern border of the Sudan. Three species occur in Egypt, two of which are discussed below. The third, which I am inclined to call *R. mehelyi*, following De Blase (1972), is common in lower Egypt, but is not known from upper Egypt and therefore probably does not reach the Sudan. In Africa, *R. ferrumequinum* and *R. euryale* are both confined to the northwestern portion. I have been greatly aided by the unpublished notes of Mr. C. C. Sanborn on this genus.

KEY TO SKULLS OF *RHINOLOPHUS* EXPECTED IN THE SUDAN

- 1-Upper canine and posterior upper premolar clearly separated by small anterior upper premolar which is in line of tooth row.
- 2-Condylacanine length more than 19 *alcyone*
- 2A-Condylacanine length less than 14 *hipposideros*
- 2B-Condylacanine length less than 19 but more than 14.
- 3-Interpterygoid groove deep and clearly defined by bordering ridges; anterior upper premolar usually more or less crowded between canine and posterior premolar so that it is at least as wide as long *simulator*
- 3A-Interpterygoid groove usually shallow, not clearly defined by bordering ridges; anterior upper premolar usually not crowded between canine and posterior premolar so that it is longer than wide (both exceptions apparently never combined).
- 4-Molar width less than half width of palate between molars *landeri*
- 4A-Molar width more than half width of palate between molars *blasii*
- 1A-Upper canine and posterior upper premolar in contact or nearly so, not separated by vestigial anterior upper premolar, which is displaced external to line of tooth row (or sometimes absent).
- 5-Basisphenoid bridge between cochleas much narrower than width of exoccipital at ventromedian end; anterior palatal emargination extending to level of anterior surface of first molar but not appreciably behind it.
- 6-Condylacanine length more than 23.5 *hildebrandti*
- 6A-Condylacanine length less than 23.5 but more than 21 *eloquens*
- 6B-Condylacanine length less than 21 *fumigatus*
- 5A-Basisphenoid bridge between cochleas almost as broad as width of exoccipital at ventromedian end; anterior palatal emargination extending approximately to level of middle of first molar *clivosus*

Rhinolophus clivosus Cretzschmar

Rhinolophus clivosus Cretzschmar, 1830 [1826-1830], p. 47 (Mohila [=Muwailih], north-western Saudi Arabia).

Rhinolophus acrotis Heuglin, 1861, p. 4 (Keren, Eritrea [now part of Ethiopia]; valid as a subspecies).

Rhinolophus andersoni Thomas, 1904b, p. 156 (Eastern desert of Egypt about latitude 22° N and longitude 35° E [=Wadi Alagi, on the present boundary between Egypt and Kassala Province, Sudan]).

Rhinolophus augur Andersen, 1904a, p. 380 (Kuruman, Cape Province, South Africa; valid as a subspecies).

Rhinolophus augur zuluensis Andersen, 1904a, p. 383 (Insuzi, near Eshowe, Zululand, Natal, South Africa; valid as a subspecies).

Rhinolophus augur zambeziensis Andersen, 1904a, p. 383 (Fort Hill, about latitude 9° 40' S, longitude 23° 30' E, northern Nyasaland [now Malawi]; synonym of *R. c. zuluensis*).

Rhinolophus acrotis brachygnathus Andersen, 1905a, p. 73 (Giza, Egypt; valid as a subspecies).

Rhinolophus keniensis Hollister, 1916, p. 2

(Mount Kenia, 7000 feet, Kenya; valid as a subspecies).

Rhinolophus acrotis schwarzi Heim De Balzac, 1934, p. 483 (Djanet, Tassali des Adzjers, about latitude 24° 40' N, longitude 9° 25' E, Algeria; valid as a subspecies).

Specimens Examined. 47 from *Equatoria*: Nagichot (one skin only, one in alcohol with extracted skull), Katire (five skins and skulls, three in ZMK, six in alcohol, two in ZMK, two others with extracted skulls), Lokwi (one skin and skull), Gilo (one skin and skull in ZMK, two in alcohol, one in ZMK), Lotti Forest (one in alcohol with extracted skull); *Kordofan*: Delami (one skin and skull in BM); *Kassala*: Wadi Alagi (five skins and skulls in BM, including type of *andersoni*), Erkowit (one skin and skull, one in alcohol with extracted skull, both in BM); *Northern*: Abd el Quadir (18 skins and skulls, three skeletons, all in NMW, mentioned by Bauer, 1963, p. 497).

Measurements. *Northern*: Forearm length, 18 adult females (43-46); condylacanine length, 20 adult females (16.2-17.2).

Kassala: Forearm length, two adult males (44-45); condylocanine length, two adult males (17.5).

Kordofan: Condylocanine length, one adult male (17.8).

Equatoria, except Lotti Forest: Forearm length, seven adult males (49-51), eight adult females (49-53); tibia length, seven adult males (17-21), nine adult females (18-21); condylocanine length, two adult males (18.2), three adult females (18.3-18.5); zygomatic width, four adult males (10.7-11.1), three adult females (11.0-11.1); interorbital width, three adult males (2.4-2.7), five adult females (2.4-2.5); mastoid width, two adult males (9.7-9.8), three adult females (9.7-9.9); palatal length between emarginations, two adult males (1.8-2.2), three adult females (1.9-2.1); maxillary tooth-row length, two adult males (7.4, 7.5), five adult females (7.3-7.7).

Lotti Forest—one adult male: Forearm length (53); tibia length (22); condylocanine length (20.5); zygomatic width (12.2); interorbital width (2.7); mastoid width (10.4); palatal length between emarginations (3.2); maxillary tooth-row length (8.8); width across last upper molars (8.5).

Other Sudan Records. *Kassala:* Port Sudan (De Beaux, 1931, p. 185).

Remarks. I have previously (Koopman, 1966) discussed the overall taxonomic and distributional patterns in *R. clivosus*. The more detailed picture in and around the Sudan appears to be as follows. Two small subspecies occur in Egypt (Hoogstraal, 1962, pp. 156-157), *R. c. clivosus* of the Eastern desert between the Nile and the Red Sea and *R. c. brachygnathus*, differing chiefly in color, of the Nile Valley. The latter is now known to reach extreme northern Sudan at Abd el Quadir. *Rhinolophus andersoni* was described from immature specimens which, as Andersen (1904b, p. 454) pointed out, are smaller than comparably aged *acrotis* to the south. I have made no direct comparison between *andersoni* and *clivosus*, but the skins of *andersoni* are certainly paler than those of *brachygnathus*. In size, the series of *andersoni* (not included in the above measurements because of immaturity) are smaller than the few typical *clivosus* I have measured (forearm 43-45 vs. 46-51, condylocanine

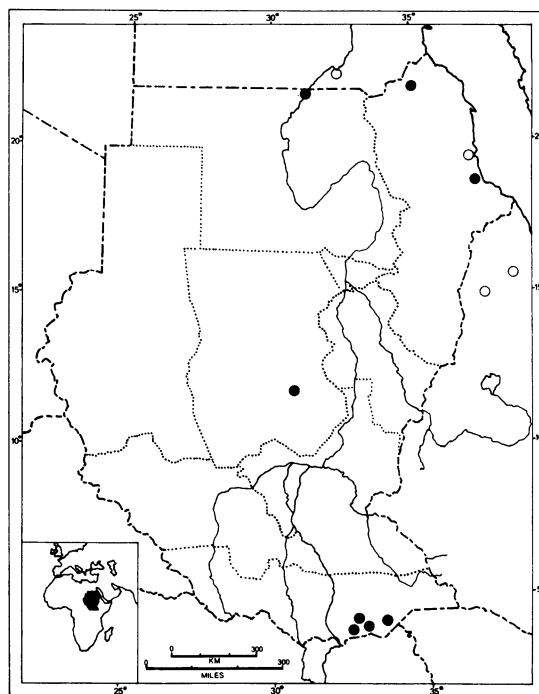


FIG. 23. Distribution of *Rhinolophus clivosus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

16.4-16.9 vs. 17.4-17.8) and agree better with *brachygnathus* (represented by the above tabulated series from Northern province). This, however, would be expected in view of the immaturity of the *andersoni* series. Kock (1969, pp. 113-114) came to the conclusion that *andersoni* is consubspecific with *brachygnathus*, the former unfortunately being the prior name. This decision is based in part, at least, on the presence or absence of the vestigial anterior upper premolar. The occurrence of this functionless tooth in *R. clivosus* is, however, so variable that I don't think any taxonomic significance should be attached to it. Probably *andersoni* is a synonym of *R. c. clivosus*, but in the absence of adults from the region, it seems impossible to say with certainty. *Rhinolophus c. acrotis*, as known in its typical form in northern Ethiopia (including Eritrea), averages larger (condylocanine 17.3-18.2). The two specimens from Erkowit (near the Red Sea)

could be either *clivosus* or small *acrotis* and may be intergrades. They are here tentatively allocated to *R. c. clivosus*. The Delami specimen agrees well with *acrotis* from Ethiopia. In Equatoria Province a more complex picture emerges. All but the Lotti Forest specimen are only a little larger than typical *acrotis* and well within the size range given by Harrison (1964a, p. 84) for specimens from southwestern Arabia referred to *acrotis*. The specimen from Lotti Forest, on the other hand, is far larger than any of the others from Equatoria Province. Of the named forms described from eastern Africa, it agrees best with *keniensis*, although larger than the three specimens I have seen from Mount Kenya (USNM 166352, AMNH 189478, MCZ 16084). These have condylocanine lengths of 19.6 and 19.7. Material I have seen from elsewhere in Kenya and eastern Uganda (Mount Elgon, Cherangani Hills, Mau Mountains, all in south-central Kenya west of Mount Kenya) is smaller than the Mount Kenya specimens, but larger than the *acrotis*-like specimens of Equatoria Province (condylocanine 18.3-19.2). Finally, in southwestern Uganda (Kisolo, Virunga Valley), the specimens are as large as typical *keniensis* (condylocanine 19.1-20.1), although apparently well separated geographically from it, and probably referable to *R. c. zuluensis* which has been recorded from Tanzania and the Kivu Province of Zaire. Tentatively the Lotti Forest specimen may be allocated to *R. c. keniensis* and the remaining specimens from Equatoria to *R. c. acrotis*. Apparently the species is more or less confined to hill and mountain areas wherever it occurs in Kenya or the southern Sudan and each distinct population differs to a greater or lesser extent from every other. I cannot agree with Hayman and Hill (1971, p. 23) in placing *deckeni* and *silvestris* in *R. clivosus*. These two forms seem clearly distinct from *R. clivosus* in showing a greater degree of inflation of the nasal sinus and a narrower basisphenoid bridge (between the periotic bones). In both of these characters, *deckeni* and *silvestris* resemble *darlingi* more than *clivosus*, and all three show some approach to the *fumigatus-eloquens-hildebrandti* complex.

Rhinolophus simulator Andersen

Rhinolophus simulator Andersen, 1904a, p. 384

(Mazoe, Mashonaland, northeastern Rhodesia). *Rhinolophus bembanicus* Senna, 1914, p. 1 (Lake Bangweulu, Zambia).

Specimens Examined. One from Equatoria: Katire (in alcohol with extracted skull).

Measurements. Forearm length, one adult male (43); condylocanine length, one adult male (16.7); maxillary tooth-row length, one adult male (6.2). A series from the southeast slope of Mount Elgon, Kenya has the following range: forearm length (43-45); condylocanine length (16.0-16.5); maxillary tooth-row length (6.2-6.6).

Other Sudan Records. This is the first record from the Sudan, and the Mount Elgon specimens are the first known from Kenya. Because the species was until fairly recently known in eastern Africa no farther north than Tanzania (Aellen, 1957, p. 197), the range is considerably extended. Recently, Hill and Morris (1971, p. 36)

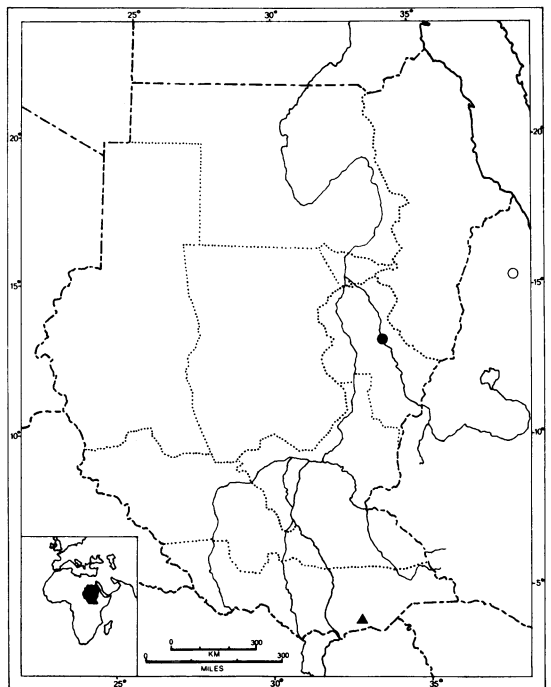


FIG. 24. Distribution of *Rhinolophus simulator* (triangle) and *R. hipposideros* (circles) in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

have also recorded it from south-central Ethiopia.

Remarks. This is basically a southern African species that barely reaches the Sudan where it appears to be restricted to the mountains of the extreme south. *Rhinolophus alticolus* of Cameroon and Nigeria is, however, very similar and, I believe, conspecific. The form reaching the Sudan would be the nominate subspecies, *R. s. simulator*.

Rhinolophus hipposideros (Bechstein)

Vespertilio hipposideros Bechstein, 1800 p. 629 (France).

Rhinolophus minimus Heuglin, 1861, pp. 4-6 (Keren, Eritrea [now in Ethiopia]; valid as a subspecies).

Specimens Examined. One from *Blue Nile*: Senaar (in alcohol at BM, mentioned by Andersen, 1904b, p. 455).

Measurements. Forearm length, one adult female (35); condylocanine length, one adult female (12.7)

Other Sudan Records. None.

Remarks. This is a rather widespread western Palearctic species. The only definite records south of Sinai, besides the two mentioned above, are Awash in central Ethiopia (Hill and Morris, 1971, pp. 35-36) and Taif on the Arabian side of the Red Sea (Harrison, 1964a, p. 86). In spite of the lack of intermediate records, it has probably reached Ethiopia and Senaar by moving along the Red Sea hills. The Sudan record is allocated to *R. h. minimus*.

Rhinolophus alcyone Temminck

Rhinolophus alcyone Temminck, 1853, p. 80 (Boutry River, Ghana).

Specimens Examined. One from *Equatoria*: Buluku (one in alcohol at IRSN), mentioned by Verschuren, 1957, p. 310.

Measurements. Forearm length, one adult male (53). An adult male from Lukolela in the province of Equator, Zaire, in AMNH has a forearm length of 52 and a condylocanine length of 20.9.

Other Sudan Records. None.

Remarks. This is essentially a west African

forest species that barely reaches the Sudan at its northeastern limits.

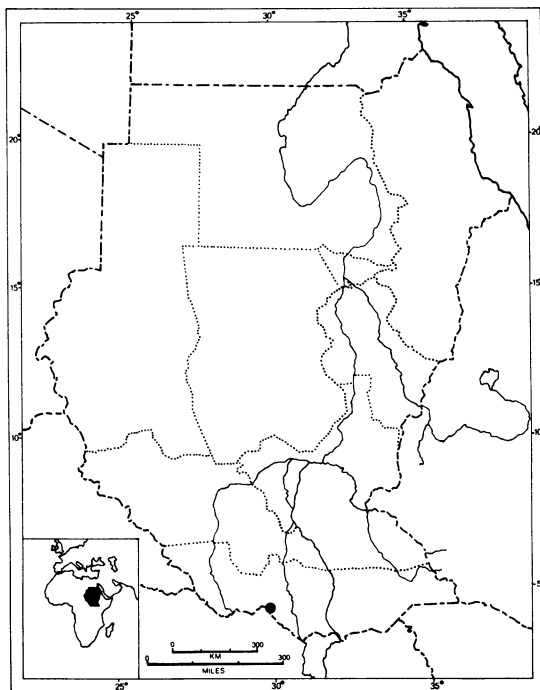


FIG. 25. Distribution of *Rhinolophus alcyone* in the Sudan.

Rhinolophus landeri Martin

Rhinolophus landeri Martin, 1838, p. 101 (Fernando Poo).

Rhinolophus lobatus Peters, 1852, p. 41 (Sena, Mozambique, as restricted by Moreau, Hopkins, and Hayman, 1946, p. 399; valid as a subspecies).

Rhinolophus dobsoni Thomas, 1904b, p. 156n ("Kordofan"; although it would be desirable to restrict this vague type locality, I have no basis for doing so; valid as a subspecies).

Rhinolophus axillaris J. A. Allen, 1917, p. 429 (Aba, Oriental Province, Zaire; synonym of *R. l. lobatus*).

Specimens Examined: 86 from *Equatoria*: Torit (six skins and skulls, one in ZMK, 13 in alcohol, two in ZMK), Nagichot (four skins and skulls, five in alcohol), Katuluru (one in alcohol), Katire (one skin and skull, one in alcohol), Tere-tainia (one in alcohol in ZMK); *Blue Nile*: Abu Zor

(four skins and skulls, 10 in alcohol, all but one skin in MCZ, reported by G. M. Allen, 1914, pp. 345-346), Roseires (two skulls only in BM), Jebel Tozi (one in alcohol at BM); *Kordofan*: no locality (two in alcohol with extracted skulls in BM, types of *dobsoni*), El Lagowa (one skin and skull in SMF), Kadugli (two skins and skulls, five in alcohol with extracted skulls, all in SMF), Jebel Digodo (16 in alcohol, two extracted skulls, in SMF); *Kassala*: Gallabat (nine skins and skulls, seven at BM, two skins only at BM).

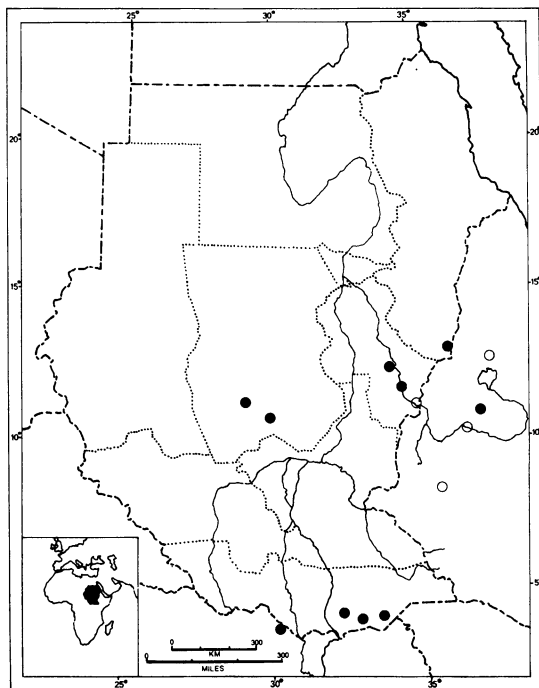


FIG. 26. Distribution of *Rhinolophus landeri* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Measurements. *Kassala, Kordofan, Blue Nile*: Forearm length, 17 adult males (40-46), 37 adult females (41-45); condylocanine length, nine adult males (15.2-15.4), 14 adult females (15.0-16.0)

Equatoria: Forearm length, 13 adult males (41-45), 7 adult females (41-46); condylocanine length, two adult males (15.9, 16.4), two adult females (15.6, 15.8).

Other Sudan Records. Blue Nile: Fazogli (Heuglin, 1877, p. 22).

Remarks. I follow Ellerman, Morrison-Scott, and Hayman (1953, p. 56) in regarding *lobatus* as a subspecies of *R. landeri* and Hayman (1940) in considering *axillaris* as a synonym of *R. l. lobatus*. If so, then *dobsoni*, which is quite similar to *lobatus* (somewhat smaller but with considerable overlap) and allopatric with it, should also be considered a subspecies of *R. landeri*. I am inclined to allocate specimens from Equatoria Province to *R. l. lobatus* and those from Kassala, Kordofan, and Blue Nile provinces to *R. l. dobsoni*. Hill and Morris (1971, p. 35) allocated also specimens from western Ethiopia to *R. l. dobsoni*. Although the known records are inadequate to establish the zone of intergradation, the absence of records of the species from south-central Sudan and its presence in western Ethiopia suggest that the connection is through the Abyssinian highlands rather than along the Nile Valley. Indeed the Kordofan records are also rather isolated from those in Blue Nile and Kassala provinces suggesting that the lowlands along the White Nile may be a barrier. Another form described as being close to *R. landeri* is *brockmani* Thomas. Study of the type specimen, however, reveals that Thomas misinterpreted the noseleaf of the distorted dried skin, and that actually the noseleaf agrees much better with that of *R. blasii* than with that of *R. landeri*. All the skull and tooth characters Thomas used to distinguish *brockmani* from *dobsoni* are actually characters that distinguish *R. blasii* and its subspecies *andreinii* and *empusa* from *R. landeri* and its subspecies. Probably *brockmani* is best considered a synonym of *R. b. andreinii*. I regard the latter as a subspecies of *R. blasii* on the basis of my own examination of the type in Florence, and also on Andersen's (1906b, pp. 191-194) analysis in which it is clear that *andreinii* is both geographically and morphologically intermediate between *blasii* and *empusa*, regarded, correctly, I believe, as conspecific by Ellerman, Morrison-Scott, and Hayman (1953, p. 56). Dorst and Hill (1972) have come to the same conclusion.

Rhinolophus fumigatus Rüppell

Rhinolophus fumigatus Rüppell, 1842a, p. 132 (Shoa Province, Ethiopia).

Rhinolophus aethiops Peters, 1869, p. 637 (Ottjimbingue, Damaraland, Southwest Africa; valid as a subspecies).

Rhinolophus macrocephalus Heuglin, 1877, p. 22 (Adowa, Tegra Province, Ethiopia).

Rhinolophus antinorii Dobson, 1885, p. 16 (Daimbi, Shoa Province, Ethiopia).

Rhinolophus fumigatus exsul Andersen, 1905a, p. 74 (Kitui, Kenya; valid as a subspecies).

Rhinolophus abae J. A. Allen, 1917, p. 428 (Aba, Oriental Province, Zaire; possibly valid as a subspecies).

Rhinolophus acrotis: G. M. Allen, 1914, p. 346 (Specimen from Magangani, Blue Nile Province, Sudan; not *Rhinolophus acrotis* Heuglin, a subspecies of *R. clivosus*).

Specimens Examined. 12 from *Equatoria*: Loquetor (one in alcohol with extracted skull), Lowai (one in alcohol), Lofi (one in alcohol), Lokwi (five in alcohol, one with extracted skull), Birra (one in alcohol in ZMK), Tungu (one in alcohol in IRSN, mentioned by Verschuren,

1957, pp. 298, 299); *Blue Nile*: Magangani (one skin and skull in MCZ, mentioned by G. M. Allen, 1914, p. 346), Roseires (one in alcohol with extracted skull in BM).

Measurements. Except Tungu: Forearm length, four adult males (47-49), four adult females (47-49); condylocanine length, one adult male (18.6), two adult females (18.7-19.0).

Tungu: Forearm length, one adult male (51).

Other Sudan Records. None.

Remarks. I have discussed the allocation of *abae* (Koopman, 1965, p. 8). It may stand as a subspecies distinct from *exsul* on the basis of somewhat larger size (forearm 48-53, condylocanine 18.6-19.6). The Tungu specimen comes from near the type locality of *abae* and has a longer forearm than any other Sudanese specimen of *R. fumigatus* and I therefore agree with Verschuren (*ibid.*) in referring it to *R. f. abae*. All other Sudanese specimens seem referable to the small *R. f. exsul*. The Blue Nile specimens might be expected to be referable to the larger *R. f. fumigatus* on geographical grounds. However, specimens of the latter from northern Ethiopia (including Eritrea) are clearly larger (forearm 51-53, condylocanine 19.6-20.3) than those from the Blue Nile. I discuss the status of *aethiops*, *eloquens*, *diversus*, and *perauritus* (all considered forms of *R. fumigatus* by Hayman and Hill, 1971, p. 22) in the following species account.

Rhinolophus eloquens Andersen

Rhinolophus hildebrandti eloquens Andersen, 1905a, p. 74 (Entebbe, Uganda).

Rhinolophus hildebrandti perauritus De Beaux, 1922a, p. 22 ("Territory of the Rahanuin"; Moreau et al., 1946, p. 399, place this in southern [formerly Italian] Somalia, south of 4° N and between the Juba River and the Webi Shebeli; valid as a subspecies).

Specimens Examined. 47 from *Equatoria*: 36 miles south of Torit (one skin and skull), Torit (nine skins and skulls, one skin only in ZMK, 24 in alcohol, one in USNM, three in ZMK, five with extracted skulls), Nagichot (one skin and skull, four in alcohol), Katire (two skins and skulls in ZMK, one in alcohol), Lowai (one in alcohol), Kapoeta (one in alcohol), Yei (one skin and skull in BM, mentioned by Hinton and Kershaw, 1920,

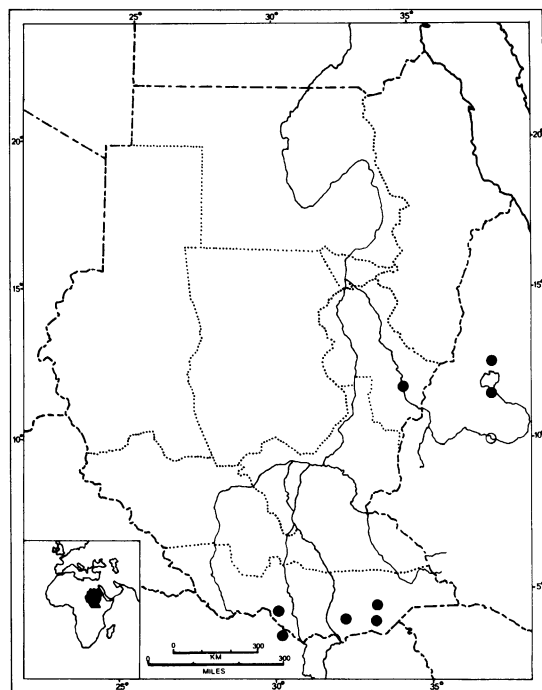


FIG. 27. Distribution of *Rhinolophus fumigatus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

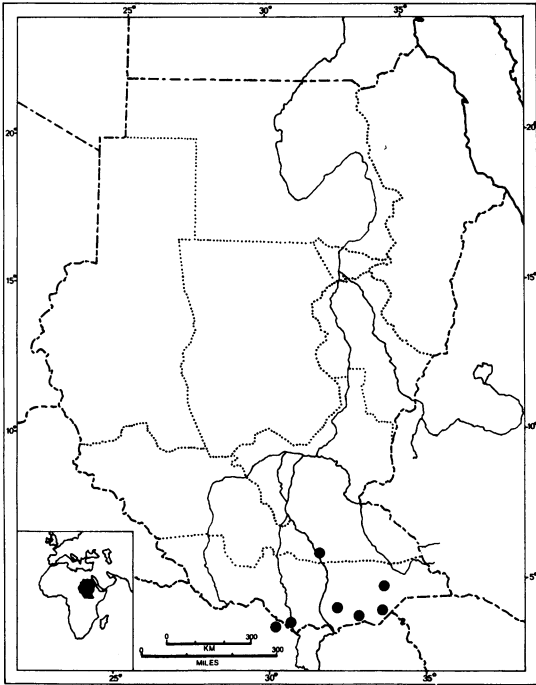


FIG. 28. Distribution of *Rhinolophus eloquens* in the Sudan.

p. 95); *Upper Nile*: Bor district (one skin and skull in BM, mentioned by Kershaw, 1924, p. 21).

Measurements. Forearm length, 11 adult males (55-60), 29 adult females (54-60), one adult unsexed (58); condylocanine length, two adult males (22.5, 22.6), 10 adult females (22.1-23.1), one adult unsexed (22.4); maxillary tooth-row length, four adult males (9.0-9.6), 11 adult females (8.7-9.4), one adult unsexed (9.1).

Other Sudan Records. None.

Remarks. I have discussed this species in relation to the larger *hildebrandti* and the smaller *fumigatus* (Koopman, 1965, pp. 7, 8; 1966, p. 158). Certainly in the southern Sudan, there are three sympatric species distinguished almost entirely by size. However, I now believe that I was in error in associating the East African *eloquens* with the Southwest African *aethiops* (Koopman, 1965, pp. 7-8; 1966, p. 158). After study of the extensive material at the British Museum, it is evident that *eloquens* does not occur south of northern Tanzania and is well separated geographically from *aethiops*. The latter form, al-

though closer in size to *eloquens* actually intergrades with *fumigatus* in Angola and to some extent in Zambia. *Rhinolophus fumigatus* therefore appears to demonstrate character displacement, being most distinct from *R. eloquens* where it occurs with it in East Africa (*R. f. exsul*) and least distinct outside the range of *eloquens* in northern Ethiopia (*R. f. fumigatus*), northwestern tropical Africa (*R. f. foxi* and *R. f. diversus*) and southwestern Africa (*R. f. aethiops*). I have seen the type and three other specimens of *perauritus* at the Genoa museum. It is closely similar to *eloquens* but is somewhat smaller (condylocanine 21.0-21.4 vs. 21.7-23.0). Tentatively it may be retained as a subspecies of *R. eloquens*. The Bor district specimen is probably best considered an unusually large individual of the same species, although it could be a small specimen of *R. hildebrandti*.

Rhinolophus hildebrandti Peters

Rhinolophus hildebrandti Peters, 1878, p. 195 (Ndi, Taita district, Kenya).

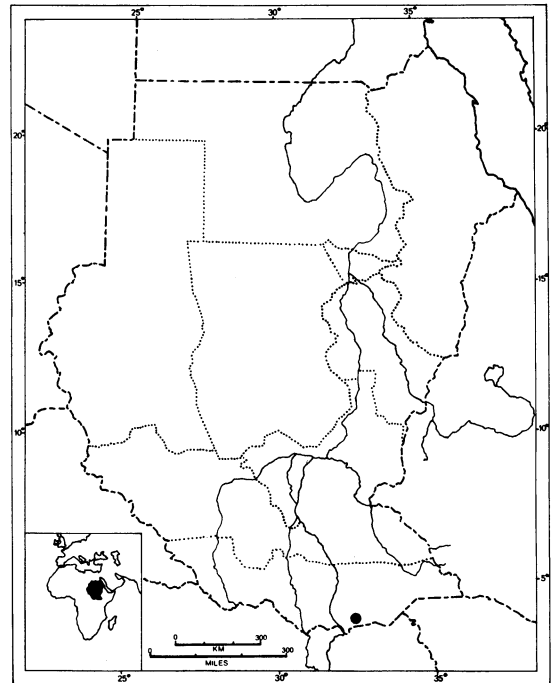


FIG. 29. Distribution of *Rhinolophus hildebrandti* in the Sudan.

Specimens Examined. Seven from *Equatoria*: Lokwi (two skins and skulls, five in alcohol, one with extracted skull).

Measurements. Forearm length, two adult males (60, 62), five adult females (61-63); condylocanine length, two adult males (23.8, 23.9); maxillary tooth-row length, two adult males (9.9, 10.0), one adult female (10.0).

Other Sudan Records. None.

Remarks. Although uncommon in collections, this species has an extensive eastern African distribution, extending from Transvaal to extreme southern Sudan.

HIPPOSIDEROS GRAY

In his revision of this widespread Old World tropical genus, Hill (1963) recognized 11 African

species. Five of these (*jonesi*, *curtus*, *fuliginosus*, *marisae*, *camerunensis*) are restricted to the main forest block and probably do not reach the Sudan. Four species (*caffer*, *beatus*, *cyclops*, *abae*) are known from the Sudan and are treated in the following accounts. The two remaining species are *megalotis* and *commersoni*. *Hipposideros megalotis* has been recorded from several localities in Ethiopia and Kenya (Hayman, 1960, pp. 61, 62) and might occur along the eastern edge of the Sudan. *Hipposideros commersoni* occurs in northeastern Zaire north of the forest (Hayman, Misonne, and Verheyen, 1966, p. 44) and southwestern Ethiopia (Thomas, 1895, p. 3) as well as southeastern Kenya (Harrison, 1961, p. 290). It therefore may occur along the southern border of the Sudan.

KEY TO SKULLS OF *HIPPOSIDEROS* EXPECTED IN THE SUDAN

- 1-Condylocanine length more than 22.
 - 2-Condylocanine length more than 28; cochlea only slightly broader than basicranial area between cochleas *commersoni*
 - 2A-Condylocanine length less than 28; cochlea much broader than basicranial area between cochleas *cyclops*
- 1A-Condylocanine length less than 22.
 - 3-Condylocanine length more than 18 *abae*
 - 3A-Condylocanine length less than 18.
 - 4-Nasal region relatively uninflated so that in dorsal view outer margin forming straight line; cochlea at least twice as broad as basicranial area between cochleas; condylocanine length less than 13 *megalotis*
 - 4A-Nasal region inflated so that in dorsal view outer margin strongly bowed or even angular; cochlea slightly broader than basicranial area between cochleas; condylocanine length more than 13.
 - 5-Posterolateral corner of inflated nasal area distinctly angular. *beatus*
 - 5A-Posterolateral corner of inflated nasal area more or less rounded *caffer*
 - Condylocanine length more than 15.5 *ruber* group
 - Condylocanine length less than 15.5 *caffer* group

Hipposideros caffer (Sundevall)

Rhinolophus caffer Sundevall, 1846, p. 118 (near Durban, Natal, South Africa).

Phyllorhina bicornis Heuglin, 1861, pp. 4-7 (Keren, Eritrea, Ethiopia).

Phyllorhina rubra Noack, 1893, p. 586 (Ngerengere River, Eastern Province, Tanzania; locality clarified by Swynnerton, 1945, p. 69; valid as a subspecies).

Hipposideros caffer centralis Andersen, 1906a, p. 275, 277 (Entebbe, Uganda; possibly valid as a subspecies).

Hipposideros tephurus Cabrera, 1906, p. 358 (Mogador, Morocco; valid as a subspecies).

Hipposideros caffer niapu J. A. Allen, 1917, p. 431 (Niapu, Oriental Province, Zaire; synonym of *H. c. centralis*).

Hipposideros nanus J. A. Allen, 1917, p. 434 (Faradje, Oriental Province, Zaire; possibly valid as a subspecies).

Specimens Examined. *caffer* group: 85 from *Equatoria*: Torit (four skins and skulls, two in ZMK, 11 in alcohol, one with extracted skull), Ikoto (two skins and skulls, three in alcohol), Loelli (one in alcohol), Lokwi (two in alcohol), Gondokoro (eight skins and skulls, nine in alcohol, all in USNM, mentioned by Hollister, 1918,

p. 85), Molongori (one in alcohol in ZMK), Rejaf (one in alcohol); *Bahr-el-Ghazal*: Seriba Ghatta (two skulls only in ZMB); *Blue Nile*: Jebelein (one skin and skull, one in alcohol, both in BM); *Kordofan*: El Obeid (one skin and skull in BM, mentioned by Andersen, 1906a, p. 276), Kadugli (seven skins and skulls, three in alcohol with extracted skulls, all in SMF), Tadoro (one skin and skull, six in alcohol with extracted skulls, all in SMF), Rheika (one in alcohol with extracted skull in SMF); *Darfur* (all localities in BM and mentioned by Thomas and Hinton, 1923, p. 249): 175 miles east of El Fasher (one skin and skull), Kulme (three skins and skulls), Zalingei (two skins and skulls); *Kassala*: Gallabat (nine skins and skulls, five in BM, one in USNM, two skins only in BM).

ruber group: 72 from *Equatoria*: Torit (four skins and skulls, one in ZMK, one skin only in ZMK, 12 in alcohol, one in ZMK), Okaru (two in alcohol), Katire (one skin and skull, two in alcohol, one in ZMK), Mupoi caves near Yambio (five in alcohol), Gondokoro (17 skins and skulls, 16 in USNM, seven in alcohol, two in USNM, all reported by Hollister, 1918, p. 85), Logot (one in alcohol in ZMK), Palotaka (four skins and skulls, nine in alcohol, all in ZMK), Lokwi (three skins and skulls in ZMK); *Bahr-el-Ghazal*: Seriba Ghatta (two skulls only in ZMB); *Upper Nile*: Bor (one in alcohol in USNM, mentioned by Hollister, 1918, p. 85); *Kordofan*: Kadugli (one skin and skull in SMF).

Measurements. Kassala and Blue Nile-caffer group: Forearm length, two adult males (45, 47), 10 adult females (46-48), one adult unsexed (46); condylocanine length, one adult male (14.8), seven adult females (14.5-15.1), one adult unsexed (14.9); width across posterior molars, one adult male (6.2), seven adult females (5.8-6.2), one adult unsexed (6.1).

Darfur, Kordofan, Equatoria-caffer group: Forearm length, 30 adult males (44-49), 25 adult females (43-49); condylocanine length, 20 adult males (14.0-14.9), 15 adult females (14.1-14.8), one adult unsexed (14.5); width across posterior molars, 23 adult males (5.5-5.9), 13 adult females (5.6-6.0), two adults unsexed (5.7).

Kordofan, Upper Nile, and Equatoria-ruber group: Forearm length, 20 adult males (49-52), 23 adult females (48-54); condylocanine length,

11 adult males (16.1-16.9), 12 adult females (16.3-16.7), one adult unsexed (16.5); width across posterior molars, 12 adult males (6.7-7.0), 10 adult females (6.6-7.1), two adults unsexed (6.7-6.9).

Other Sudan Records. Khartoum: Khartoum (Kock, 1969, p. 132). D. C. D. Happold (*in litt.*) informed me of a specimen in the Sudan Natural History Museum at Khartoum from *Kordofan*: Um Dona. Kock (1969, p. 132) recorded *H. caffer tephurus* from a number of other localities, including two from *Bahr-el-Ghazal*, of which I have mapped Duggu.

Remarks. As can be seen from the above localities and measurements, there are two discrete sympatric taxonomic entities in the southern Sudan (occurring together at least around Torit and Gondokoro and in southern Kordofan). I was at first inclined to agree with Hollister

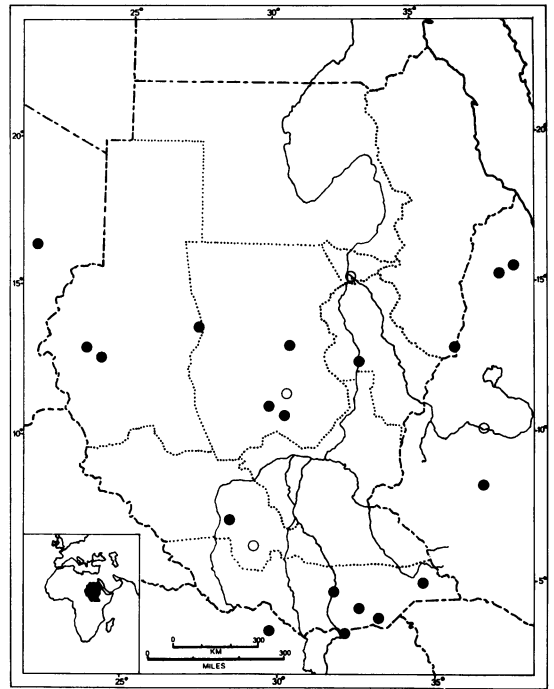


FIG. 30. Distribution of *Hipposideros caffer caffer*, *H. c. tephurus*, and *H. c. nanus* in the Sudan (see text for probable limits of the three subspecies). Localities from which specimens have been examined shown solid, other records hollow.

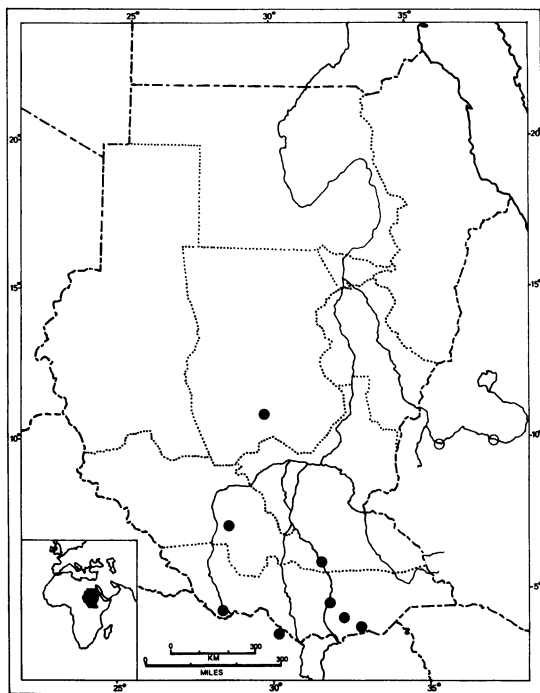


FIG. 31. Distribution of *Hipposideros caffer centralis* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

(1918, pp. 85-86) that two species were involved. Inspection of extensive material at the British Museum shows that although the larger (*ruber*) and the smaller (*caffer*) forms are perfectly distinct across northern tropical Africa from Senegal to Ethiopia and Uganda, intergradation apparently takes place in Angola. I, therefore, am inclined to consider *caffer* and *ruber* conspecific, even though Hayman and Hill (1971, pp. 28-29) on the basis of the same data came to the opposite conclusion. The *ruber* group remains fairly close to the forest and the *caffer* group tends to occur in dryer savanna areas (Verschuren, 1957, pp. 354, 373), but the precise ecological relationships between them are far from clear. All Sudanese specimens of the *ruber* group are referred to *H. c. centralis*, although it is uncertain whether that subspecies is really distinct from *H. c. ruber*. The situation as regards the *caffer* group is somewhat more complex. Material from Kassala and Blue Nile provinces seems best referred to *H. c.*

caffer which occurs in Kenya and Ethiopia. Specimens from Equatoria, Kordofan, and Darfur, however, tend to be somewhat smaller in size and are better referred to *H. c. tephurus*, originally described from Morocco, but with an extensive distribution in the dryer parts of northern tropical Africa (see Andersen, 1907, p. 8). Probably most of the Sudan can be regarded as within the zone of intergradation between the two subspecies. The still smaller *H. c. nanus* (possibly a synonym of *H. c. tephurus*) appears to be confined to the savanna area of the northeastern Congo (see Koopman, 1965, p. 10). Although there are old records from "Nubia" (Andersen, 1907, p. 12) and Khartoum, I know of no twentieth century record from the Nile Valley north of Jelebein.

Hipposideros beatus Andersen

Hipposideros beatus Andersen, 1906a, p. 279 (15 miles from the Benito River, Rio Muni [Spanish Guinea]).

Hipposideros beatus maximus Verschuren, 1957, p. 362 (Pidigala-Nord, Garamba National Park, Oriental Province, Zaire; valid as a subspecies).

Specimens Examined. Three in IRSN, mentioned by Verschuren, 1957, p. 363, from *Equatoria*: Soudan River (one in alcohol), Buluku (two in alcohol).

Measurements. Forearm length, two adult males (43, 46), one adult unsexed (43). Specimens from several localities in the southern Cameroon (Carnegie Museum) yield the following measurements: forearm length, one adult male (43), two adult females (45, 46); condylocanine length, two adult males (13.9, 14.0), one adult female (14.1); width across last molars, two adult males (6.0, 6.2).

Other Sudan Records. None.

Remarks. This is a West African forest species that barely reaches the southwest corner of the Sudan. The subspecies there is *H. b. maximus*.

Hipposideros cyclops (Temminck)

Phyllorhina cyclops Temminck, 1853, p. 75 (Boutry River, Ghana).

Hipposideros langi J. A. Allen, 1917, p. 434 (Avakubi, Oriental Province, Zaire).

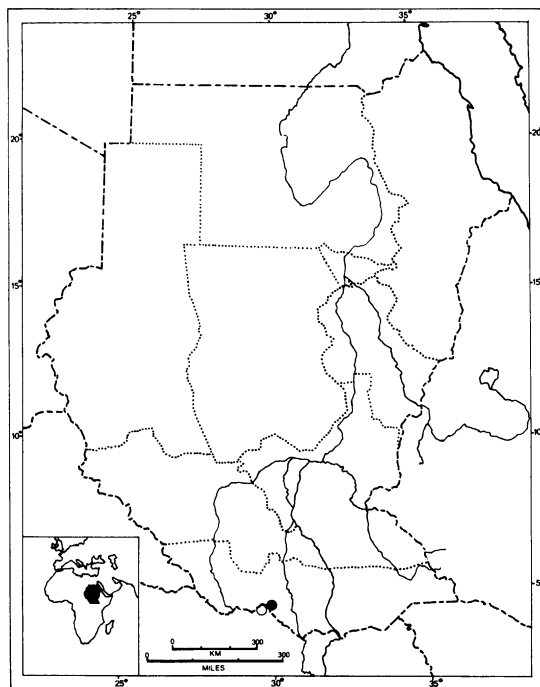


FIG. 32. Distribution of *Hipposideros beatus* in the Sudan. Locality from which specimens have been examined shown solid, other records hollow.

Specimens Examined. 10 from *Equatoria*: Issore (one in alcohol), Palwar (two in alcohol), PFNK 16 (three in alcohol), Taere (two in alcohol), Buluku (two in alcohol), specimens from last three localities in IRSN and mentioned by Verschuren, 1957, p. 314.

Measurements. Forearm length, four adult males (62-70), three adult females (67-73). A series in AMNH from northeastern Zaire yields the following: forearm length, two adult males (61, 65), five adult females (65-69); condylocanine length, one adult male (24.7), four adult females (24.4-25.3).

Other Sudan Records. None.

Remarks. Like the previous species, this one is primarily of the west African forest block, but extends farther east to southwestern Kenya (Harrison, 1961, p. 290). It barely reaches the southwestern corner of the Sudan and the mountains along its southern border to the east.

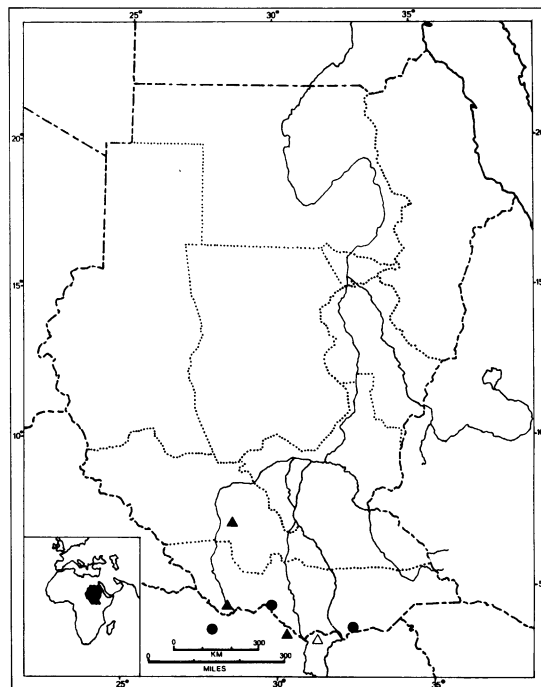


FIG. 33. Distribution of *Hipposideros cyclops* (circles) and *H. abae* (triangles) in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Hipposideros abae J. A. Allen

Hipposideros abae J. A. Allen, 1917, p. 432 (Aba, Oriental Province, Zaire).

Specimens Examined. Seven from *Equatoria*: Mupoi and Marangu caves near Yambio (six in alcohol); *Bahr-el-Ghazal*: Seriba Ghatta (one skull in ZMB).

Measurements. Forearm length, three adult males (58), three adult females (55-58); condylocanine length, one unsexed (19.1); width across last molars, one unsexed (8.6). A series of paratypes (AMNH) yields the following: forearm length, 12 adult males (56-59), 12 adult females (54-60); condylocanine length, 11 adult males (19.0-19.7), 11 adult females (18.6-19.6); width across last molars, 13 adult males (8.2-8.8), 12 adult females (8.3-8.7).

Other Sudan Records. None. These appear to be the first records from the Sudan.

Remarks. This is still another species largely confined to the main forest block. It almost reaches the Nile in northwestern Uganda, but in the Sudan is known only from the southwest.

ASELLIA GRAY

Two species of this southwestern Asian and northern and northeastern African genus are known, the widespread *tridens*, discussed below, and *patrizii*. The latter is a good species now known from four localities in northern and central Ethiopia, including Eritrea (see Hill and Morris, 1971, p. 41). It may reach Kassala Province, Sudan, along the Red Sea coast.

Asellia tridens (E. Geoffroy)

Rhinolophus tridens E. Geoffroy, 1813, p. 265 (Egypt; Geoffroy mentioned two localities, the Tombs of the Kings [near Luxor] and the Temple of Denderah [near Qena]; following Kock, 1969, p. 122, I restrict the type locality to the Tombs of the Kings, near Luxor, Qena Province, Egypt; the Field Museum of Natural History has a small series of this species collected near Luxor by H. Nelson in 1939).

Asellia tridens italosomalica De Beaux, 1931, p. 190 (Oddur, southern Somalia; valid as a sub-species).

Specimens Examined. 47 from *Blue Nile*: Senaar (one in alcohol in ZMB); *Darfur*: Um Esheishat well (seven skins and skulls in BM, mentioned by Thomas and Hinton, 1923, p. 249); *Khartoum*: Jebel el Azraq (22 in alcohol in BM); *Kassala*: Suakin (one in alcohol in ZMB), Kassala (one skin and skull, two skins only in BM), Port Sudan (one skin and skull in BM), Wadi Alagi (one skin and skull in BM, mentioned by Flower, 1932, p. 397); *Northern*: Shendi (two skins and skulls, one skin only in BM, seven in alcohol, six in BM, one in USNM, mentioned by Hollister, 1918, p. 88).

Measurements. Forearm length, 19 adult males (46-52), 24 adult females (46-52), two adults unsexed (48, 49); condylocanine length, 10 adult males (15.8-17.3), five adult females (16.0-16.4), one adult unsexed (16.9).

Other Sudan Records. *Northern*: Meroe pyramids (De Winton, 1901c, p. 397). Some of the above-listed specimens from Shendi were evi-

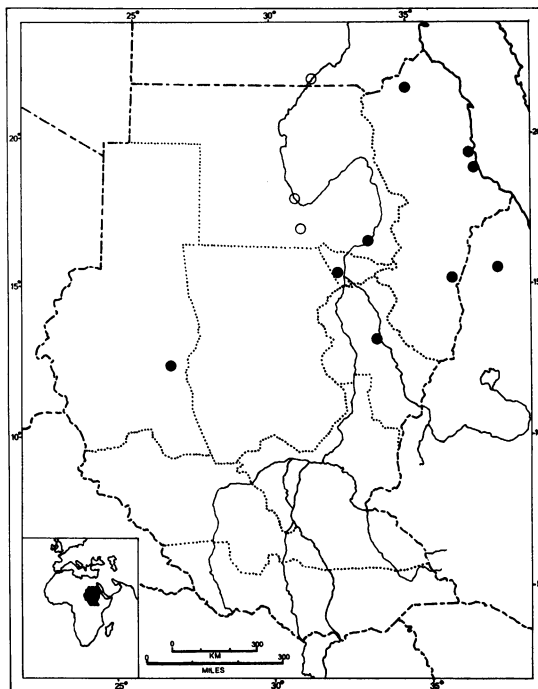


FIG. 34. Distribution of *Asellia tridens* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

dently collected from the Meroe pyramids, but it is impossible to tell from the labels or catalog entries which ones. Kock (1969, p. 130) listed several other records from *Northern* (including Old Dongola and Bir Abu Gulud) and *Khartoum* provinces.

Remarks. This is primarily a southwestern Palearctic species that has obviously entered the Sudan from the north. It is one of the species best adapted to desert conditions having been recorded from several remote oases in Egypt (Hoogstraal, 1962, p. 158). Its southern limits in northeastern Africa correspond rather closely to the boundary between the subdesert steppe and the wooded steppe (see Keay, 1959). *Asellia*, however, has apparently not colonized the isolated subdesert steppe region of northwestern Kenya and southeastern Sudan as has *Rhinopoma*. *Asellia tridens italosomalica*, of the subdesert steppe of Somalia, is a form somewhat

intermediate in size between *A. t. tridens* and *A. patrizii*, but definitely closer to the former. Kock (1969, p. 128) has synonymized *italosomalica* with *A. t. tridens*, but I am inclined to retain it in view of its considerably smaller size (forearm 43-49, condylocanine 14.5-15.3). One interesting point is that the ranges of *Asellia* and of *Hipposideros caffer* in Africa are largely mutually exclusive. It is possible that competitive exclusion is at work.

VESPERTILIONIDAE

I am inclined to recognize 15 African genera in this cosmopolitan family. Of these, 10 have been recorded from the Sudan and are treated below. Of the remaining five, *Nyctalus* has been recorded from south of the Sahara only once (from Mozambique) and the record is probably of an accidental (Ellerman, Morrison-Scott, and Hayman, 1953, p. 78). The genus *Laephotis* has a range from southwest Africa to southern Kenya, but probably does not reach the Sudan. The remaining three genera, however, very possibly do reach the Sudan.

Of the seven species of *Myotis* listed by G. M. Allen (1939, pp. 90-91) from the mainland of Africa south of the Sahara, two (*africanus* and *megalopus*) appear, from records at the British Museum, to be based on mislabeled specimens from India. Thomas (1915a, pp. 608-612) evidently was already aware of this because he synonymized *africanus* with *M. blythi* and *megalopus* with *M. longipes*, both Indian species. The named form *africanus* (*Vespertilio africanus* Dobson, 1875) is in any case a junior homonym of *Vespertilio pipistrellus* var. *africanus* Ruppell, 1842 (a *Pipistrellus* discussed below). More recently however, Aellen and Brosset (1968, pp. 453, 454) have revived the name *megalopus* and referred a specimen from Congo (Brazzaville) to it. I have not seen this specimen and Aellen and Brosset did not make any comparisons between it and any African species. I am therefore not prepared to say what Aellen and Brosset's *megalopus* might be. Two of the remaining African species of *Myotis* (*venustus* and *welwitschii*) are currently regarded as conspecific. *Myotis welwitschii* has been recorded from the region of Mount Elgon in Kenya and from northwestern Ethiopia (Kock, 1967). It may reach the moun-

tains of the extreme southern Sudan. *Myotis scotti* of the Abyssinian highlands may reach the eastern edge of the Sudan. *Myotis bocagei* reaches extreme northeastern Zaire (see Koopman, 1965, p. 11), Uganda (AMNH 219739 from Fort Portal), and central Kenya (Harrison, 1961, p. 292) and may occur along the southern border of the Sudan. *Myotis tricolor* has an extensive distribution from the Cape Province to northwestern Ethiopia (BM specimens from Dangila, 40 miles south of Lake Tana). It may occur in the southeastern Sudan. Recently, Hill (Hill and Morris, 1971, pp. 43-46) described a new species (*M. morisi*) from eastern Ethiopia related to *M. bocagei* and *M. tricolor*. It may also reach the eastern edge of the Sudan. Allen (1939, p. 83) listed *Cistugo* as a valid genus with two species, confined to southwestern Africa. Ellerman, Morrison-Scott, and Hayman (1953, pp. 72, 74) regarded this as a subgenus of *Myotis*. Summing up, there are five species of *Myotis* that may occur in the Sudan, none of which has been recorded from within its borders.

Barbastella leucomelas, originally described from Sinai, has also been recorded from Massaua, Eritrea (now in Ethiopia). It is to be expected in the Red Sea hills of northeastern Sudan. Kock (1969, pp. 176-179) regarded *leucomelas* as a subspecies of *B. barbastellus* on the basis of its slight differentiation and allopatric distribution. Unfortunately, he did not discuss the status of *darjelingensis* regarded by Ellerman and Morrison-Scott (1951, p. 176) as a subspecies of *B. leucomelas*. In view of the sympatry between *barbastellus* and *darjelingensis* in the Caucasus region, it seems wise to keep *barbastellus* and *leucomelas* separate until the systematics is better worked out.

The genus *Kerivoula* has numerous African species most of which are either confined to areas well to the south of the Sudan or in the main forest block. *Kerivoula harrisoni*, however, occurs in Ethiopia and northern Kenya (Harrison, 1961, p. 294) as well. It may occur in the southeastern Sudan. I have made no attempt to place *Nycticejus eriophorus* of Heuglin from northwestern Ethiopia. This was tentatively allocated by G. M. Allen (1939, p. 101) to *Kerivoula*. I have seen no *Kerivoula* from the region of the type locality of *K. eriophora*, but Heuglin's

reference to woolly pelage and occurrence in bird nests strongly suggests *Kerivoula*.

PIPISTRELLUS KAUP

This is one of the largest and most complex genera of African bats. I have previously (Koopman, 1965, pp. 11-13; 1966, pp. 159-161) discussed (and hopefully in part resolved) some of the taxonomic questions among the African members of this genus, but many remain. The knotty problems involving interrelationships of the species of *Pipistrellus* with those of *Eptesicus* are discussed under the latter genus. The following is a tentative distributional summary of the *Pipistrellus* of Africa with special reference to the Sudan.

Three species occur in northwestern Africa (Panouse, 1951; Hill, 1964). Two of these (*P. pipistrellus* and *P. savii*) are Palearctic species that do not occur elsewhere in Africa. The third, *P. kuhli*, has an extensive African distribution, including the Sudan, and is discussed in its account below. *Pipistrellus maderensis* is confined to the Madeira and Canary Islands. *P. savii* also occurs in the latter. Four species (*kuhli*, *deserti*, *ariel*, and *rueppelli*) are known from Egypt. All occur in the Sudan and are treated in the accounts below.

Of the species confined to the Ethiopian region, *musculus*, *nanulus*, *crassulus*, and the newly described *eisentrauti* (Hill, 1968, p. 45), all are within the main forest block, where they occur with the widespread *P. nanus*. *Pipistrellus nanulus*, however, does reach Uganda and so may occur in extreme southwestern Sudan. Five species occur in southern Africa (see Koopman, 1966, pp. 159-161), but only *anchietai* is confined to the south, the other four (*nanus*, *kuhli*, *rusticus*, *rueppelli*) occurring also in the Sudan.

This leaves three apparently localized species not known from the Sudan. *Pipistrellus permixtus* (Aellen, 1957, pp. 200-204) is still known only from the type (which I have not seen) collected in northeastern Tanzania. From Aellen's description, it appears to be quite distinct from any other African species. It probably does not reach the Sudan.

Pipistrellus aero is known only from a limited area in central Kenya (see Harrison, 1961, p.

293). In its most diagnostic features it is essentially like *P. kuhli* but is significantly smaller (condylobasal length 11.6-11.7 vs. 12.1-13.0 for *kuhli* from nearby areas). It may be merely a small Kenya highland subspecies of *P. kuhli* or a southern subspecies of *P. deserti*. Another possibility, that I believe less probable, is that it is an east African representative of the southern African *P. anchietai* with which it agrees in size and general appearance of the skull. *Pipistrellus aero* differs from *P. anchietai*, however, in its clearly simple (as opposed to usually bifid) inner upper incisor, its more reduced outer upper incisor, its higher braincase, and its deeper dorsal nasal emargination. If *P. aero* is a valid species, as I think it is, it may reach the mountains of extreme southern Sudan.

Pipistrellus inexpectatus was described by Aellen (1959, pp. 226-228) on the basis of a single specimen from northern Cameroon, but I have recently (Koopman, 1965, p. 30), with some hesitation, allocated to it a specimen from western Zaire. Aellen also allocated a single specimen from El Garef, Blue Nile Province, Sudan, to this species. I have seen the specimen (MCZ 14466), which G. M. Allen (1914, pp. 347-348) identified as *P. marginatus*, and I believe that it is too immature to be identified with confidence. The British Museum has a specimen identified as *P. inexpectatus* from Kampala in Uganda. It is in alcohol and the skull has not been extracted and the teeth are much worn. Although it seems rather similar to *P. inexpectatus*, the identification at present is by no means certain. *Pipistrellus inexpectatus* therefore might reach the Sudan, but this is highly uncertain.

I have found it convenient to make a tentative grouping of African *Pipistrellus*, which I present here. I have depended on Tate (1942, pp. 234-248) for some of the general framework of groups in *Pipistrellus*, but have supplemented his work with my own observations. The characters given are, however, of the Ethiopian region members and do not necessarily apply to extralimital species.

P. pipistrellus group (including *P. nanus* and *P. permixtus*): Anterior upper incisor usually more or less bifid but not deeply cleft; posterior upper incisor relatively long, usually more than half length of inner upper incisor; anterior upper pre-

molars small but usually well developed with upper canine and posterior upper premolar separated, so that the small premolar between can usually be readily seen from the side; a definite concavity where the forehead meets the rostrum; penis relatively short.

P. hesperus group¹ (including *P. musciculus*): Anterior upper incisor more or less bifid but not deeply cleft; posterior upper incisor relatively long, more than half length of inner upper incisor; anterior upper premolars reduced with upper canine and posterior upper premolar more or less in contact, so that premolar between cannot be readily seen from the side; concavity between forehead and rostrum (which is shortened and broadened) poorly developed; penis relatively short.

P. kuhli group (including *P. deserti*, *P. aero*, *P. anchietai*, *P. rusticus*, and *P. inexpectatus*): Anterior upper incisor simple or bifid but not deeply cleft; posterior upper incisor relatively short, usually less than half length of inner upper incisor; anterior upper premolars reduced with upper canine and posterior upper premolar more or less in contact, so that the premolar between cannot be readily seen from the side; concavity

between forehead and rostrum usually absent or poorly developed; penis relatively short.

P. savii group (including *P. maderensis* and *P. ariel*): Anterior upper incisor simple, posterior upper incisor relatively long, somewhat more than half length of inner upper incisor; anterior upper premolar vestigial with upper canine and posterior upper premolar in contact, so that the tiny anterior premolar is invisible from the side; rostrum markedly flattened and interorbital constriction poorly developed; penis relatively short.

P. rueppelli group (including *P. crassulus*, *P. eisenrauti*, and *P. nanulus*): Anterior upper incisor deeply cleft; posterior upper incisor variable but usually less than half length of inner upper incisor; anterior upper premolar variable but usually separating upper canine and posterior upper premolar, so that the small anterior upper premolar is visible from the side; braincase tends to be inflated; penis unusually long with a large baculum.

Although there are available genus-group names for all but the *hesperus* group, I believe that with the possible exception of the *rueppelli* group, they should not be put in different subgenera. I do not believe that there is any special relationship between *P. rueppelli* and the Indian species *P. dormeri* with which it has been associated in the subgenus *Scotozous*. The name *Vansonia* Roberts, 1946, is available, however, for the *rueppelli* group if subgeneric separation from the rest of the genus *Pipistrellus* is desired.

¹I do not use Tate's name "*tenuis* group," because I do not believe that *P. tenuis* belongs to it. I would restrict this group to *P. musciculus* of Africa and *P. hesperus* of North America. Of these, *P. hesperus* H. Allen, 1864, is the older name.

KEY TO SKULLS OF *PIPISTRELLUS* EXPECTED IN THE SUDAN

- 1-Inner upper incisor strongly bifid; anterior upper premolar in tooth row and clearly visible from outer side.
 - 2-Condylbasal length less than 11.5 *nanulus*
 - 2A-Condylbasal length more than 11.5 *rueppelli*
- 1A-Inner upper incisor at most rather weakly bifid.
 - 3-Posterior upper incisor less than half length of anterior upper incisor.
 - 4-Forehead almost flat; condylbasal length less than 11.5 *rusticus*
 - 4A-Forehead more or less distinctly concave.
 - 5-Posterior upper incisor extending well beyond cingulum of anterior upper incisor, which is bifid unless greatly worn; interdental palate approximately as wide as long *inexpectatus*
 - 5A-Posterior upper incisor barely extending beyond cingulum of anterior upper incisor, which is usually simple; interdental palate clearly longer than wide.
 - 6-Condylbasal length more than 11.8 *kuhli*
 - 6A-Condylbasal length less than 11.8.
 - 7-Condylbasal length more than 11.5 (may occur in southern Sudan) *aero*
 - 7A-Condylbasal length less than 11.5 (known from northern Sudan) *deserti*

3A-Posterior upper incisor more than half length of anterior upper incisor.

8-Rostrum markedly flattened; interorbital constriction poorly developed; anterior upper incisor simple; anterior upper premolar vestigial, not visible from outer side *ariel*

8A-Rostrum rounded on top; interorbital constriction well developed; anterior upper incisor more or less bifid; anterior upper premolar usually well developed and visible from outer side *nanus*

Pipistrellus nanus (Peters)

Vespertilio pipistrellus var. *africanus* Rüppell, 1842b, p. 156 (Shoa Province, Ethiopia; I have seen the type at SMF and it is clearly a specimen of *P. nanus*, not of *P. kuhli*).

Vespertilio nanus Peters, 1852, p. 16, pl. 16, fig. 2 (Inhambane, Mozambique).

Vesperugo pusillus Noack, 1887, p. 216, pl. 2, fig. 2; pl. 5, fig. 60-61 (Boma, near mouth of the Congo River, Zaire; I have seen the type at SMF and it is clearly an immature specimen of *P. nanus* and not of *Eptesicus* as previously supposed).

Pipistrellus helios Heller, 1912, p. 3 (Merelle Water, 60 miles south of Mount Marsabit, Kenya; possibly valid as a subspecies).

Pipistrellus abaensis J. A. Allen, 1917, p. 442 (Aba, Oriental Province, Zaire).

Specimens Examined. 80 from *Equatoria*: Torit (seven skins and skulls, one skin only in ZMK), Nimule (four skins and skulls, three in AMNH, four skins only in ZMK), Loa (two skins and skulls, one in ZMK), Terangole (one skin and skull, eight in alcohol), Loguren (one skin and skull, one in alcohol), Lokwi (one in alcohol), Yambio (one in alcohol), Juba (one skin and skull in AMNH), Opari (one in alcohol in ZMK), Gilo (three skins and skulls, one in ZMK, seven in alcohol, one with extracted skull, seven others in ZMK), Issore (four skins and skulls, seven in alcohol, one with extracted skull), Katire (one skin and skull in ZMK, 12 in alcohol, eight in ZMK); *Bahr-el-Ghazal*: Ngop (three in alcohol, one with extracted skull); *Kordofan* (all at SMF and mentioned by Kock, 1969, p. 171): Rheika (two in alcohol with extracted skulls), Kadugli (one in alcohol with extracted skull).

Measurements. All except *Gilo*, *Issore* and *Katire*: Forearm length, 28 adult males (25-29), 41 adult females (25-31); condylobasal length, nine adult males (10.0-10.8), 10 adult females

(10.0-11.0); interorbital width, nine adult males (3.0-3.3), 10 adult females (3.1-3.3); maxillary tooth-row length, 10 adult males (3.3-3.6), nine adult females (3.4-3.7).

Gilo, *Issore*, *Katire*: Forearm length, 16 adult males (30-33), 13 adult females (31-33); condylobasal length, four adult males (10.7-11.3), four adult females (10.5-11.4); interorbital width, four adult males (3.3-3.5), five adult females (3.3-3.5); maxillary tooth-row length, four adult males (3.7-3.8), five adult females (3.7-3.9).

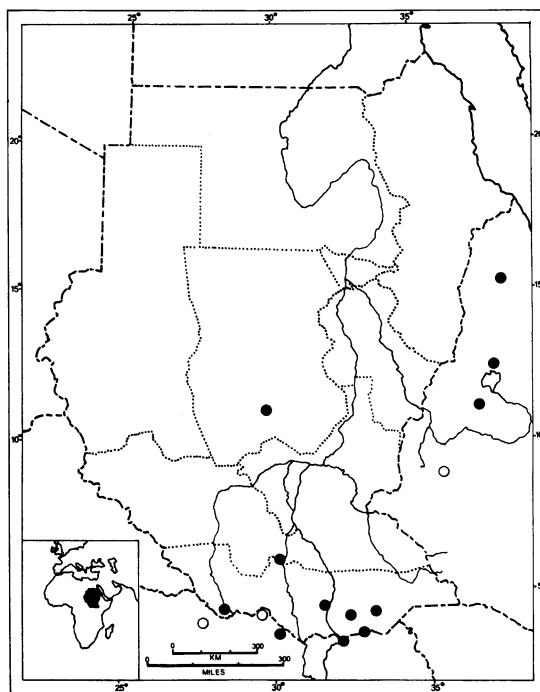


FIG. 35. Distribution of *Pipistrellus nanus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Other Sudan Records. Equatoria: Gondokoro (Sassi, 1908, p. 157).

Remarks. I have previously (Koopman, 1965, pp. 11-13; 1966, p. 160) discussed some of the taxonomic problems in this species. My first conclusion from study of most of the above-listed Sudan material was to recognize two species: *nanus* for the larger from Gilo, Issore, and Katire; *helios* (later regarded as a subspecies of *stampflii*, described from Liberia) for the smaller from most of the remaining localities. However, with analysis of more Sudan specimens and a great deal more from elsewhere in Africa, it became evident that the two species could not be maintained (see also Rosevear, 1965, pp. 264-269). There still appear to be two fairly different groups of populations in the Sudan, one confined to the Imatong mountain region (Gilo, Issore, Katire) and the other largely outside it (but including Lokwi from the Imatong area). The second group agrees well with *helios* from northern Kenya, whereas the first conforms more nearly with specimens from various localities in Africa identified as *nanus*. I believe that the recognition of subspecies in *P. nanus* serves no useful purpose without a great deal more study of geographical variation of the species throughout its extensive range in the Ethiopian region; it seems very likely, however, that these two population groups will be found to fall into different subspecies. *Pipistrellus nanus* seems clearly to have entered the Sudan from the south and the two different infraspecific entities appear to have reached the Sudan separately by somewhat different routes.

I earlier considered *africanus* Rüppell a form of *P. kuhli*, as did Kock (1969, p. 167), following Mertens (1925, p. 22). However, several years ago Felten had occasion to extract the skull of the type of *africanus* and realized that it was not *P. kuhli*, but rather *P. nanus*, an identification with which I fully concur. It is unfortunate that the obscure name, *africanus* Rüppell, 1842, has priority over the well-known name, *nanus* Peters, 1852. Felten is considering this question and for the present, I continue to call this species *P. nanus* until the problem can be settled. In connection with the relationship of *Eptesicus* to *Pipistrellus*, discussed below, it should be noted that one of the above-listed specimens (FMNH

77642 from Loguren) was at first identified as *Eptesicus* because it lacks the small anterior upper premolar on both sides (as does also one of the original specimens of *helios* from Kenya, USNM 182671). It was only after failure to identify it with any species of *Eptesicus* that comparison with the remainder of the series of *P. nanus helios* showed it to be indistinguishable except for the missing pair of teeth.

Pipistrellus kuhli (Kuhl)

Vespertilio kuhlii Kuhl, 1819, p. 199 (Trieste [now in Italy]).

Vespertilio pipistrellus var. *aegyptius* Fischer, 1829, p. 105 (Thebes, Egypt; probably valid as a subspecies).

Vespertilio marginatus Cretzschmar, 1830 [1826-1830], p. 74, pl. 29a (Anderson and De Winton, 1902, p. 127, gave Egypt as the locality of the type specimen; since the plate with the original description shows a bat with a narrow white edging on the wing, it is evident that the type specimen came from the Nile Valley or eastern desert, rather than the western desert where the white edging is wide; synonym of *P. k. aegyptius*).

Pipistrellus kuhli fuscatus Thomas, 1901b, p. 34 (Naivasha, Kenya; valid as a subspecies).

Specimens Examined. 13 from *Equatoria*: Nagichot (two in alcohol, one with extracted skull), Katire (three skins and skulls, seven in alcohol, two with extracted skulls, six, including one skull, in ZMK); *Northern*: Shereik (one skin and skull in BM, mentioned by Schwann, 1905).

Measurements. Equatoria: Forearm length, five adult males (32-34), five adult females (34-35); condylobasal length, two adult males (12.2, 12.3), two adult females (12.2, 12.4); maxillary tooth-row length, three adult males (4.4-4.6), three adult females (4.5-4.9); interorbital width, three adult males (3.3-3.6), three adult females (3.4-3.5).

Northern: Forearm length, one adult male (31); condylobasal length, one adult male (11.9); maxillary tooth-row length, one adult male (4.2); interorbital width, one adult male (3.2).

Other Sudan Records. None.

Remarks. This is basically a Mediterranean and southwestern Asian species that extends south along the eastern side of Africa. Although

an abundant bat in Egypt, it is uncommon and localized in the Sudan, known only from the north and southeast.

The northern record is referable to the subspecies, which Gaisler, Madkour, and Pelikan (1972) have shown should probably be separated subspecifically from the European *P. k. kuhli*. However, the earliest valid name for the Egyptian subspecies appears to be *P. k. aegyptius* rather than *marginatus* as used by Gaisler, Madkour, and Pelikan (1972). The Equatoria specimens are referable to the more southern subspecies with a more robust skull and with less distinct white edging to the wing, *P. k. fuscatus*. The two subspecies probably do not meet in the Sudan, but probably do meet and presumably intergrade in northern Ethiopia. The northern *P. k. aegyptius*, with its prominent white edging to the wing extends down the arid coastal strip at least to French Somaliland (FMNH specimen). *Pipi-*

strellus kuhli fuscatus is known from several localities in the Abyssinian highlands.

Pipistrellus deserti Thomas

Pipistrellus deserti Thomas, 1902, p. 4 (Murzuk, Libya).

Specimens Examined. None from the Sudan.

Measurements. None from the Sudan. The type (male) has a forearm length of 29 and a condylobasal length of 11.4.

Other Sudan Records. Northern: Wadi Halfa (Kock, 1969, p. 172).

Remarks. This is a poorly known Saharan species, authentically recorded from only four localities, the two mentioned above, Luxor in Egypt, and Djanet in southeastern Algeria (Gaisler, Madkour, and Pelikan, 1972). There are also records in the literature from Kenya (G. M. Allen, 1911, p. 325; Dollman, 1914, p. 308; De Beaux, 1923, pp. 97-98) and Uganda (Dollman, 1914, p. 308). I have looked at Allen's specimen (MCZ 8273) and it is a small individual of the form I now call *P. nanus helios*. The specimens reported by Dollman have since been reidentified as *Eptesicus somalicus*. I am inclined to believe that all southern "deserti" are likewise *P. nanus* or *Eptesicus somalicus*. It is nevertheless possible that the closely related *aero* of Kenya is conspecific with *P. deserti*, of which it would then presumably become a subspecies. On the other hand, both might be independently dwarfed derivatives of *P. kuhli*. Further taxonomic or zoogeographical speculation seems fruitless.

Pipistrellus rusticus (Tomes)

Scotophilus rusticus Tomes, 1861, p. 35 (Damaraland, Southwest Africa; G. M. Allen, 1939, p. 83, stated that the lectotype is from Olifants Vlei).

Pipistrellus marrensis Thomas and Hinton, 1923, p. 249 (Foothills of the southern Jebel Marra, Darfur Province, Sudan; valid as a subspecies).

Eptesicus minutus somalicus: G. M. Allen, 1914, p. 348 (not *Vespertilio minutus somalicus* Thomas, an *Eptesicus*).

Specimens Examined. 15 from Equatoria: Torit (one skin and skull, six in alcohol, two with extracted skulls), Fula Rapids (one in alcohol with extracted skull); Upper Nile: Bor district

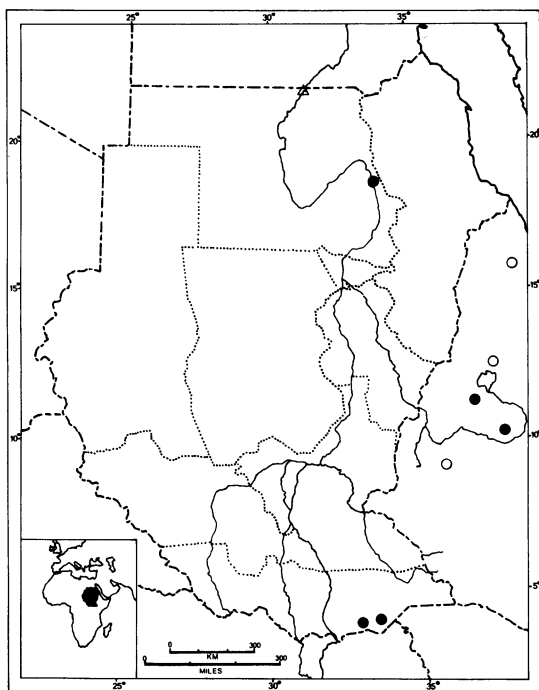


FIG. 36. Distribution of *Pipistrellus kuhli* (circles) and *P. deserti* (triangles) in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

(one skin and skull in BM, mentioned by Kershaw, 1924, p. 21); *Blue Nile*: Bados (one in alcohol in MCZ, mentioned by G. M. Allen, 1914, p. 348); *Kordofan* (both in alcohol with extracted skulls in SMF): Kadugli (one), Tadoro (one); *Darfur*: Foothills of southern Jebel Marra at 4000 feet (three skins and skulls in BM, including type of *marrensis*).

Measurements. Forearm length, 10 adult males (26-27), four adult females (27-30); condylobasal length, five adult males (10.3-11.1), one adult female (10.7); interorbital width, six adult males (3.1-3.4), one adult female (3.2); width across last molars, six adult males (4.7-5.3), two adult females (4.8-5.1); maxillary tooth-row length, seven adult males (3.7-3.9), one adult female (3.8).

Other Sudan Records. None.

Remarks. *Pipistrellus marrensis* was compared only with *deserti* and *kuhli*, but it appears to me to be considerably more like the southern African *rusticus* in its flat forehead. The Sudanese skulls tend to have narrower rostra than do those from southern Africa, but there is considerable variability. Another possibility is that more than one species is represented among the specimens here assigned to *P. r. marrensis*, but in view of their small number and geographical scatter, I cannot establish this. I am convinced that none of these specimens agree better with any other African species. Some of the Torit specimens were at first identified as *Eptesicus* as was G. M. Allen's Bados specimen. Only when a skull was removed from one (FMNH 68112) and cleaned, was a minute anterior upper premolar discovered on one side. Besides the specimens listed here, the Field Museum has a skin and skull from Wahina in northwestern Ethiopia (FMNH 28778) which appears to belong to *P. r. marrensis*. The geographical separation between the two subspecies of *P. rusticus* appears to be real, no specimens being known between southern Sudan and northwestern Zambia (see Koopman, 1966, p. 160).

Pipistrellus ariel Thomas

Pipistrellus ariel Thomas, 1904b, p. 157 ("Eastern Egyptian Desert, 22° N, 35° E, altitude 2000 feet"; Flower, 1932, p. 383, stated that the type was collected near Wadi Alagi,

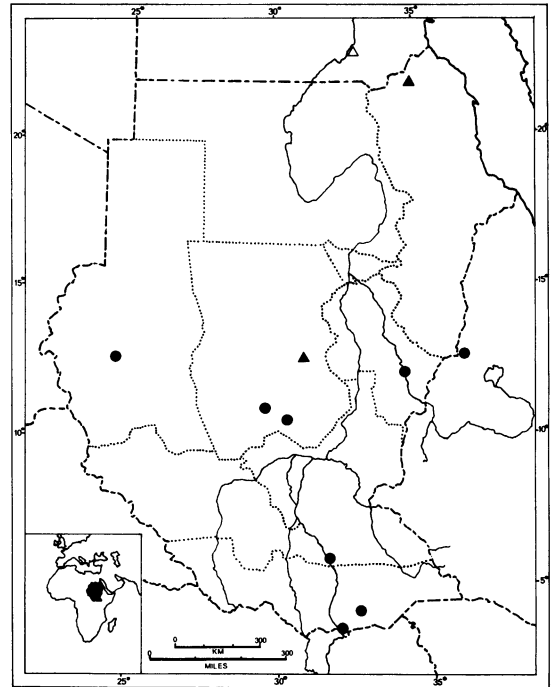


FIG. 37. Distribution of *Pipistrellus rusticus* (circles) and *P. ariel* (triangles) in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

on the Sudanese side of the boundary [in Kassala Province]).

Specimens Examined. Three from *Kassala*: Near Wadi Alagi (skins and skulls in BM, including type); *Kordofan*: Rahad (one skin only in BM, mentioned by Flower, 1932, p. 383).

Measurements. Forearm length, one adult male (28), one adult female (31); condylobasal length, one adult male (10.9), one adult female (10.4); interorbital width, one adult male (2.7), one adult female (2.8).

Other Sudan Records. None.

Remarks. This poorly known species is currently regarded as a relative of the Palearctic *P. savii*. If so, it has presumably moved into the northeastern Sudan along the Red Sea hills. Another relative of *P. savii* (*P. bodenheimeri*) has presumably moved into southwestern Arabia along the hills on the eastern side of the Red Sea (see Harrison, 1964a, p. 163). Besides the two

localities listed above, Gaisler, Madkour, and Pelikan (1972) tentatively identified a specimen from Sayala in Egypt (on the Nile about 60 miles north of the Sudan border) as this species.

Pipistrellus rueppelli (Fischer)

Vespertilio temmincki Cretzschmar, 1826 [1826-1830], p. 17, pl. 6 (not of Horsfield, 1824, a *Scotophilus*).

Vespertilio rueppelli Fischer, 1829, p. 109 (renaming of *V. temmincki* Cretzschmar; Dongola given as locality in Cretzschmar's description, but Mertens, 1925, p. 22, gave Schendi [=Shendy] in referring to the type specimen; the two localities are both in Northern Province, about 250 miles apart).

Vesperugo hypoleucus Fitzinger, 1866, p. 546 ("In Senaar, zwischen Kereri, Halfaye und Surerat am Nil in der Nähe von Chartum" [=Khartoum North]).

Vesperugo pulcher Dobson, 1875b, p. 471 (Zanzibar; valid as a subspecies).

Pipistrellus fuscipes Thomas, 1913, p. 315 (60 miles west of Entebbe, Uganda; probably valid as a subspecies).

Specimens Examined. 55 from *Equatoria*: Loa (one in alcohol with extracted skull), Amadi (three in alcohol), Mongalla (one skin and skull in BM, mentioned by Wroughton, 1911, p. 458), Gondokoro (one in alcohol in NMW, mentioned by Sassi, 1908, p. 157); *Bahr-el-Ghazal*: Yirol (two in alcohol), 100 miles north of Wau (one in alcohol); *Upper Nile*: Fashoda (one skin and skull in BM, mentioned by Thomas, 1901c, p. 274), Tonga (three in alcohol, one with extracted skull in BM); *Blue Nile*: Senaar (one in alcohol), Goz Abu Guma (one skin and skull in BM, mentioned by Thomas 1901c, p. 274), Ed Dueim (one in alcohol in AMNH); *Khartoum*: Khartoum (five skins and skulls, three in USNM, two in BM, mentioned by Thomas 1901c, p. 274, 28 in alcohol, six in USNM, 17 in BM), Omdurman (one in alcohol in BM), Wad Mariam (one skin and skull in BM); *Northern*: Dongola (two skins and skulls at RML), Shendy (two skins and skulls at SMF, including type of *temmincki*).

Other Sudan Records. *Kassala*: Gallabat (Anderson and De Winton, 1902, p. 129); *Equatoria*: Nimule (De Beaux, 1922b, p. 368). Kock (1969, p. 175) recorded the species from

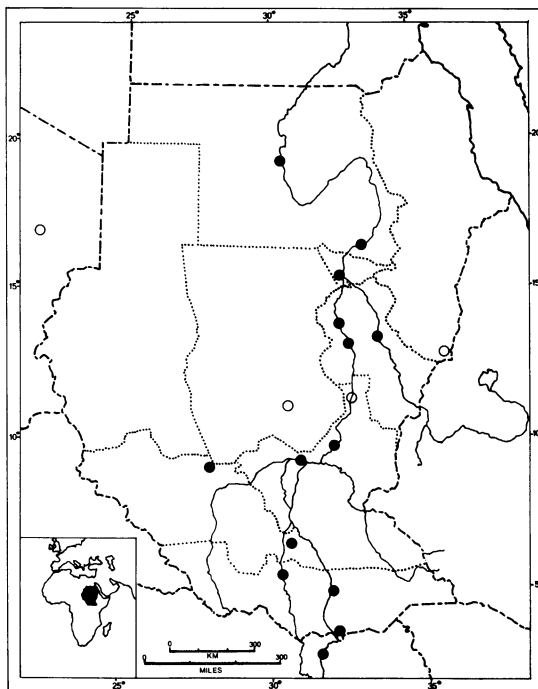


FIG. 38. Distribution of *Pipistrellus rueppelli* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

several other Sudanese localities including Wad Akona (*Upper Nile*) and the Nuba mountains in *Kordofan*.

Measurements. Forearm length, 22 adult males (28-33), 26 adult females (29-34); condylobasal length, four adult males (12.2-12.8), four adult females (12.1-12.9).

Remarks. Dobson described *pulcher* on the basis of a single alcoholic specimen of which the skull has since been lost. I have studied this type specimen and can see no external characters by which it can be distinguished from *P. rueppelli* on a species level. The only skull character used by Dobson to distinguish *pulcher* and *rueppelli* is "lower incisors in the direction of the jaws vs. at right angles to the jaws." This evidently refers to the presence or absence of imbrication between adjacent lower incisors. This character shows considerable variation in *P. rueppelli*. I am therefore inclined to regard *pulcher* as a subspecies of *P. rueppelli*.

Thomas described *fuscipes* as a separate species and it has been so considered by Aellen (1957, p. 203). However, I am inclined to follow Hayman, Misonne, and Verheyen (1966, p. 55) in regarding it as a subspecies of *P. rueppelli* because the two best characters, the larger lateral upper incisor and the grayer underparts, are both somewhat variable. Specimens from Northern Khartoum, Kassala, and Blue Nile provinces can probably be assigned with confidence to *P. r. rueppelli*, whereas those from Equatoria Province north to Yirrol are probably best identified as *P. r. fuscipes*, but available evidence is not adequate to show where the boundary should be drawn. The species probably has a continuous range, at least along the Nile from the northern to the southern boundary of the Sudan.

EPTESICUS RAFINESQUE

This is another large cosmopolitan genus with a number of African species. Before discussing the problem of its distinction from *Pipistrellus*, a summary of its African species is in order. The number of valid species of *Eptesicus* is still uncertain. Rosevear (1962) has straightened out some of the tangled taxonomy of African *Eptesicus* but much remains to be done. G. M. Allen (1939) recognized 26 species of *Eptesicus* and three of *Rhinopterus*. I agree with Ellerman, Morrison-Scott, and Hayman (1953) that *Rhinopterus* is best included in *Eptesicus*. Of these 29 recognized species, two (*humbloti* and *matroka*) are confined to Madagascar and will not be considered further. Of the 27 recognized mainland species, four are listed by Ellerman, Morrison-Scott, and Hayman (1953) as synonyms or subspecies, *ater* (of *E. tenuipinnis*), *megalurus* and *smithi* (of *E. hottentotus*, which was omitted by G. M. Allen), and *vansonii* (of *E. zuluensis*). Previously (Koopman, 1965), I merged the following subspecies: *faradjius* and *phasma* (with *E. rendalli*), *garambae* (with *E. capensis*), and *ugandae* (with *E. somalicus*, which was erroneously listed as a subspecies of *E. capensis* by G. M. Allen). *Eptesicus innesi* is now regarded as a subspecies of the Asian *E. bottae* (see Harrison, 1964a, pp. 140-144). Braestrup (1935) has synonymized *lowei* with *E. floweri*. Rosevear (1962, p. 472) regarded *grandidieri* as a form of *E. capensis*. I have seen the type at the

Paris Museum (an adult female in alcohol with the skull not extracted, dark wings, forearm 33 mm.) and am inclined to agree with him.

Of the 19 remaining currently recognized species, I would regard *brunneus*, *capensis*, *somalicus*, *flavescens*, *guineensis*, *bottae*, *hottentotus*, *melckorum*, *rendalli*, *serotinus*, *tenuipinnis*, and *floweri* as probably valid species. These are discussed below.

I discuss the status of *pusillus* and *rectitragus* under the *E. guineensis* species account. The remaining five species (*bicolor*, *loveni*, *platyops*, *zuluensis*, and *notius*), none of which are known to occur in the Sudan, must now be considered.

Eptesicus bicolor, apparently still known only from the type locality in Angola, is rather puzzling. If it is really a light-winged *Eptesicus* it may be a form of *E. tenuipinnis*, as Hayman and Hill (1971, p. 43) suggest. Another possibility, however, is that it is based on a specimen of *Pipistrellus anchietai* with missing anterior upper premolars. I have seen cotypes of both *anchietai* and *bicolor* at the British Museum and am inclined to regard them as conspecific. Unfortunately *bicolor* has priority.

Eptesicus loveni and *E. platyops* belong to the giant *Eptesicus* group, which has two species in northern Africa, *E. serotinus* and *E. bottae* (see Harrison, 1963, 1964a). There is also a species in southern Africa (*E. hottentotus*). However, between Zambia and southwestern Arabia or the northern coastal region of Africa, there is a vast gap. There are only two specimens from definite localities in this intervening area, the types of *platyops* from Nigeria and *loveni* from Mount Elgon in Kenya. (The latter might reach the mountains of southeastern Sudan.) Both forms, together with *innesi* (the Egyptian subspecies of *E. bottae*) were regarded as forms of *E. hottentotus* by Rosevear (1962, p. 474), but later (1965, p. 259) he retained *platyops* as a separate species. I think he was in error in placing the considerably smaller *innesi* in *E. hottentotus*. It is possible that *hottentotus* is a subspecies of *E. serotinus*, into which *platyops* and *loveni* probably also fall. However, until the giant *Eptesicus* group is revised (including all the above-mentioned forms together with the American *E. fuscus*), *platyops* and *loveni* may best be retained as separate species.

It seems highly probable that *zuluensis* is con-

specific with *E. somalicus*. Rosevear (1962) unfortunately did not discuss this question. He referred a series from South-West Africa to *somalicus*, however, and this is clearly referable to the species called *zuluensis* by Ellerman, Morrison-Scott, and Hayman (1953). There is an apparent hiatus between the ranges of *zuluensis*, which extends north to western Zambia (see Ansell, 1960a, p. 20), and *somalicus*. The latter reaches southern Kenya (see Harrison, 1961, p. 292, also a specimen in the American Museum of Natural History from 50 miles south of Mictow) and northern Tanzania (a specimen in the Academy of Natural Sciences of Philadelphia from the Serronea River). I strongly suspect, however, that the specimens from central Tanzania identified as *pusillus* (see Swynnerton and Hayman, 1951, p. 293) are actually *E. somalicus*.

Eptesicus notius is still known only from the type, collected at Cape Town, South Africa. Comparison of the type at the Museum of Comparative Zoology with a Sudanese specimen of *E. floweri*, with which it has been associated in the subgenus *Rhinopterus* shows that while there is some external resemblance, the skulls are quite different. *Eptesicus notius* is a typical *Eptesicus*. It does not show the broad flat rostrum and prominent supraorbital ridges so characteristic of *E. floweri*. Thomas (1919, p. 747) in describing *E. walli* from Iraq, mentioned that it resembled *Rhinopterus* in the presence of warts, but did not show its skull characters, and specifically mentioned the possibility that *notius* was a warty true *Eptesicus* rather than a *Rhinopterus*, and I fully agree. Gaisler (1970, pp. 25-26) has suggested that the warts of *walli* are produced by parasitic nematodes. Except for the warts, the type of *E. notius* is indistinguishable from specimens of *E. capensis* (with which the type specimen was originally identified), and I believe it is highly probable that the type of *notius* is only a specimen of *E. capensis* infected with nematodes.

Returning to the 12 reasonably valid species mentioned above, five (*capensis*, *somalicus*, *guineensis*, *rendalli*, and *floweri*) are known from the Sudan and are discussed below. *Eptesicus brunneus* and *E. tenuipinnis* are essentially West African forest forms. *Eptesicus tenuipinnis*, however, does reach the savanna belt of northeastern Zaire (see Koopman, 1965, pp. 13-14) and

Uganda (Hollister, 1918, p. 92) and so may reach the southwestern edge of the Sudan. Three species (*flavescens*, *hottentotus*, and *melckorum*) are confined to southern Africa, none being known north of Angola and Zambia (but see discussion of *loveni* above). I cannot agree with Hayman and Hill (1971, p. 44) that *flavescens* and *melckorum* are conspecific. In skull characters, *melckorum* is like a giant *capensis*, whereas *flavescens* is like a giant *rendalli*. *Eptesicus serotinus* and *E. bottae* do not occur in Africa within or south of the Sahara, although the latter is known from northeastern Egypt. G. M. Allen (1939, p. 87) recognized a form (*E. serotinus gabonensis*) from West Africa, but it is clear from the records at the British Museum that this form, like *Myotis africanus* and *megalopus*, was based on mislabeled specimens from India (Hayman and Hill, 1971, p. 44).

In conclusion, I would arrange the African mainland *Eptesicus* as follows:

- E. (Eptesicus) serotinus* group: *serotinus* (including *isabellinus*), *platyops*, *loveni*, *hottentotus* (= *megalurus*, *smithi*), *bottae* (including *innesi*).
- E. (Eptesicus) capensis* group: *melckorum*, *brunneus*, *capensis* (= *notius*, including *grandidieri*, *garambae*), *somalicus* (including *ugandae*, *van-soni*, *zuluensis*), *guineensis* (including *rectitragus*).
- E. (Eptesicus) tenuipinnis* group: *flavescens* (= *angolensis*), *rendalli* (including *faradjius*, *phasma*), *tenuipinnis* (including *ater*).
- E. (Rhinopterus) floweri* group: *floweri* (= *lowei*).

As many cases are known in which species of *Pipistrellus* lack the anterior upper premolar and more rarely in which species of *Eptesicus* (e.g., *tenuipinnis*) have it, an attempt has been made to find some other character that will cleave the large number of *Pipistrellus* and *Eptesicus* species into two major groups. I have been unable to find any. If one disregards the presence or absence of the anterior upper premolar and tries to fit African *Eptesicus* into African *Pipistrellus* groups, it is evident that there are no African *Eptesicus* species that are very similar to the *pipistrellus*, *hesperus*, *savii*, or *rueppelli* groups of African *Pipistrellus*. Likewise, not one of the African *Pipistrellus* shows a close resemblance to the *Eptesicus hottentotus*, *tenuipinnis*, or *floweri* groups. There is, however, a resemblance, in

some cases amounting to virtual identity (if the anterior upper premolar is ignored) between the *Eptesicus capensis* group on one hand and the *Pipistrellus kuhli* group (*kuhli*, *deserti*, *aero*, *anchietai*, *rusticus*, and *inexpectatus*) on the other. It is probable that the anterior upper premolar has been lost more than once here and that the true phyletic relationships run across the "generic" line. It is even possible that in some cases an "*Eptesicus* species" and a "*Pipistrellus* species" are actually conspecific, but in my opinion the available material is insufficient to

establish this with certainty for any such pair at the present time, although I mentioned above that this may be true for *P. anchietai* and *E. bicolor*. For the present I am keeping *Pipistrellus* and *Eptesicus* separate, since I believe that the problem should be attacked on a worldwide basis. It should be recognized, however, that this arrangement is almost certainly wrong and that the problem of valid biological genera and species in this group is the most difficult one in African chiroptology.

KEY TO SKULLS OF *EPTESICUS* EXPECTED IN THE SUDAN

- 1-Dorsal side of rostrum almost completely flat and clearly marked off from lateral surfaces. *floweri*
- 1A-Dorsal side of rostrum transversely convex or with convex and concave portions, not clearly marked off from lateral surfaces.
- 2-Condylbasal length more than 15 *loveni*
- 2A-Condylbasal length less than 15.
- 3-Interdental palate at least as broad as long.
- Condylbasal length more than 12 *rendalli*
- Condylbasal length less than 12 *tenuipinnis*
- 3A-Interdental palate longer than broad.
- 4-Condylbasal length less than 11.1 *guineensis*
- 4A-Condylbasal length more than 11.1.
- 5-Condylbasal length more than 11.9, width across last molars more than 5.1, maxillary tooth-row length more than 4.0 *capensis*
- 5A-Condylbasal length usually less than 11.9, width across last molars usually less than 5.1, maxillary tooth-row length usually less than 4.0 *somaticus*

Eptesicus (Eptesicus) guineensis (Bocage)

Vesperugo guineensis Bocage, 1889, p. 6 (Bissau, Portuguese Guinea).

Eptesicus rectitragus Wettstein, 1916, p. 191 (Dilling, Kordofan, Sudan; probably valid as a subspecies).

?*Pipistrellus* vel ?*Eptesicus* (spec. indet.): Kock, 1969, p. 175.

Specimens Examined. 13 from *Equatoria*: Torit (five skins and skulls, one in ZMK, five in alcohol, one in ZMK, two with extracted skulls, one in ZMK), Nzara (one in alcohol with extracted skull in SMF, mentioned by Kock, 1969, p. 175); *Kordofan*: Dilling (one in alcohol with extracted skull in NMW, type of *rectitragus*), Rheika (one in alcohol with extracted skull, mentioned by Kock, 1969, p. 163).

Measurements. Forearm length, seven adult

males (27-30), five adult females (28-30); condylbasal length, three adult males (10.4-11.0), three adult females (10.8-11.0); width across last molars, five adult males (4.5-4.7), four adult females (4.6-4.7); maxillary tooth-row length, five adult males (3.7), five adult females (3.8-3.9).

Other Sudan Records. None.

Remarks. The taxonomy of the small dark-winged *Eptesicus* of Africa is in a very confused state. I believe, however, that, at least in the Sudan, three species can be distinguished on skull size and proportions. I think there is little doubt that *E. capensis* is the oldest available name for the largest and *E. somaticus* for the middle-sized. The small species has usually been referred to as *minutus* or *pusillus*, although specimens of *E. somaticus* have also been identified under these names. The name *minutus* probably goes with *capensis* (see Rosevear, 1962) and is antedated in

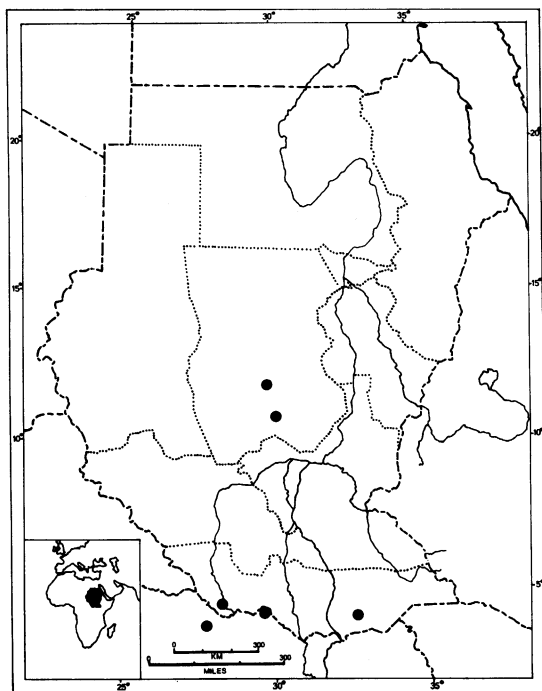


FIG. 39. Distribution of *Eptesicus guineensis* in the Sudan.

any case. *Eptesicus pusillus* has been based on two sources, Leconte (1858, p. 10) and Noack (1889, p. 216), which have been tacitly assumed to represent the same form. *Vespertilio pusillus* Leconte is unidentifiable from the original description and a diligent search for the type at the Academy of Natural Sciences of Philadelphia (where other Leconte types are located) has failed to turn it up and it must be presumed lost. I have seen the type of *Vesperugo pusillus* Noack at Senckenberg and it is clearly an immature specimen of *Pipistrellus nanus* as indicated above. Thus *pusillus* is either unidentifiable or is a synonym of *P. nanus*. I have seen no authentic material of *P. guineensis* from anywhere near its type locality, but from Rosevear's (1965) discussion, it appears to be quite similar to the above listed specimens and also to specimens in the American Museum and the Brussels Museum from north-eastern Zaire and in the American Museum from Kyabe in southern Chad. The type of *rectitragus* clearly belongs here, rather than in *E. capensis* where Rosevear (1962, p. 474) placed it.

Due to confusion with *E. somalicus*, the distribution of *E. guineensis* is uncertain. If my attribution of names is correct, the species extends across northern tropical Africa from Senegal and Portuguese Guinea to the Sudan and northeastern Zaire. Whether it extends farther south is highly dubious. I doubt that it occurs in Angola, as the only specimens I have seen from there ("*pusillus*" at the Field Museum, reported on by Sanborn, 1950, p. 58) agree better with *E. somalicus*. I have not seen the specimens from Tanzania reported as *pusillus* by Swynnerton and Hayman (1951, p. 293). All small dark-winged *Eptesicus* I have seen from Tanzania, however, seem best referred to *E. somalicus*, which is not recorded from Tanzania by Swynnerton and Hayman. It is therefore doubtful whether *E. guineensis* occurs south of the equator. Its distribution is undoubtedly less spotty, however, than the relatively few records indicate. Kock (1969, p. 164) listed a number of these. However, I believe one of the two specimens from Rheika he referred to *guineensis* actually belongs to the following species. I have compared the specimen from Nzara which Kock (1969) left unidentified [*?Pipistrellus* vel *?Eptesicus* (sp. indet.)] with various species of *Eptesicus* and *Pipistrellus* occurring in or near the Sudan. (Kock's specimen has an anterior upper premolar on one side but not on the other.) Of these species, best agreement is shown with *E. guineensis*, although it is larger than any of the other males in forearm and condylobasal length.

Eptesicus (Eptesicus) somalicus (Thomas)

Vespertilio minutus somalicus Thomas, 1901b, p. 32 (Hargeisa, Somalia [formerly British Somaliland]).

Eptesicus ugandae Hollister, 1916, p. 3 ("Ledgus, Uganda" [now in Equatoria Province, Sudan]; see Moreau, Hopkins, and Hayman, 1946, p. 399; valid as a subspecies).

Eptesicus guineensis: Kock, 1969, p. 165 (SMF 33277, not *Vesperugo guineensis* Bocage).

Specimens Examined. 23 from Equatoria: Torit (one skin and skull, 10 in alcohol, one with extracted skull), Katire (two in alcohol with extracted skulls, one in ZMK), 20 miles north of Ngangala (one in alcohol with extracted skull), Lawudo (one in alcohol with extracted skull),

Ledgus (three in alcohol in USNM, two with extracted skulls, including type of *ugandae*), Kiriba (three in alcohol in USNM, one with extracted skull); *Kordofan*: Rheika (one in alcohol with extracted skull in SMF, see synonymy above); *Khartoum*: Khartoum (one in alcohol in MHP).

Measurements. Forearm length, 13 adult males (26-29), 11 adult females (27-30); condylobasal length, five adult males (11.2-11.7), five adult females (11.2-12.1); width across last molars, five adult males (4.5-5.0), five adult females (4.6-5.3); maxillary tooth-row length, four adult males (3.9-4.2), four adult females (3.8-4.4).

Other Sudan Records. None.

Remarks. I cannot agree with Hollister (1916, pp. 3, 4; 1918, p. 92) in regarding *somaticus* as a subspecies of *E. capensis* and *ugandae* as a separate species. *Eptesicus somaticus* has a smaller skull than that of *E. capensis* and is partly sympatric with it. Hollister separated *ugandae* from *somaticus* on the basis of its larger, flatter

skull. There is some average differences between the two forms in both characters, but also a wide overlap. Tentatively *ugandae* may be regarded as a western subspecies of *E. somaticus* with all Sudanese specimens provisionally allocated to it. The Khartoum specimen is widely separated geographically from other Sudanese specimens (although the species has been recorded from northern Ethiopia, formerly Eritrea), and is identified as *E. somaticus* with some hesitation. It is in alcohol and the skull has never been extracted. The wings are dark but much of the uropatagium is only lightly pigmented. *Eptesicus somaticus* is best known from east Africa. Its western and southern limits are uncertain due to confusion with the larger *capensis* and the smaller *guineensis*. Of the two specimens Kock (1969, p. 165) referred to *E. guineensis*, the larger agrees better in its measurements with my fairly extensive series of *E. somaticus*, although admittedly an unusually small individual of it. On the other hand, I believe that the specimen from Nzara referred to *somaticus* by Kock actually belongs to *E. capensis*.

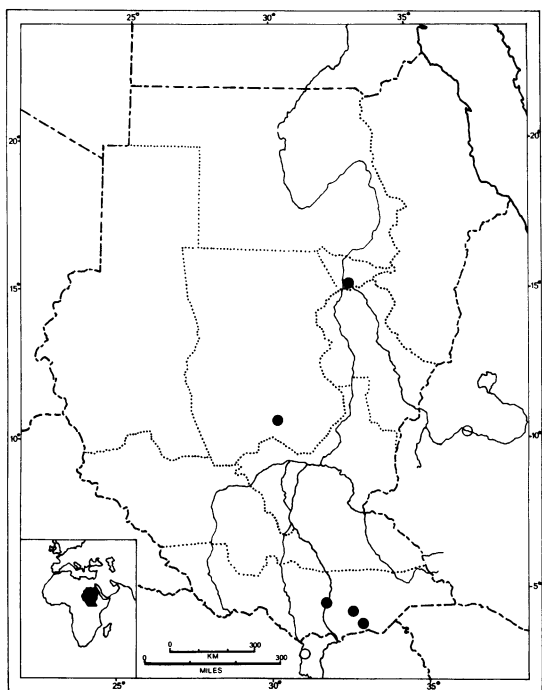


FIG. 40. Distribution of *Eptesicus somaticus* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Eptesicus (Eptesicus) capensis (A. Smith)

Vespertilio capensis A. Smith, 1829, p. 435 ("Cape"; restricted to Grahamstown, eastern Cape Province, South Africa, by Roberts, 1951, p. 89).

Vesperugo (Vesperus) Grandidieri Dobson, 1876c, p. 500 (Zanzibar; probably valid as a subspecies).

Eptesicus garambae J. A. Allen, 1917, p. 445 (Garamba, Oriental Province, Zaire; valid as a subspecies).

Eptesicus somaticus ugandae: Kock, 1969, p. 165 (specimen from Nzara, not *Eptesicus ugandae* Hollister).

Specimens examined. Eight from *Equatoria*: Torit (one skin and skull, one in alcohol), Loelli (two in alcohol, one with extracted skull), Yei (three in alcohol, one with extracted skull in BM), Nzara (one in alcohol with extracted skull in SMF, mentioned by Kock, 1969, p. 165).

Measurements. Forearm length, three adult males (31-33), four adult females (28-30); condylobasal length, one adult male (12.6), three adult females (12.0-12.1); width across last molars, one adult male (5.7), three adult females (5.2-5.4);

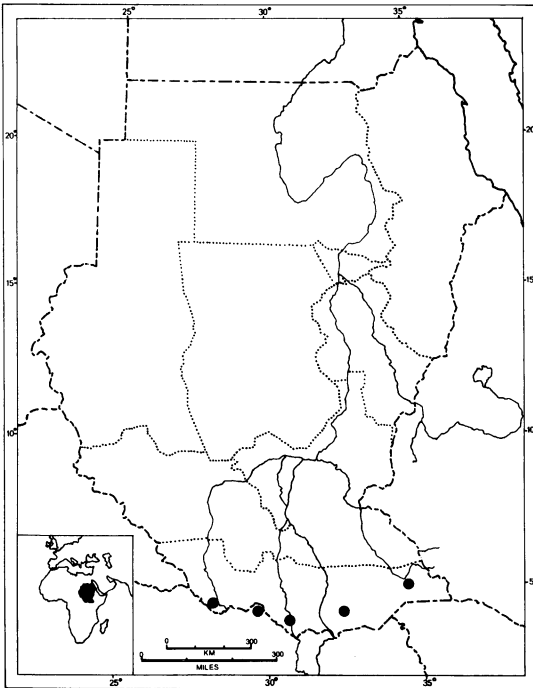


FIG. 41. Distribution of *Eptesicus capensis* in the Sudan.

maxillary tooth-row length, one adult male (4.4), three adult females (4.1-4.5).

Other Sudan Records. None. These appear to be the first authentic records of *E. capensis* from the Sudan.

Remarks. I have previously (Koopman, 1965, p. 16) discussed the basis for including *garambae* in *E. capensis*, and the basis for the inclusion of *grandidieri* in *E. capensis* is mentioned above in the general *Eptesicus* account. I would refer all Sudanese specimens to *E. c. garambae*. With the usual caution, based on probable misidentification of some specimens, it appears that *E. capensis* is a widespread tropical African species, which, however, is known in the Sudan only from the extreme south. It may, however, occur elsewhere in the Sudan in view of a series in UFMZ from Adi Ugru in northern Ethiopia (formerly Eritrea). These specimens were identified as *somalicus* and may in part belong to that species. However, the forearms of the adults range from 29-32 and the skull of one of the largest (the only one that has been extracted) has

a condylobasal length of 12.8, width across last molars 5.6, and maxillary tooth-row length 4.7, which agrees much better with *E. capensis* than with *E. somalicus*. Kock (1969, p. 165) referred the Nzara specimen to *E. somalicus*, but in my opinion it is better regarded as a small individual of *E. capensis*.

Eptesicus (Eptesicus) rendalli (Thomas)

Vesperugo (Vesperus) rendalli Thomas, 1889, p. 382 (Bathurst, Gambia).

Eptesicus phasma G. M. Allen, 1911, p. 327 (Meru River, Northern Guaso Nyiro, Kenya; probably valid as a subspecies).

Eptesicus faradjius J. A. Allen, 1917, p. 444 (Faradje, Oriental Province, Zaire; synonym of *E. r. phasma*).

Specimens Examined. 81 from *Equatoria*: Gondokoro (one skin and skull in USNM, mentioned by Hollister, 1918, p. 92, 55 in alcohol in NMW, mentioned by Sassi, 1908, p. 158, one skull in BM); *Bahr-el-Ghazal*: Lake Nyibor (15 skins and skulls in AMNH); *Upper Nile*: Malek (four skins and skulls in BM, mentioned by Kershaw, 1924, p. 21); *Blue Nile*: El Garef (one skin and skull, one in alcohol at MCZ), Aredeiba (one skin and skull at MCZ), Magangani (one in alcohol at MCZ), Rosieres (one in alcohol at MCZ).

Measurements. Forearm length, 36 adult males (32-36), 26 adult females (34-38); condylobasal length, 15 adult males (12.2-13.1), six adult females (12.7-13.1), one adult unsexed (13.1).

Other Sudan Records. *Equatoria*: Nimule (De Beaux, 1922b, p. 369); *Upper Nile*: Abu Doleib [Kock, *in litt.*, the specimen previously erroneously identified as *E. (Rhinopterus)*].

Remarks. *Eptesicus rendalli* has a rather extensive, albeit spotty distribution in tropical Africa and probably has a more extensive range in the Sudan than the few localities suggest. Although I previously (Koopman 1965, p. 28) was inclined to regard *faradjius* tentatively as a valid subspecies, I must confess that I can see no differences between it and *phasma*. Although the latter may turn out to be indistinguishable from typical *rendalli*, in the absence of comparable series from West Africa, I refer all specimens from Kenya, Somalia, Sudan, Uganda, and northeastern Zaire to *E. r. phasma*. Hayman and Hill

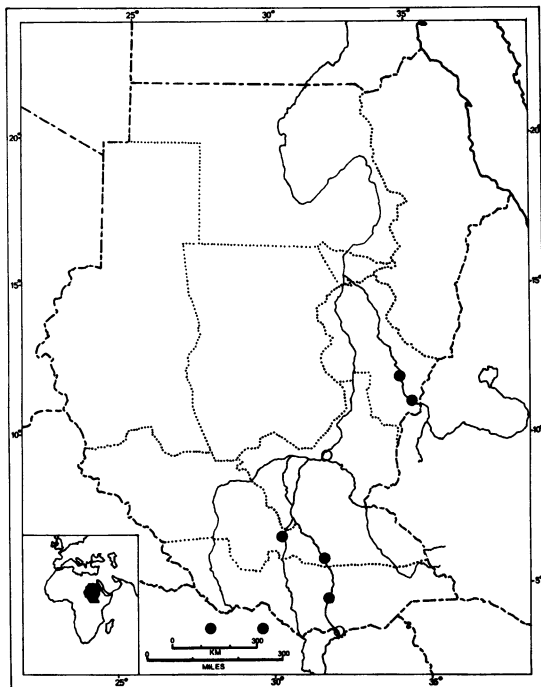


FIG. 42. Distribution of *Eptesicus rendalli* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

(1971, p. 43) were in error in listing Eritrea (rather than Somalia) in its range.

Eptesicus (Rhinopterus) floweri (De Winton)

Glauconycteris floweri De Winton, 1901b, p. 46 (Wad Marium, 12 miles above Khartoum on White Nile, Khartoum Province, Sudan).

Rhinopterus lowei Thomas, 1915b, p. 559 (Blue Nile, 20 miles above Senaar, Blue Nile Province, Sudan).

Specimens Examined. 13 from *Blue Nile*: White Nile (west bank) 100 miles south of Khartoum (one in alcohol with extracted skull in AMNH), Kosti (one skin and skull in BM, one in alcohol in AMNH), Abu Zeit (one in alcohol in BM, mentioned by De Winton, 1901b, p. 45), Kamisa (two skins and skulls in BM), Blue Nile 20 miles above Senaar (one in alcohol with extracted skull in BM, type of *lowei*), 12 miles northwest of Singa (one skin and skull in BM);

Kordofan: El Obeid (two in alcohol in NMW, mentioned by Wettstein, 1918, p. 652); *Khartoum*: Wad Marium (one skin and skull in BM, type of *floweri*); *Northern*: Shendy (two skins and skulls in BM, mentioned by De Winton, 1901c, p. 397).

Measurements. Forearm length, six adult males (34-37), two adult females (38); condylobasal length, four adult males (11.8-13.1), one subadult female (11.6).

Other Sudan Records. Kock (1969, p. 167) listed two additional records from *Kordofan* (between Rashad and Um Berembeita) and *Upper Nile* (Abu Doleib). However, he has written me that the latter is not *E. (Rhinopterus)* but is rather *E. rendalli*.

Remarks. Braestrup (1935, p. 92) tentatively synonymized *lowei* with *E. floweri* and I believe he was justified. If only the types of the two forms are compared, the differences are marked, but other specimens do not support this dichot-

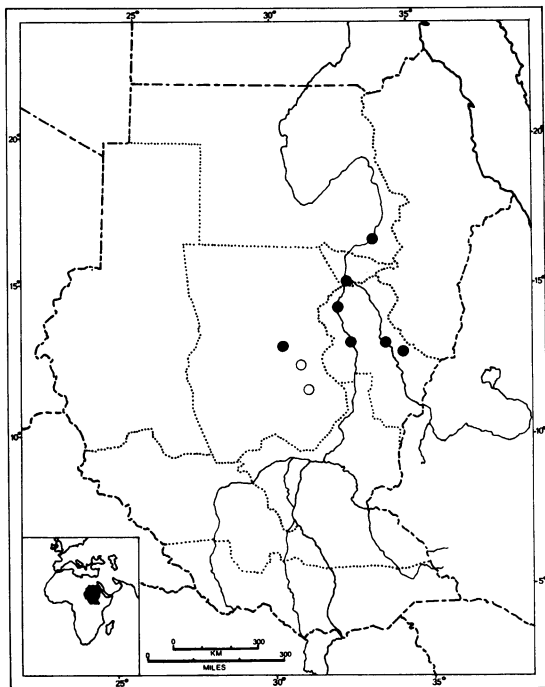


FIG. 43. Distribution of *Eptesicus floweri* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

omy. Hayman and Hill (1971, p. 53) seem to be in complete agreement on the facts, although unfortunately they persist in regarding *floweri* and *lowei* as distinct species. All the Sudan records are concentrated in a surprisingly small area (within a 200-mile radius of Ed Dueim), but Braestrup (1935, p. 92) has recorded the species from Timbuktu in Mali, far to the west (although in a similar vegetation zone). Possibly its limited known range is related to its partiality for thorny acacia thickets (Anderson and De Winton, 1902, p. 129).

CHALINOLOBUS PETERS

I have previously treated this genus (Koopman, 1971), concluding that the African *Glauconycteris* is only a subgenus of the Australasian *Chalinolobus*. In the same paper I have also taken up the problem of the number of African species, which I considered to be probably seven. Since then, Peterson (1973) has described another apparently valid species. Most of these are confined to the main forest block and only two extend appreciably north or east of it. One of these, *C. variegatus*, has been recorded from the Sudan and is treated in the account below. The other, *C. argentata*, is known from several localities in Kenya (see Harrison, 1961, p. 292) and from northeastern Zaire somewhat north of the main forest block (Hayman, Misonne, and Verheyen, 1966, p. 49). It may, therefore, reach the southern edge of the Sudan.

Chalinolobus (Glauconycteris) variegatus (Tomes)

Scotophilus variegatus Tomes, 1861, p. 36 (Otjoro, Southwest Africa).

Glauconycteris papilio Thomas, 1905, p. 77 (Entebbe, Uganda; possibly valid as a subspecies).

Glauconycteris phalaena Thomas, 1915b, p. 560 (White Nile near Fashoda, Upper Nile Province, Sudan; possibly valid as a subspecies).

Specimens Examined. One from *Upper Nile*: Fashoda (one in alcohol with extracted skull in BM, type of *phalaena*).

Measurements. Forearm length, one adult female (43); condylobasal length, one adult female (13.0).

Other Sudan Records. Kock (1969, p. 176) recorded this species from two localities in southeastern *Kordofan* (Kadugli and Jebel Otoro).

Remarks. *Chalinolobus variegatus* is a widespread savanna species, which in the more arid southwestern and northeastern parts of its range has differentiated slightly. Particularly in the Sudan and adjacent areas, however, too few specimens are available to assess their taxonomic status. A single specimen from Somalia (De Beaux,

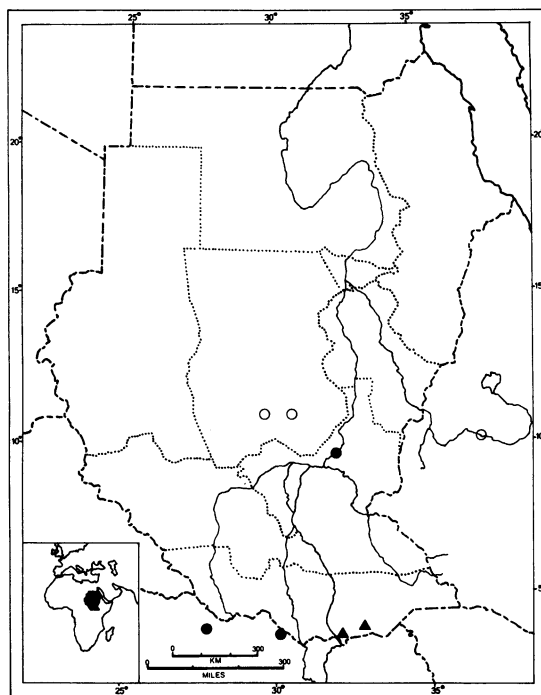


FIG. 44. Distribution of *Chalinolobus variegatus* (circles) and *Mimotillus moloneyi* (triangles) in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

1934, pp. 265-271), which was allocated to *phalaena* is a male with a forearm length of 38 and a condylobasal length of 12.9. Another Somali specimen (ZMB) is an unsexed adult with a forearm length of 40 and a condylobasal length of 12.8). On the other hand, Hill and Morris (1971) allocated a single specimen from northeastern Ethiopia to *S. v. variegatus*. Obviously the distri-

bution of *C. variegatus* and the subspecies *phalaena* (if valid) in the region of the Sudan is still imperfectly known.

Mimetillus moloneyi (Thomas)

Vesperugo (*Vesperus*) *moloneyi* Thomas, 1891, p. 528 (Lagos, southern Nigeria).

Specimens Examined. Three from *Equatoria*: Loa (two in alcohol, one skull extracted), Katire (one skin only).

Measurements. Forearm length, one adult male (28), one adult unsexed (28); condylobasal length, one adult male (13.1).

Other Sudan Records. None.

Remarks. This species, the only one in its genus, is a widespread forest species, albeit with a spotty distribution. It appears to enter the Sudan only along its southern edge, where its presence would have been expected since it was previously known from both northeastern Zaire (Hayman, Misonne, and Verheyen, 1966, p. 50) and northern Kenya (Start, 1969, p. 223). Sudan specimens presumably are referable to the nominate northern subspecies rather than to *moloneyi bernerii* or *m. thomasi* of southern Africa.

NYCTICEIUS RAFINESQUE

This widespread chiefly tropical and warm temperate genus has a markedly discontinuous range. The African forms have usually in the past been allocated to the genus *Scoteinus* with a single African species, *S. schlieffeni*. Sinha and Chakraborty (1971) have shown, however, that the type of *Scoteinus* (*S. emarginatus*) is a form of the Indo-Malayan genus *Scotomanes* and is clearly not congeneric with *N. schlieffeni*. Moreover, I find that *schlieffeni* is very similar to the North American *N. humeralis*, the type of *Nycticeius*. I therefore strike *Scoteinus* from the African list and allocate *N. schlieffeni* to *N. (Nycticeius)*.

Nycticeius (Nycticeius) schlieffeni (Peters)

Nycticejus schlieffenii Peters, 1859, p. 223 (Cairo, Egypt).

Nycticejus adovanus Heuglin, 1877, p. 34 (Asam River at Adowa, Tigre, Ethiopia).

Scoteinus schlieffeni albiventer Thomas and

Wroughton, 1908, p. 540 (Naikhala, Northern Province, Sudan [not within the present boundary of Egypt, as stated in the original description]).

Nycticeius africanus G. M. Allen, 1911, p. 328 (Meru River, Northern Guaso Nyiro, Kenya).

Scotoecus cinnamomeus Wettstein, 1916, p. 191 (Nubbaka, Kordofan Province, Sudan).

Specimens Examined. 31 from *Equatoria*: Kibish Wells (four skins and skulls in DH); *Kordofan*: (all mentioned by Thomas and Wroughton, 1923, p. 250; Wettstein, 1918, p. 652; or Kock, 1969, p. 187); 70 miles west of Nahud (one skin and skull in BM), 35 miles east of Nahud (two skins and skulls, one skin only, all in BM), 50 miles west of El Obeid (one skin and skull in BM), Nubbaka (two in alcohol, one with extracted skull, in NMW, including type of *cinnamomeus*), Dilling (one in alcohol in NMW), Tadoro (one skin and skull, two in alcohol with extracted skulls, all in SMF), Rheika (five in alcohol with extracted skulls in SMF), Kadugli (one in alcohol with extracted skull in SMF), Semeih (two in alcohol with extracted skulls in SMF); *Darfur*: Khor Mallum (one skin and skull in USNM, one skin only in BM), El Fasher (one skin and skull in BM); *Kassala*: Suakin (two in alcohol, one with extracted skull, in BM, mentioned by Anderson and De Winton, 1902, p. 130), Port Sudan (one in alcohol with extracted skull in BM); *Northern*: Shendy (one in alcohol with extracted skull in BM), Naikhala (one skin and skull in BM, type of *albiventer*).

Measurements. Forearm length, 18 adult males (29-34), 12 adult females (30-33); condylobasal length, 18 adult males (11.6-12.9), nine adult females (12.1-12.6); width across last molars, 18 adult males (5.2-5.8), nine adult females (5.5-5.9); maxillary tooth-row length, 18 adult males (4.1-4.7), 10 adult females (4.2-4.6).

Other Sudan Records. Kock (1969, pp. 189-190) recorded specimens from additional localities in *Kordofan* (Delami) and *Darfur*.

Remarks. There has been considerable confusion in the literature between this and the following species. Thus the specimen that G. M. Allen (1914, p. 349) recorded as *Scoteinus schlieffeni* from Blue Nile Province is actually *Scotoecus hirundo*, whereas the material described by Wettstein as *Scotoecus cinnamomeus* proves, on

examination, to be actually *Nycticeius schlieffeni* (as Kock, 1969, p. 189, has shown). It is doubtful that any of the numerous synonyms of this species (including several besides those listed above) designate valid subspecies. However, careful comparison of numerous good series (possibly not now available) throughout the extensive African and southwestern Asian range of this species

allocated to it) stands as a good genus, albeit close to *Nycticeius*. With the exception of *cinnamomea* (discussed above under *N. schlieffeni*), I agree with Hayman and Hill (1971) that there are probably only two species of *Scotoecus*, *S. hirundo* and *S. albofuscus*. All records of the latter are far to the south or west, but *hirundo* does occur in the Sudan and is treated in the account below.

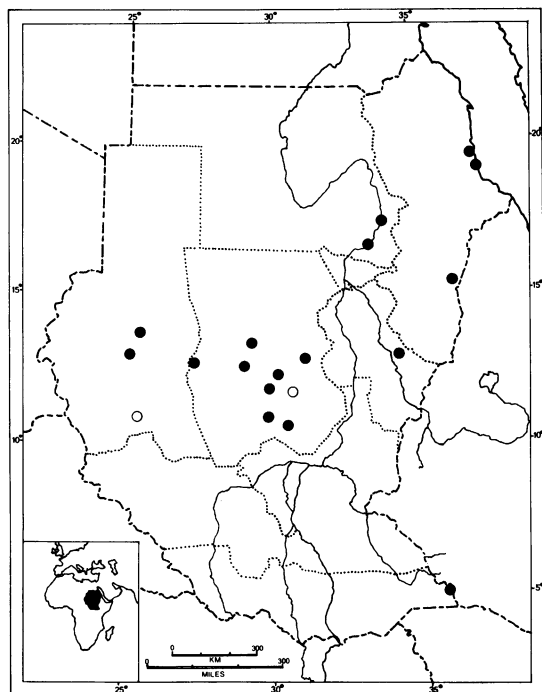


FIG. 45. Distribution of *Nycticeius schlieffeni* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

will be necessary to establish this one way or the other. The distribution of *N. schlieffeni* resembles that of *Rhinopoma hardwickii* in having a hiatus between the central Sudan and the southeastern corner, although the overall distributions of the two species are quite different.

SCOTOECUS THOMAS

Although I have held other views in the past, I now believe that *Scotoecus* (probably including the Indian *pallidus* as well as the African species

Scotoecus hirundo (De Winton)

Scotophilus hirundo De Winton, 1899, p. 355 (Gambaga, Ghana).

Scotoecus hindei Thomas, 1901a, p. 264 (Kitui, Kenya; valid as a subspecies).

Scotoecus albigula Thomas, 1909, p. 544 (Mount Elgon, Kenya; synonym of *N. h. hindei*).

Scotoecus artinii De Beaux, 1923, p. 98. Archer's Post, Northern Guaso Nyiro, Kenya. Synonym of *N. h. hindei*.

Scoteinus schlieffeni: G. M. Allen, 1914, p. 349 (not *Nycticejus schlieffeni* Peters).

Specimens Examined. Six from *Equatoria*: Kibera (two in alcohol, one with extracted skull, in USNM, mentioned by Hollister, 1918, p. 94), Torit (one in alcohol with extracted skull), Loa (one in alcohol with extracted skull); *Bahr-el-Ghazal*: Yirol (skin and skull in AMNH); *Blue Nile*: Bados (skin and skull in MCZ, mentioned by G. M. Allen, 1914, p. 349).

Measurements. Forearm length, three adult males (32-34), two adult females (30); condylobasal length, two adult males (12.8, 13.2), two adult females (12.2, 12.6); width across last molars, two adult males (6.4, 7.0), two adult females (6.3, 6.5); maxillary tooth-row length, two adult males (5.0, 5.2), two adult females (4.9, 5.0).

Other Sudan Records. None.

Remarks. Although this species has a wide range, chiefly in the savanna areas of tropical Africa, there are relatively few specimens extant and this probably explains its rather spotty known distribution. I have previously (Koopman, 1965, pp. 16, 17) corrected G. M. Allen's (1914) misidentification and discussed the status of the three forms described from Kenya, which I would synonymize under the name *N. h. hindei* and to which I would refer the specimens from the Sudan.

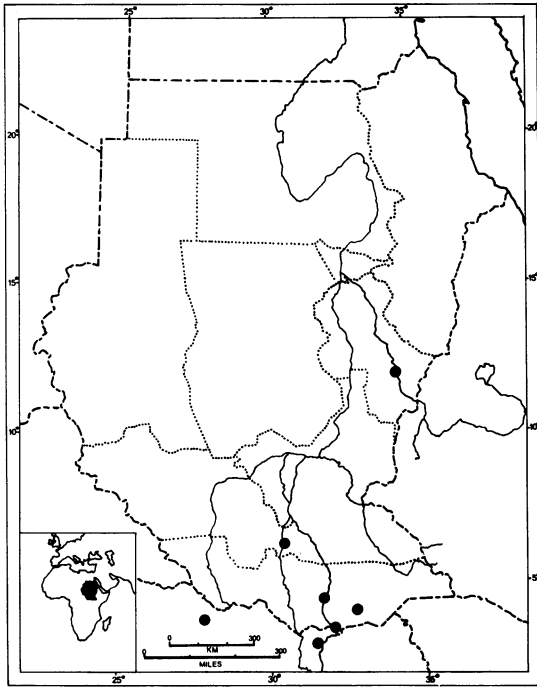


FIG. 46. Distribution of *Scotoecus hirundo* in the Sudan.

SCOTOPHILUS LEACH

Scotophilus is a widespread Old World tropical genus. G. M. Allen (1939) recognized seven African species. Of these, two (*borbonicus* and *robustus*) are now regarded as being strictly insular (Madagascar, Mascarenes). *Scotophilus gigas* (with its synonym *alvenslebeni*) is much larger than any of the other mainland forms and is a very distinct species. It has recently been recorded from the Sudan and is treated below. Two species recognized by Allen (*nigritellus* and *murinoflavus*) I regard as forms of *N. nigrita* and are treated in the account of that species. The remaining two species I regard as distinct. I cannot agree with Aellen (1956b, pp. 28-31) or Kock (1969, pp. 192, 193) in considering *S. viridis* to be conspecific with some or all the *nigrita* group. I therefore regard *S. viridis* as a southern African species extending no farther north than Tanzania and therefore unlikely to occur in the Sudan. The problem is further discussed in the *S. nigrita* account.

Scotophilus nigrita (Schreber)

- Vespertilio nigrita* Schreber, 1774, pp. 171, 188, pl. 58 (Senegal).
Nycticejus leucogaster Cretzschmar, 1826 [1826-1830], p. 71 ("Brunnen Nedger," Kordofan; I have been unable to place this locality; valid as a subspecies).
Nycticejus murino-flavus Heuglin, 1861, pp. 5, 15 (Garden of Makullu, near Massaua, Ethiopia [formerly Eritrea]; synonym of *S. n. leucogaster*).
Nycticejus flavigaster Heuglin, 1861, pp. 5, 14 (Keren, Ethiopia [formerly Eritrea]; synonym of *S. n. leucogaster*).
Nycticejus serratus Heuglin, 1877, p. 35 (Arashkol, Sherq el Aqabah, Blue Nile Province, Sudan; synonym of *S. n. leucogaster*).
Scotophilus nigritellus De Winton, 1899, p. 355 (Gambaga, Ghana; valid as a subspecies).
Scotophilus nigrita colias Thomas 1904a, p. 207 (Fort Hall, Kenya; valid as a subspecies).
Scotophilus altilis G. M. Allen, 1914, p. 350 (Aradeiba, above Rosieres, Blue Nile Province, Sudan; synonym of *S. n. leucogaster*).
Pachyotus (Scotophilus) borbonicus: Sassi, 1908, p. 158 (specimens from Khor Attar; not necessarily *Vespertilio borbonicus* E. Geoffroy).

Specimens Examined. 151 from *Equatoria*: Katire (one in alcohol), Latome (one in alcohol with extracted skull), Torit (one skin and skull, four in alcohol), Ikotos (two skins and skulls), Katuluru (two in alcohol), Terangole (one skin only at ZMK); *Bahr-el-Ghazal*: Yirol (five skins and skulls in AMNH), Lake Nyibor (five skins and skulls in AMNH); *Upper Nile*: Khor Attar (three in alcohol at NMW, mentioned by Sassi, 1908, p. 158), 8 miles east of Lake No (one skin and skull in BM); *Blue Nile*: Aradeiba (one skin and skull in MCZ, type of *altilis*), Fazogli (one skin and skull, one in alcohol, both in MCZ, mentioned by G. M. Allen, 1914, pp. 349, 351), Magangani (two in alcohol, one with extracted skull, both in MCZ, mentioned by G. M. Allen, 1914, p. 349), El Serifa (one in alcohol with extracted skull in MCZ, mentioned by G. M. Allen, 1914, p. 351), Bados (one skin and skull, mentioned by G. M. Allen, 1914, p. 351), Barakat (two in alcohol, one with extracted skull), Abu Zeit (two in alcohol in BM); *Kordofan*: El Obeid (two skins and skulls, eight skulls only, all in SMF and mentioned by Kock, 1969, p. 193, two

in alcohol in NMW and mentioned by Wettstein, 1918, p. 654), 60 miles west of El Obeid (one skin only in BM, mentioned by Thomas and Hinton, 1923, p. 250), no exact locality (one skin and skull in RML, two skins only in SMF, including type of *leucogaster*, one in alcohol in SMF), Kadugli (15 skins and skulls, four skulls only, 14 in alcohol, three with extracted skulls, all in SMF and mentioned by Kock, 1969, p. 193), Dilling (two skins and skulls, 17 in alcohol with extracted skulls, all in SMF and mentioned by Kock, 1969, p. 193), Rheika (one in alcohol with extracted skull in SMF, mentioned by Kock, 1969, p. 193), Khor Umm Adara (one in alcohol with extracted skull in SMF, mentioned by Kock, 1969, p. 193), Semeih (three in alcohol with extracted skulls in SMF, mentioned by Kock, 1969, p. 193), Kologi (three skins and skulls in SMF, mentioned by Kock, 1969, p. 193); *Darfur*: (all mentioned by Thomas and Hinton, 1923, p. 250): Zalingei (six skins and skulls, five in BM, one in MSNG, two skins only in BM), foothills of southern Jebel Marra at 4000 feet (one skin and skull, two skins only, all in BM); *Khartoum*: Khartoum (24 in alcohol, 21 in SMF, 14 with extracted skulls, one skull only in BM).

Measurements. Forearm length, 40 adult males (42-52), 64 adult females (44-53); condylobasal length, 26 adult males (16.1-17.7), 53 adult females (16.6-18.2); maxillary tooth-row length, 30 adult males (5.9-6.8), 58 adult females (6.1-6.7); width across last molars, 29 adult males (7.8-8.7), 57 adult females (7.9-8.8).

Other Sudan Records. Kock, 1969, pp. 197, 198 recorded this species from a few other localities in the Sudan, none of which add much distributional information.

Remarks. Clearly there are two sympatric species of *Scotophilus* in southern Africa (aside from *S. gigas*). The situation in the north is less clear. With the rather extensive series of Sudanese *Scotophilus* listed above, I cannot find any indication that two species are involved and therefore synonymize all alleged taxa from the Sudan and northern Ethiopia under the oldest name, *leucogaster*. Smaller individuals of the latter are only a little larger than *nigritellus* of the northern savanna belt of West Africa (forearm 42-44, condylobasal 15.6-16.0). I am therefore inclined to agree with Aellen (1956b, pp. 28-31)

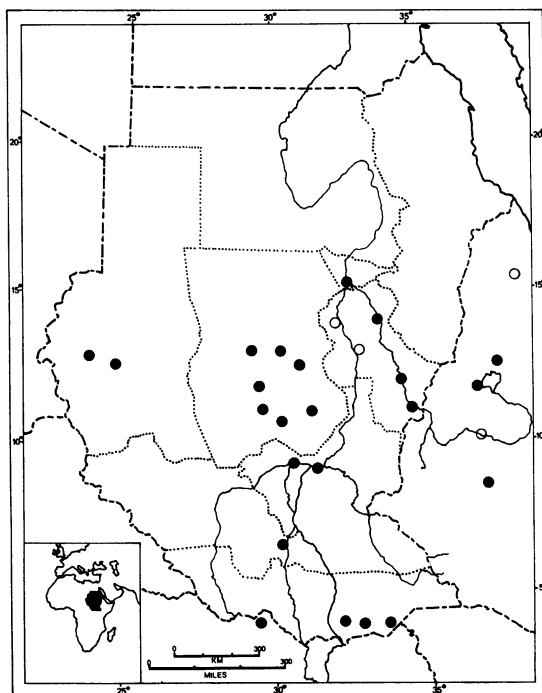


FIG. 47. Distribution of *Scotophilus nigrita* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

in regarding the two forms as conspecific. These relatively small northern savanna forms, with a range from Senegal to western Ethiopia are also very similar to the Southern African *viridis*. There also seems to be limited sympatry between the small savanna *nigritellus* and the large forest *S. n. nigrita*, at least in Senegal, with no indication of intergradation. I was therefore at first inclined to agree with Aellen (1956b, pp. 28-31) that the small northern savanna forms and the small southern African *viridis* should be combined as one species, distinct from *S. nigrita*, for which the oldest name would be *leucogaster*. Ansell (1960a, p. 23) also followed Aellen in referring the small southern African species to *S. leucogaster*.

Study of specimens from Somalia and eastern Ethiopia, however, convinces me that this reasonable suggestion is untenable. These populations bridge the gap between *S. n. colias* of Uganda, Kenya, and southern Somalia on one hand and *S. n. leucogaster* of the Sudan and western Ethiopia

on the other. It therefore seems clear that *leucogaster* and *nigritellus* must be disassociated from *S. viridis* and included in *S. nigrita* in spite of their greater resemblance to the former than to the latter. *Scotophilus nigrita leucogaster* appears to occupy the entire Sudan south of the desert as well as the northeastern corner of Zaire and northwestern Ethiopia; *S. n. colias* is the only *Scotophilus* recorded from Kenya, but it is not clear exactly where the zone of intergradation with *S. n. leucogaster* should be drawn, although specimens from southern Somalia seem clearly referable to *colias*. Kock's (1969, p. 196) arrangement is quite different, but for the reasons given above, appears untenable.

Scotophilus gigas Dobson

Scotophilus gigas Dobson, 1875a, p. 122 (Lagos, Nigeria).

Scotophilus alvenslebeni Dalquest, 1965, p. 258 (Save River, south bank [212 km. SSW Beira], Mozambique; valid as a subspecies).

Specimens Examined. Three from Kordofan: Kadugli (one skin and skull, two in alcohol with extracted skulls, all in SMF and mentioned by Kock, 1969, p. 204).

Measurements. Forearm length, two adult males (80, 83), one adult female (89); condylobasal length, two adult males (27.0), one adult female (27.7).

Other Sudan Records. None

Remarks. The few known localities for this species range from Senegal to Mozambique. Until Kock's record, however, none were from anywhere near the Sudan and its occurrence there was quite unexpected. Presumably the species has an even wider distribution than the few records indicate. Dalquest later recognized (1966, p. 134) that his new species was a synonym of *S. gigas*. De Vree (1973), however, recognized *alvenslebeni* as a valid subspecies. Sudanese specimens are referable to *S. g. gigas*.

Otonycteris hemprichi Peters

Otonycteris hemprichi Peters, 1859, p. 223 (no type locality designated; Kock, 1969, pp. 183, 184, has restricted it to the Nile Valley between Assuan in Egypt and Northern Province, Sudan).

Plecotus ustus Heuglin, 1877, p. 30 (the earlier

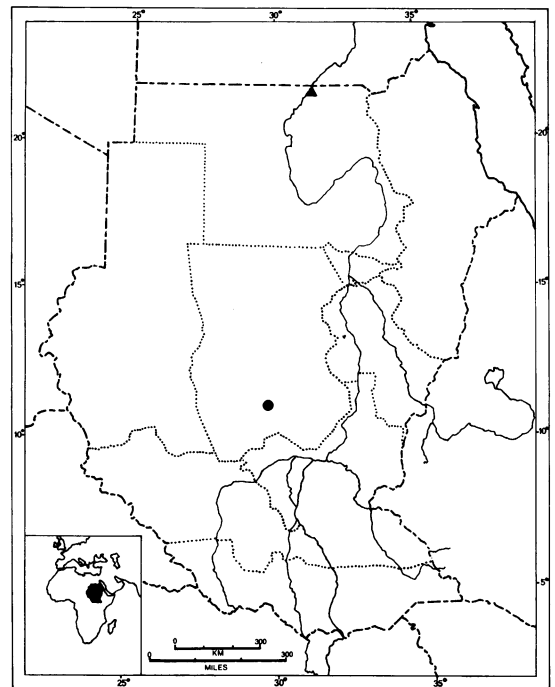


FIG. 48. Distribution of *Scotophilus gigas* (circle) and *Otonycteris hemprichi* (triangle) in the Sudan.

appearance of this name in Fitzinger, 1866, p. 546, is a *nomen nudum*; Wadi Halfa, Baten el Hadjar, Northern Province, Sudan).

Specimens Examined. One from Northern: Wadi Halfa (one in alcohol at NMW, type of *ustus*).

Measurements. Forearm length, one adult male (58). Skull not extracted.

Other Sudan Records. None.

Remarks. This is a species of the arid southwestern portion of the Palearctic region. It enters the Sudan only at its extreme northern edge, possibly only along the Nile River.

Plecotus auritus (Linnaeus)

Vespertilio auritus Linnaeus, 1758, p. 32 (Sweden).

Vespertilio auritus austriacus Fischer, 1829, p. 117 (Vienna, Austria; valid as a subspecies, at least).

Vespertilio auritus aegyptius Fischer, 1829, p. 117 (Giza, Egypt [not *Vespertilio pipistrellus*]

var. *aegyptius* Fischer, 1829, p. 105, which = *Pipistrellus kuhli*]).

Plecotus christii Gray, 1838, p. 495 ("North Africa"; valid as a subspecies).

Specimens Examined. None from the Sudan.

Measurements. Specimens from Sakkara and Siwa in Egypt: Forearm length, three adult males (37-39), six adult females (37-40); condylobasal length, two adult males (14.8, 15.5), four adult females (15.0-15.5).

Other Sudan Records. Northern: Fifth Cataract of the Nile (Flower, 1932, p. 381).

Remarks. A number of authors (e.g. Bauer, 1960, and Hanak, 1966) have shown quite convincingly that two closely related forms of *Plecotus*, acting like species, occur sympatrically over much of Europe, the oldest valid names being *auritus* and *austriacus*. Although the two forms in Europe can be distinguished on the basis of several characters, some of these, at least, have a tendency to break down outside Europe (see Wallin, 1969, pp. 341-342 and Harrison, 1964a, p. 181). For instance, the Arabian-North African

subspecies *christii* agrees better in size with *auritus*, but in color, bullar size, and shape of the baculum with *austriacus*. Inasmuch as the two European species have not been clearly distinguished throughout their extensive Palearctic range and as intergradation between them in southern or eastern Asia remains a distinct possibility, I prefer to retain them in a single species, *P. auritus*. It is probable, however, that a clear-cut species differentiation can eventually be demonstrated, in which case *christii* will presumably stand as a subspecies of *P. austriacus*. *Plecotus* is very marginal in the Sudan, with only a single record known. It has also been recorded in Ethiopia (Senna, 1905, p. 285; Kock, 1969, p. 180), however, and is therefore to be expected in the Red Sea hills. Clearly it has entered the Sudan from the north.

MINIOPTERUS BONAPARTE

G. M. Allen (1939, pp. 102-104) recognized nine species of the genus *Miniopterus* on the continent of Africa. However, as a result of the work of several recent authors (Aellen, 1956a, p. 891; Harrison, 1953; Koopman, 1966, p. 161), this number has been reduced to three, the large *inflatus*, the middle-sized *schreibersi* (also found in the Palearctic), and the small *minor*. Of these three species, *minor* is not known north of extreme southern Kenya (Harrison, 1961, p. 294), and almost certainly does not reach the Sudan. *Miniopterus schreibersi* does reach the Sudan and is treated in the account below. *Miniopterus inflatus* is not known from the Sudan, but its northeastern subspecies, *M. i. africanus*, is known from Ethiopia (Sanborn, 1936, pp. 111-112), Somalia (Funaioli and Lanza, 1968, pp. 200-201), Kenya (Harrison, 1961, p. 294), and Uganda (AMNH specimens from Busia). It is probable therefore that it reaches the mountains of south-eastern Sudan.

Miniopterus schreibersi (Kuhl)

Vespertilio schreibersi Kuhl, 1819, p. 185 (Kulmbozer Cave, mountains of Southern Bannat, Hungary [now in Romania]).

Vespertilio natalensis A. Smith, 1833, pp. 59, 60 (Natal, South Africa, fixed by Roberts, 1951, at Durban; valid as a subspecies).

Miniopterus breyeri Jameson, 1909, p. 471 (Gat-

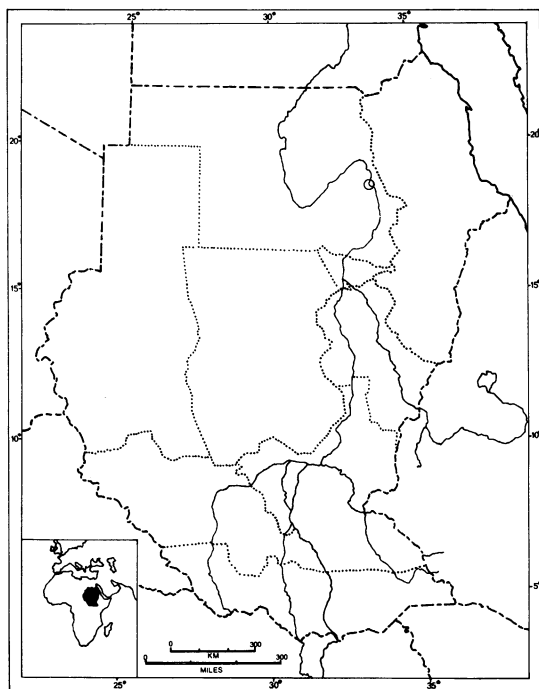


FIG. 49. Distribution of *Plecotus auritus* in the Sudan; a single published record, not seen.

koppies, Waterberg Dist., western Transvaal, South Africa; synonym of *M. s. natalensis*).

Miniopterus natalensis arenarius Heller, 1912, p. 2 (Guaso Nyuki, Northern Guaso Nyiro, Kenya; valid as a subspecies).

Miniopterus breyeri vicinior J. A. Allen, 1917, p. 450 (Aba, Oriental Province, Zaire; probably valid as a subspecies).

Specimens Examined. 15 from *Equatoria*: Imurok (three skins and skulls, three in alcohol), Katire (three skins and skulls in ZMK, four in alcohol, two in ZMK), Lokwi (one in alcohol); *Upper Nile*: Kaka (one in alcohol in USNM).

Measurements. Forearm length, six adult males (44-45), six adult females (43-45); condylobasal length, one adult male (14.1), four adult females (14.1-14.8).

Other Sudan Records. Kock (*in litt.*) reported a specimen in the Alexander Koenig Museum (Bonn) from somewhere on the Bahr-el-Ghazal.

Remarks. The distribution of *Miniopterus schreibersi* (as now constituted) in Africa is markedly discontinuous. As is the case of many

Palaearctic species it occurs in northwestern Africa (Morocco to Tunisia) and around the eastern end of the Mediterranean as far south as Israel, but not in Egypt. However (unlike most Palaearctic species), very similar (and I believe conspecific) populations occur south of the Sahara from Guinea to Ethiopia and south to South Africa. In the Sudan it is only known from three localities in or near the Imatong Mountains in the extreme southeast and from two records much farther north. Very likely *Miniopterus* is confined in the Sudan to more mesic areas, but even so, it probably occurs more widely than it has been recorded. Its occurrence in southwestern Sudan is to be expected in view of its presence at Aba, close to its borders in northeastern Zaire.

Available Sudan specimens agree more closely with the East African subspecies, *arenarius*, than with the smaller Zaire *vicinior* (condylobasal 13.6-14.1). The latter subspecies may occur in the southwestern Sudan, however. Much of the Sudan lies in the great hiatus between the Palaearctic and Ethiopian portions of the range of *M. schreibersi*. Just where the former connection between these two portions might have been is uncertain.

MOLOSSIDAE

This is a widespread almost cosmopolitan family. G. M. Allen (1939) recognized eight African genera. However, of these, *Nyctinomus* is currently regarded as a synonym of *Tadarida*, whereas *Chaerephon*, *Mops*, and *Mormopterus* are considered subgenera of it (Ellerman, Morrison-Scott, and Hayman, 1953, p. 64) and I believe that *Xiphonycteris* should also be included within *Tadarida*. The status of these generic names will be discussed in the *Tadarida* account below. On the other hand, Peterson (1965, p. 12) considered *Sauromys* (treated by Allen as a subgenus of *Platymops*) to be a full genus. Of the five genera here recognized, *Tadarida* and *Platymops* are known from the Sudan and are treated below. *Sauromys* is confined to southern Africa and almost certainly does not reach the Sudan. The remaining two genera, *Myopterus* (= *Eomops*) and *Otomops*, however, may occur there although not at present recorded.

Myopterus whitleyi has been recorded from

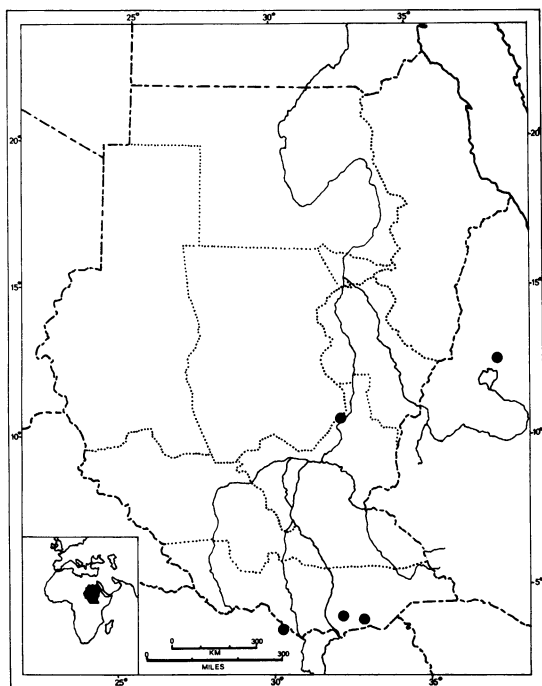


FIG. 50. Distribution of *Miniopterus schreibersi* in the Sudan.

Uganda (De Beaux, 1922b, p. 369), and *M. albatrus* is known from northeastern Zaire (Hayman, Misonne, and Verheyen, 1966, p. 68). *Otomops martiensseni* occurs in the Garamba National Park in northeastern Zaire (Verschuren, 1957, p. 427) and French Somaliland (Hill and Morris, 1971, p. 46). Any of these three species may reach the southern edge of the Sudan.

TADARIDA RAFINESQUE

This is by far the largest and most complex genus of molossids, with a distribution that is virtually coextensive with that of the family. Africa is undoubtedly the continent with the maximum number and diversity of species of *Tadarida*, and the determination of the actual number of good species has been a major problem. I have tried to summarize the present state of our knowledge on this topic before going into the species known from the Sudan. Probably the most convenient way of doing this is to take up the various subgenera in turn, although there has been some disagreement concerning what species to allocate to what subgenera.

Subgenus *Mormopterus* — G. M. Allen (1939, p. 109) recognized three species but *setiger* has since been transferred to *Platymops* (Harrison and Fleetwood, 1960). *Tadarida (M.) albiventer* (for which *jugularis* is apparently the oldest name, see Hayman and Hill, 1971, p. 59) is confined to Madagascar, but *T. (M.) acetabulosus* has been recorded twice from the mainland as well as occurring on Madagascar and the Mascarenes. The latter species has been found in Ethiopia (Hill and Morris, 1971, p. 48) and South Africa and may therefore occur in the southeastern Sudan.

Subgenus *Tadarida* — G. M. Allen (1939) called this subgenus the genus *Nyctinomus* and included 15 species in it. Since then, one (*spillmani*) has been transferred to the subgenus *Chaerephon* (Ellerman, Morrison-Scott, and Hayman, 1953, p. 67), another (*ochraceus*) has been transferred to a species I now include in the subgenus *Xiphonycteris* (Koopman, 1965, p. 22), a third (*condylurus*) has been transferred to the subgenus *Mops* (Ellerman, Morrison-Scott, and Hayman, 1953, p. 69), whereas *dubius* is considered to be indeterminate (Ellerman, Morrison-Scott, and Hayman, 1953, p. 70). On the other hand, *bivittatus*, considered a *Chaerephon* by

Allen is here considered to be a member of the subgenus *Tadarida* (see account below). *Tadarida rueppelli*, considered by Allen to be a senior synonym of *T. (Mops) midas*, has since been shown (Ellerman and Morrison-Scott, 1951, p. 134) to be a subspecies of the Palearctic *T. (T.) teniotis*. Another African species of the subgenus *Tadarida* has been described since 1939, *T. masoni* Roberts, 1946. The latter is probably no more than a subspecies of *T. (T.) fulminans*, which has an extensive eastern African distribution (Hayman and Hill, 1971, p. 65). I have previously dealt with *anchietae* and *bocagei* as a form of *T. aegyptiaca* (Koopman, 1966, p. 161) and I concur with Kock (1969, p. 137) in treating *tongaensis* as a synonym of *aegyptiaca*. Peterson (1972, p. 15) has shown that the type of *brunnea* should also be included in *T. aegyptiaca*, although another specimen (from western Zaire) later referred to *brunnea* (Kershaw, 1923, pp. 358, 359) has been reidentified as *T. (Chaerephon) aloysiisabaudiae*. As explained below, I regard *cisturus* as a subspecies of *T. (T.) bemmeli*. The African members of *T. (Tadarida) sensu* Rosevear (1965, p. 325) may be arranged as follows:

- T. teniotis* group (large forms) — *teniotis* (including *rueppelli*), *lobata*, *fulminans* (including *masoni*), *africana*.
- T. aegyptiaca* group (relatively small with low braincase, anterior palatal emargination unconstricted) — *aegyptiaca* (including *tongaensis*, *anchietae*, *brunnea*, *bocagei*).
- T. bemmeli* group (relatively small with a high braincase, anterior palatal emargination constricted) — *bivittata*, *ansorgei*, *bemmeli* (including *cistura*).

Of these species, *africana*, *aegyptiaca*, *bivittata*, *ansorgei*, and *bemmeli* are all known from the Sudan and are treated in accounts below. *Tadarida teniotis*, although several times (erroneously) recorded from the Sudan, is not definitely known in Africa south of lower Egypt and probably does not occur in the Sudan. *Tadarida fulminans* has a fairly extensive eastern African distribution but is not known north of southern Kenya (Harrison, 1961, p. 291) and therefore probably does not reach the Sudan. *Tadarida lobata*, on the other hand, was described from northwestern Kenya, and may reach the southern edge of the Sudan. Long known only by the type, it has recently (Peterson and Harrison, 1970) been recorded far to the south in Rhodesia as well as from a second locality in northwestern Kenya.

Subgenus *Chaerephon* — G. M. Allen (1939)

included 20 species in this subgenus (by him considered a genus). However, as explained below, I am transferring *bivittata* to *T. (Tadarida)*. Also, I have seen numerous specimens of *leucostigma* (including the type) and it is clear that it should be placed in the subgenus *Mops*, probably as a subspecies of *T. (M.) condylura*. However, *aloyysiabaudiae*, placed by Allen as a subspecies of *Mops angolensis*, has been shown by Lanza and Harrison (1963) to be a good species of *T. (Chaerephon)*. As I earlier pointed out (Koopman, 1965, pp. 21, 22), *spillmani* should be removed from *Nyctinomus* where Allen placed it and transferred to *Chaerephon* as a subspecies of *T. (C.) nigeriae*. Two members of the subgenus *Chaerephon* have been described since Allen but neither appear to be valid as a species. *Chaerephon faini* Hayman (1951, p. 82) is at most a subspecies of *T. (C.) pumila* (see Hayman, Misonne, and Verheyen, 1966, p. 62). *Tadarida cyclotis* Brosset (1966, p. 80) appears, on the basis of comparison of Brosset's description and figure with a specimen, description, and figures of *T. (C.) aloysiisabaudiae*, to be only a western form of that species (with which it was not compared by Brosset). Fenton and Peterson (1972, p. 20) have come to the same conclusion. The following forms recognized as separate species by Allen are here regarded as forms of *T. pumila*: *frater*, *gambianus*, *hindei*, *limbatus*, *websteri*, *cristatus*, *langi*, *nigri* (see Koopman, 1965, 1966; and Kock, 1969). Two insular forms (*leucogaster* and *pusillus*) are also close to *T. pumila* and are probably subspecies of it. They will not be considered further. *Chaerephon abae* has already been merged with *T. (C.) major* (see Koopman, 1965, p. 25). Ellerman, Morrison-Scott, and Hayman (1953, p. 69) have merged *lancasteri* and *shortridgei* with *T. (C.) chapini*. Thus I recognize only six African mainland species of *T. (Chaerephon)*: *nigeriae*, *major*, *pumila*, *chapini*, *russata*, *aloyysiabaudiae*. Of these, *major* and *pumila* are known from the Sudan and are treated below. *Tadarida russata*, known from only a few localities (see Fenton and Peterson, 1972), appears to be confined to the main forest block and probably does not reach the Sudan. *Tadarida nigeriae*, *T. chapini*, and *T. aloysiisabaudiae*, however, are each known from northeastern Zaire north of the forest (Hayman, Misonne, and Verheyen, 1966; Peterson, 1972, p. 14), whereas *T. nigeriae* has recently (Hill and Morris, 1971, p. 47) been recorded from central Ethiopia. Any one of them, therefore, may occur in southern Sudan.

Subgenus *Xiphonycteris* – *Xiphonycteris* was

described by Dollman (1911) to include a single still poorly known species, *X. spurrelli*. Randolph Peterson first pointed out to me (oral commun.) the close resemblance between this species and *T. (Mops) nanulus* and I have since confirmed this by direct comparison of a male paratype of *nanulus* with the (male) type of *spurrelli*. I am convinced that they belong together in what seems most reasonably to be regarded as a subgenus of *Tadarida*. Two other species (*leonis* and *thersites*) are closely related to *T. nanulus*, and should be placed here. Thus conceived, *T. (Xiphonycteris)* would include forms with a reduced last upper molar (and therefore previously placed in the subgenus *Mops*) and with a well-developed anterior palatal emargination (as in the subgenus *Tadarida*). The subgenus *Mops* would then be restricted to species with a reduced last upper molar and a closed palate. So conceived, *Xiphonycteris* remains an African mainland group restricted to the Ethiopian region, since the Malagasy (*leucostigma*, *miarensis*) and Indo-Malayan (*mops*, *lanei*, *sarsinorum*) species of *Mops* all have a closed palate. Besides the four above-mentioned West African species (*spurrelli*, *nanulus*, *leonis*, *thersites*) there is a poorly known East African form (*brachypterus*) that probably belongs here. Actually, it may be the eastern representative of one of the four better known west African species, but its name antedates any of them. I have previously (Koopman, 1965, pp. 22, 25) shown that *ochraceus* and *occipitalis* (listed as valid species of *Mops* by G. M. Allen, 1939) are best regarded as subspecies of *leonis* and *thersites*, respectively. *Tadarida (X.) spurrelli*, *leonis*, and *thersites* all seem to be confined to the West African forest block, although *leonis* does occur in the Budongo Forest of western Uganda (AMNH specimens). *Tadarida (X.) brachyptera* has been recorded from as far north as southern Kenya (Dobson, 1880, p. 194) and southern Uganda (De Beaux, 1922b, pp. 369-370). Probably none of these reach the Sudan. *Tadarida (X.) nanula*, however, reaches extreme northeastern Zaire, Uganda, and Kenya (see De Beaux, 1922b, pp. 372, 373; Hayman, Misonne, and Verheyen, 1966, p. 66; Start, 1969, pp. 220-223). It might, therefore, reach the southern edge of the Sudan. No member of the subgenus has been recorded from the Sudan, however.

Subgenus *Mops* – The remainder of what has been called *Mops* (i.e., those species of *Tadarida* that share a reduced last upper molar with a closed anterior palatal emargination) constitutes the subgenus *Mops* as understood here. Leaving out the species that I have transferred to *Xipho-*

nycteris, Allen recognized 10 species. However, as indicated above, *aloyisiabaudiae* (listed as a subspecies of *angolensis* by Allen) has since been transferred to *T. (Chaerephon)*. The species called *Nyctinomus condylurus* by Allen has, as indicated above, been transferred to *Mops* and is the oldest name for the species called *angolensis* by Allen. Study of the original material of *angolensis niveiventer* makes it clear that it has the characters of *chitauensis* rather than *condylura* (= *angolensis*) (see Koopman, 1966, pp. 162, 163). *Tadarida niveiventer* being the older name must take precedence over *chitauensis*. It should be pointed out that examination of the types shows that both *leucostigma* G. M. Allen, 1918, and *orientis* Allen and Loveridge, 1942, are forms of *T. condylura*, not of *T. niveiventer*. As indicated above, Allen was in error in regarding *rueppelli* as a senior synonym of *midas* so *T. (M.) midas* becomes the proper name of the species. I have previously shown (Koopman, 1965) that *faradjius* is best considered a synonym of *T. (M.) demonstrator* and *osborni* a subspecies of *T. (M.) condylura*. The Malagasy forms, *leucostigma* and *miarensis*, seem best considered subspecies of *T. (M.) condylura* and *T. (M.) midas* respectively. In 1965, I treated *niangarae* as a separate species and *trevori* as a subspecies of *T. congica*. Recently Peterson (1972) has shown, on the basis of considerably more material than was available previously, that *congica* and *trevori* differ by several characters and are sympatric in the Budongo Forest of western Uganda. He also

interpreted the one character of *niangarae* as due to the method of preparation of the skin. I am skeptical as to the possibility that the great distortion he postulated could have occurred but, in view of the absence of any other specimens or characters for *niangarae*, I reluctantly follow him. The species of *T. (Mops)* therefore may be grouped as follows:

Tadarida condylura group (forms with only partially reduced third commissure on last upper molar) — *condylura* (including *angolensis*, *leucostigma*, *osborni*, *orientis*).

Tadarida mops group (small forms with greatly reduced third commissure on last upper molar) — *niveiventer* (including *chitauensis*), *demonstrator* (including *faradjius*); the Asian species *mops* and *sarsinorum* (including *lanei*) also belong here.

Tadarida midas group (large forms with greatly reduced third commissure on last upper molar — *trevori* (including *niangarae*), *congica*, *midas* (including *miarensis*)).

Of these African mainland species, *condylura*, *demonstrator*, and *midas* are known from the Sudan. *Tadarida (M.) niveiventer* is a southern form whose known northern limit is in Rwanda (Hayman, Misonne, and Verheyen, 1966, p. 65) and so is unlikely to reach the Sudan, as is *congica*, which is probably confined to the main forest block. *Tadarida (M.) trevori* is known from northeastern Zaire north of the forest block and in northwestern Uganda, and so may reach the southwestern edge of the Sudan.

KEY TO SKULLS OF *TADARIDA* EXPECTED IN THE SUDAN

- 1-Only one upper premolar; three pairs of lower incisors; condylobasal length less than 15 *acetabulosus*
- 1A-Almost invariably two upper premolars; not more than two pairs of lower incisors in Sudanese species; condylobasal length generally more than 15.
- 2-Anterior palatal emargination well developed, extending behind upper incisors, and including area of incisive foramina.
- 3-Third commissure of last upper molar well developed, almost as long as second commissure.
- 4-Condylobasal length more than 21.
- 5-Interdental palatal length more than twice width at anterior end *lobata*
- 5A-Interdental palatal length less than twice width at anterior end *africana*
- 4A-Condylobasal length less than 21.
- 6-Forehead flat; width of anterior palatal emargination more than diameter of upper incisor *aegyptiaca*
- 6A-Forehead elevated; width of anterior palatal emargination less than diameter of upper incisor.
- 7-Condylobasal length more than 17.
- 8-Zygomatic breadth more than 12 *bivittata*
- 8A-Zygomatic breadth less than 12 *ansorgei*
- 7A-Condylobasal length less than 17 *bemmelini*

- 3A-Third commissure of last upper molar reduced, much shorter than second commissure .*nanula*
 2A-Anterior palatal emargination greatly reduced, not extending behind upper incisors and separated from incisive foramina by bony bar.

9-Third commissure of last upper molar well developed, almost as long as second commissure.

10-Basisphenoid pits deep, separated by high ridge; forehead invariably well elevated *aloysiisabaudiae*

10A-Basisphenoid pits shallow, separated at most by a low ridge.

11-Forehead virtually flat; maxillary tooth-row length more than 6.3.

12-Interdental palate approximately twice as long as wide (measured at the anterior end of the posterior premolar) *nigeriae*

12A-Interdental palate clearly less than twice as long as wide (measured at the anterior end of the posterior premolar). *major*

11A-Forehead distinctly elevated; maxillary tooth-row length less than 6.3.

12-Interdental palate approximately twice as long as wide . . *chapini*

12A-Interdental palate approximately one and a half times as long as wide *pumila*

9A-Third commissure of last upper molar reduced, clearly shorter (usually much shorter) than second commissure.

13-Condylbasal length more than 23 *midas*

13A-Condylbasal length less than 23 but more than 21 . . *trevori*

13B-Condylbasal length less than 21.

14-Third commissure of last upper molar clearly present and approximately half as long as second commissure

. *condylura*

14A-Third commissure of last upper molar absent or vestigial *demonstrator*

Tadarida (Tadarida) africana (Dobson)

Nyctinomus africanus Dobson, 1876b, p. 348.
 Transvaal, South Africa.

Specimens Examined. Five from *Equatoria*: Katire (two skins only, three in alcohol with extracted skulls).

Measurements. Forearm length, one adult male (63), three adult females (63-64); condylbasal length, three adult females (22.9-23.7); zygomatic width, two adult females (14.8, 15.2); interorbital width, three adult females (5.8-6.1); width across last molars, three adult females (10.3-10.8); maxillary tooth-row length, three adult females (8.7-9.4).

Other Sudan Records. None. These appear to be the first records from the Sudan.

Remarks. Until recently, this species was known only from southern Africa, but in recent years it has turned up in northeastern Zaire, Kenya, Ethiopia (Hill and Morris, 1971, p. 47), and Tanzania (Harrison, 1971), so its occurrence in the Imatong Mountains of southeastern Sudan is not surprising. It is to be expected in other mountains in the region.

Tadarida (Tadarida) aegyptiaca (E. Geoffroy)

Nyctinomus aegyptiacus E. Geoffroy, 1818, p. 128, pl. 2, no. 2 ("Egypt"); I hereby restrict the type locality to Giza, where several of the other bats described by E. Geoffroy originated; most later Egyptian specimens of this species have come from near this locality).

Dysopes geoffroyi Temminck, 1827, p. 226 (substitute name for *aegyptiacus*).

Dysopes talpinus Heuglin, 1877, p. 28 (Kodj District, west bank of Bahr el Jebel, Bahr-el-Ghazal Province, Sudan).

Nyctinomus tongaensis Wettstein, 1916, p. 192 (Tonga, Upper Nile Province, Sudan).

Specimens Examined. 21 from *Equatoria*: Lokwi (18 in alcohol, two with extracted skulls); *Upper Nile*: Tonga (two in alcohol in NMW, one with extracted skull, including type of *tongaensis*); *Darfur*: 125 miles east of El Fasher (one skin and skull in BM, mentioned by Thomas and Hinton, 1923, p. 251).

Measurements. Forearm length, 10 adult males (51-55), 11 adult females (49-54); condylbasal length, two adult males (19.4, 20.1), two adult females (19.1, 19.5); zygomatic width, two adult

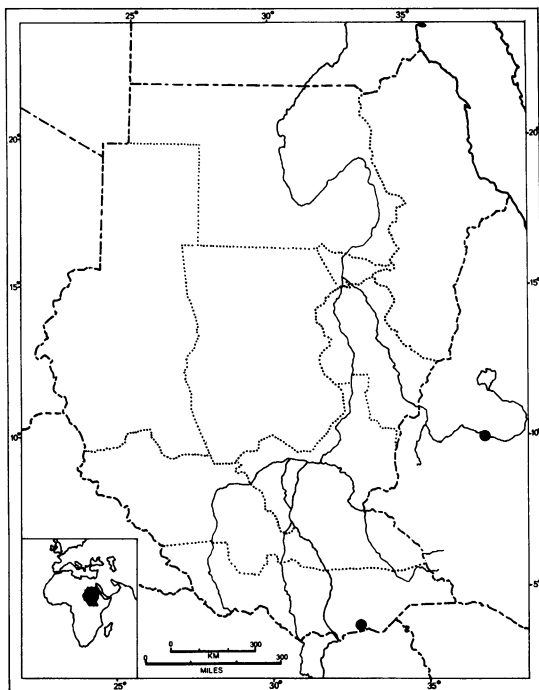


FIG. 51. Distribution of *Tadarida africana* in the Sudan.

males (12.3, 12.9), two adult females (12.1, 12.4); interorbital width, two adult males (4.6, 4.9), two adult females (4.2, 4.7); width across last molars, two adult males (8.8, 8.9), two adult females (8.5, 8.6); maxillary tooth-row length, two adult males (7.4, 7.7), two adult females (7.4).

Other Sudan Records. None except Kock's (1969, p. 138) vague record from "Bahr el Zeraf" in Upper Nile Province.

Remarks. I am in thorough agreement with Kock (1969, p. 137) in synonymizing *tongaensis* with *T. a. aegyptiaca*. G. M. Allen (1939, p. 104) placed *talpinus* in the synonymy of *T. bivittata*, but Hayman and Harrison (1966, p. 225) rejected this. Kock (1969, p. 137) has tentatively placed this name in the synonymy of *T. aegyptiaca* and I am inclined to agree. This species has a wide, albeit spotty, distribution from India to Nigeria and South Africa. There are no records along the Nile between Tonga and lower Egypt, however, and the Egyptian localities seem rather isolated. However, the records from Queseir (southeastern Egypt) and Keren (northern Ethiop-

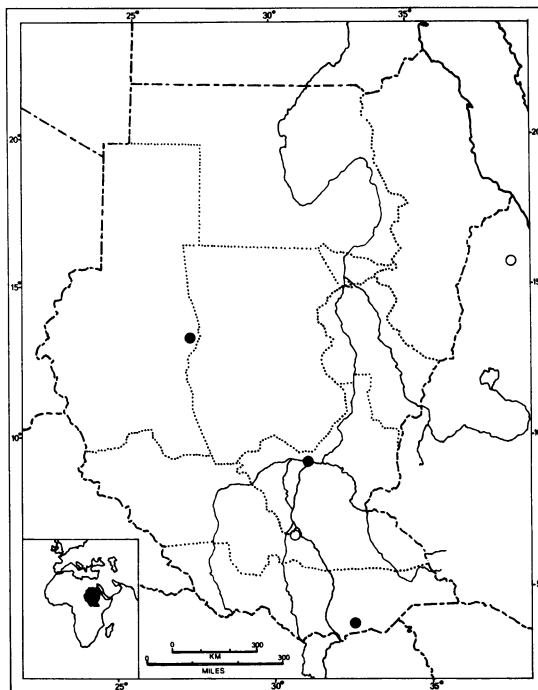


FIG. 52. Distribution of *Tadarida aegyptiaca* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

ia), both cited by Kock (1959, p. 138), suggest that the past (and possibly present) connection is along the Red Sea hills.

Tadarida (Tadarida) bivittata (Heuglin)

Nyctinomus bivittatus Heuglin, 1861, pp. 4, 13 (Keren, Eritrea [now in Ethiopia]).

Specimens Examined. Eight from *Equatoria*: Katire (one skin and skull, two in alcohol), Ikoto (four skins and skulls, one in alcohol with extracted skull).

Measurements. Forearm length, five adult males (48-51), three adult females (48); greatest length of skull, one adult male (19.7), three adult females (19.3-19.9); condylobasal length, one adult male (18.2), three adult females (18.0-18.5); zygomatic width, three adult males (12.4-12.7), two adult females (12.2, 12.3); interorbital width, three adult males (4.2-4.3), three adult females (4.3-4.4); width across last molars, three adult males (8.8-9.2), three adult females (8.4-8.9); maxillary tooth-row length,

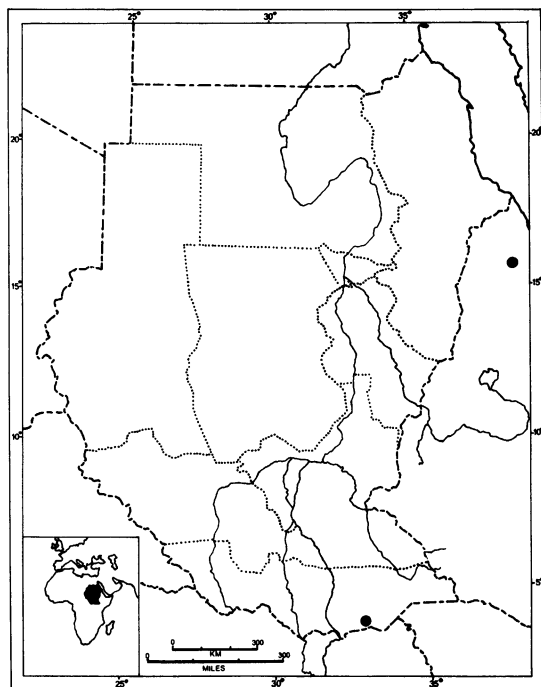


FIG. 53. Distribution of *Tadarida bivittata* in the Sudan.

three adult males (7.1-7.6), three adult females (7.0-7.1).

Other Sudan Records. None. These appear to be the first records from the Sudan.

Remarks. Hayman and Harrison (1966) have greatly clarified the status of this species and I am inclined to agree with them that *hepaticus* and *talpinus* should be excluded from the synonymy. The former has been tentatively allocated to *T. condylura* and the latter to *T. aegyptiaca* following Kock's (1969, p. 148) suggestions. I also agree with Hayman and Harrison in rejecting G. M. Allen's (1914, pp. 352, 353) record from the Blue Nile. I have seen the two specimens in question and identify them as *T. (Mops) demonstrator*. I cannot agree with Hayman and Harrison, however, in referring *bivittata* to the subgenus *Chaerephon* and it is not clear to me why this was done except that *bivittata* had been previously placed close to *T. (Chaerephon) plicata* of Asia, a relationship which now seems unlikely. I believe that *bivittata* belongs close to *ansorgei* and *bemmelini* with which it shares a high braincase and constricted (but not closed) anteri-

or palatal emargination. If these species are to be referred to *Chaerephon* (and if some are, then I think all should), then this subgenus must be redefined. If all species in which the anterior palatal emargination is constricted are to be allocated to *Chaerephon*, then the Australasian *australis* (including *kuboriensis*) and the following American species currently allocated to the subgenus *Tadarida* must also be allocated to *Chaerephon*: *macrotis* (= *molossa*), *aurispinosa*, *laticaudata* (including *yucatanica* and *europis*), and presumably *femorosacca* (which I have not checked in this regard). This would restrict typical *Tadarida* to the *teniotis* group, *aegyptiaca*, and *brasiliensis*. *Tadarida bivittata* has a rather extensive eastern African distribution from Ethiopia to Zambia, but in the Sudan is only known from the mountain region of the extreme southeast.

Tadarida (Tadarida) ansorgei (Thomas)

Nyctinomus ansorgei Thomas, 1913, p. 318 (Malange, Angola).

Specimens Examined. Four from Equatoria: Lokwi (two in alcohol with extracted skulls), Torit (one in alcohol with extracted skull), Kibish Wells, (one skin and skull in DH, mentioned by Harrison, 1959, p. 226).

Measurements. Forearm length, two adult males (44, 45) two adult females (44, 46); total length of skull, one adult male (19.3), two adult females (18.6, 19.1); condylobasal length, one adult male (17.9), two adult females (17.4, 17.6); zygomatic width, one adult male (11.9), two adult females (11.0, 11.3); interorbital, one adult male (4.0), two adult females (8.3, 8.4); maxillary tooth-row length, two adult males (7.0, 7.2), two adult females (6.9, 7.0).

Other Sudan Records. None.

Remarks. This is another chiefly eastern African species that barely reaches the extreme southern Sudan. Although only recorded from the southeast, its presence in Garamba National Park of northeastern Zaire makes its presence in the extreme southeast probable.

Tadarida (Tadarida) bemmelini (Jentinck)

Nyctinomus bemmelini Jentinck, 1879, p. 125 ("Liberia"; Kuhn, 1965, p. 327, considered this "locality" doubtful).

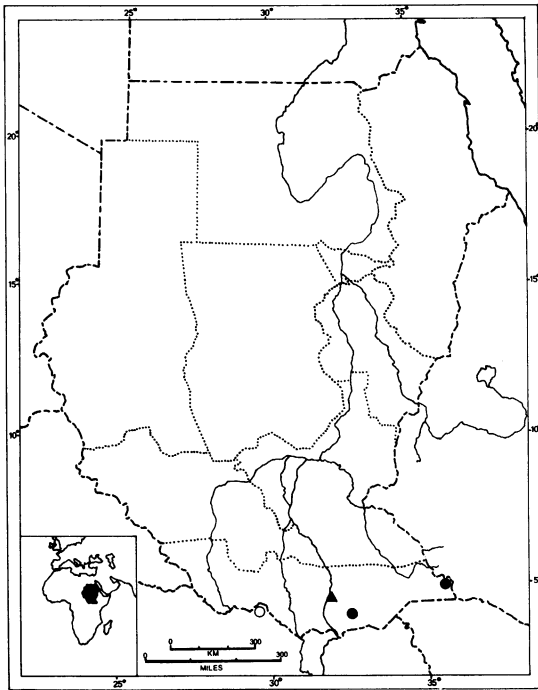


FIG. 54. Distribution of *Tadarida ansorgei* (circles) and *Tadarida bemmelinei* (triangle) in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Nyctinomus cisturus Thomas 1903c, p. 502 (Mongalla, Equatoria Province, Sudan; valid as a subspecies).

Specimens Examined. One from *Equatoria*: Mongalla (one in alcohol with extracted skull in BM, type of *cisturus*).

Measurements. All of one adult male: Forearm length (46); total length of skull (17.8); condylobasal length (16.6); zygomatic width (10.9); interorbital width (3.9); width across last molars (7.8); maxillary tooth-row length (6.5); braincase height (6.9).

Other Sudan Records. None.

Remarks. I have compared a specimen (AMNH 83921) from Mawere, Tanzania, with the types of both named forms. The Mawere specimen is clearly similar to both and I am therefore merging them. I am therefore in full agreement with Peterson (1971, pp. 1350-1351), who made *cistura* a subspecies of *bemmelinei* on the basis of a large series of *T. b. bemmelinei* from

Cameroon. All known localities of *T. b. cistura* are in a relatively small area of southern Sudan, Uganda, western Kenya, northern Tanzania, and northeastern Zaire.

Tadarida (Chaerephon) major (Trouessart)

Nyctinomus pumilus var. *major* Trouessart, 1897, p. 146 ("Cataract of the Nile"; label of type specimen [BM 49.2.8.36], however, clearly says "Fifth Cataract of the Nile," which is in Northern province, Sudan; for further discussion of this type locality, see Kock, 1969, p. 149).

Nyctinomus emini De Winton, 1901a, p. 40 (Usambara, Tanzania).

Chaerephon (Lophomops) abae J. A. Allen, 1917, p. 464 (Aba, Oriental Province, Zaire).

Tadarida (Chaerephon) pumila: Happold, 1967, p. 122 (not *Dysopes pumilus* Cretzschmar).

Specimens Examined. 31 from *Equatoria*: Lafon (one skin and skull), Summit of Mount Otego (one skin and skull in AMNH), Gondokoro (one in alcohol with extracted skull in USNM, mentioned by Hollister, 1918, p. 99), Tungu (one in alcohol in IRSN, mentioned by Verschuren, 1957, p. 386); *Upper Nile*: Malakal (nine in alcohol); *Blue Nile*: Wad Medani (12 in alcohol, nine with extracted skulls in SMF, mentioned by Kock, 1969, p. 149); *Kordofan*: El Obeid (four skins and skulls in SMF, mentioned by Kock, 1969, p. 149); *Khartoum*: Sabaloka hills (one in alcohol in BM, mentioned by Happold, 1967, p. 122); *Northern*: Fifth Cataract of the Nile (one skin and skull in BM, type of *major*).

Measurements. Forearm length, 15 adult males (39-44), nine adult females (40-43); condylobasal length, 12 adult males (16.9-17.7), three adult females (17.1-17.4); maxillary tooth-row length, 12 adult males (6.5-7.1), four adult females (6.4-6.8).

Other Sudan Records. None that are valid.

Remarks. This is a rather widespread species in the savanna regions of Africa from Mali to Tanzania. However, localities represented by specimens in museums are rather few and literature records are treacherous as many specimens are misidentified, particularly with smaller species of the subgenus *Mops*. Thus, the record from Rosieres (Wroughton, 1911, p. 458) is actually of *T. M. condylura*, whereas that from Aradeiba

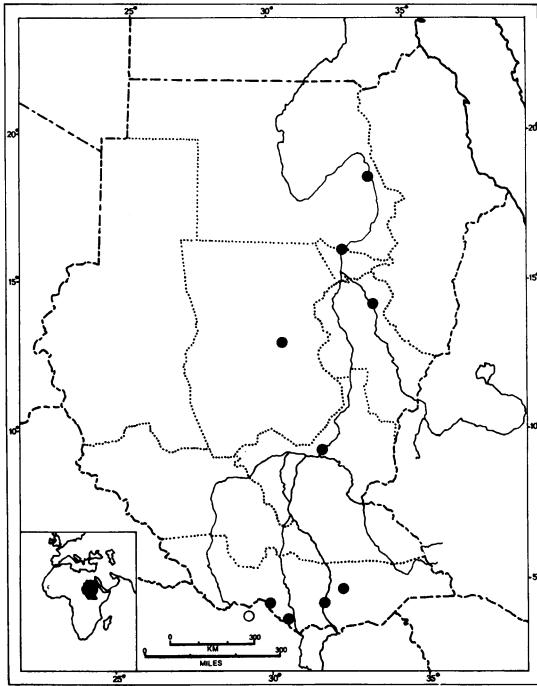


FIG. 55. Distribution of *Tadarida major* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

(G. M. Allen, 1914, p. 352) is actually *T. (M.) demonstrator*. Kock (1969, pp. 146, 150) has pointed out that the Happold's Sabaloka hills specimen is too large (forearm 41) to be allocated to *T. pumila*. The specimen is immature, so an adult would be even larger. The specimen seems best placed here.

Tadarida (Chaerephon) pumila (Cretzschmar)

Dysopes pumilus Cretzschmar, 1826 [1826-1830], p. 69, pl. 27 (Massawa, Eritrea [now in Ethiopia]).

Nyctinomus hindei Thomas, 1904a, p. 210 (Fort Hall, Kenya; valid as a subspecies).

Chaerephon websteri Dollman, 1908, p. 546 (Yola, Nigeria; possibly valid as a subspecies).

Chaerephon pumilus naivashae Hollister, 1916, p. 4 (Naivasha Station, Kenya; synonym of *T. p. hindei*).

Tadarida (Chaerephon) faini Hayman, 1951, p. 82 (Wago Forest, Oriental Province, Zaïre; possibly valid as a subspecies).

Specimens Examined. 169 from *Equatoria*: Mongalla (four skins and skulls, one in MSNG, eight in alcohol in USNM, four with extracted skulls, mentioned by Hollister, 1918, p. 95), Gondokoro (three skins and skulls, seven in alcohol, four with extracted skulls, all in USNM and mentioned by Hollister, 1918, p. 95), Juba (10 skins and skulls, four in AMNH, three in ZMK, two skins only in ZMK, 14 in alcohol, one in USNM), Lafon (two skins and skulls, one in alcohol), Torit (one skin and skull, one skin only, four in alcohol, one in AMNH, one skull extracted), Kibish Wells (four skins and skulls in DH); *Bahr-el-Ghazal*: Yirol (two skins and skulls in AMNH, one in alcohol with extracted skull), Lake Nyibor (six skins and skulls, two in alcohol, all in AMNH), Rumbek (one skin only in BM), Tonj (three in alcohol in BM); *Upper Nile*: Bor (two skins and skulls, one in BM), Malakal (two skins and skulls in BM, 29 in alcohol, six in USNM), Tonga (one in alcohol in NMW, mentioned by Wettstein, 1918, p. 656), Khor Attar (one in alcohol in NMW, mentioned by Sassi, 1908, p. 159), Taufikia (one skin and skull in BM); *Blue Nile*: El Garef (two skins and skulls, two in alcohol, one with extracted skull, all in MCZ, and mentioned by G. M. Allen, 1914, p. 353), Magangani (one skin and skull in AMNH, mentioned by G. M. Allen, *ibid.*), Wad Medani (one skull only in SMF, 22 in alcohol, three in USNM, one in BM, 10 in SMF, of which nine have extracted skulls, mentioned by Kock, 1969, p. 140), Senaar (three in alcohol, two in SMF, of which one has an extracted skull, mentioned by Kock, *ibid.*), Bunzugu (five skins and skulls, eight in alcohol, one with extracted skull, all in SMF, and mentioned by Kock, *ibid.*), Jebelein (10 in alcohol with extracted skulls in SMF, mentioned by Kock, *ibid.*); *Kassala*: Gallabat (three skins and skulls in BM, mentioned by Flower, 1932, p. 386).

Measurements. Forearm length, 69 adult males (32-38), 100 adult females (32-40); condylobasal length, 27 adult males (14.0-15.4), 33 adult females (13.8-15.1).

Other Sudan Records. Kock (1969, p. 146) listed a number of other records, of which the most important appears to be *Kordofan*: Jebel Ghulfan.

Remarks. Braestrup (1935, pp. 93, 94) would put northern Sudan specimens in *T. p. websteri*,

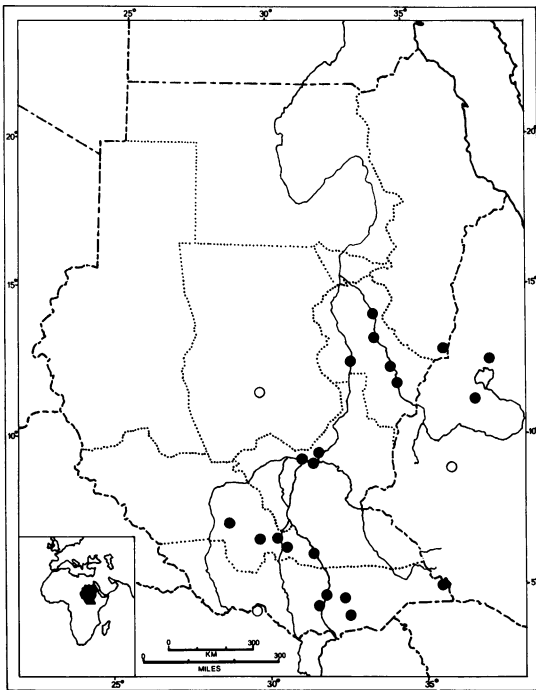


FIG. 56. Distribution of *Tadarida pumila* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

but after studying considerably more material than he did, it appears to me that geographical variation in the Sudan is negligible, at least as far as size is concerned (the character used by Braestrup). The status of *websteri* is actually very much in dispute (compare Rosevear, 1965, pp. 330-332 with Kock, 1969, p. 146) and I therefore allocate all Sudan specimens to the small *T. p. pumila*. To the southeast in Kenya and southern Somalia, a considerably larger subspecies (*T. p. hindei*) occurs (condylobasal 15.4-17.0). I can detect no intergradation between the two in specimens from Equatoria, but I do find some in Ethiopia. Although I found wing color a useful subspecific character in southern Africa (Koopman, 1966, p. 162), it seems much less useful in the northeast. I therefore cannot agree with Kock's arrangement, which seems very artificial to me. I also disagree with Kock in his lumping of *T. chapini* with *T. pumila*. Although the two species are closely related, I believe *T. chapini* can always be distinguished by its narrower

palate as well as the longer bicolored crest in the male.

Tadarida (Mops) condylura (A. Smith)

Nyctinomus condylurus A. Smith, 1833, p. 54 (Port Natal [=Durban], South Africa).

Nyctinomus angolensis Peters, 1870, p. 124 (Quenza River [=?Cuanza River], Angola).

Mops (Allomops) osborni J. A. Allen, 1917, p. 473 (Kinshasa, Zaire; possibly valid as a subspecies).

Mops angolensis wonderi Sanborn, 1936, p. 114 (Sotuba [7 km. east of Bamako], Mali; probably valid as a subspecies).

Mops angolensis orientis G. M. Allen and Loveridge, 1942, p. 166 (Kitaya, Rovuma River, southeastern Tanzania; possibly valid as a subspecies).

Chaerephon emini: R. C. Wroughton, 1911, p. 458 (specimen from Rosieres [not *Nyctinomus emini* De Winton]).

Specimens Examined. 10 from Equatoria:

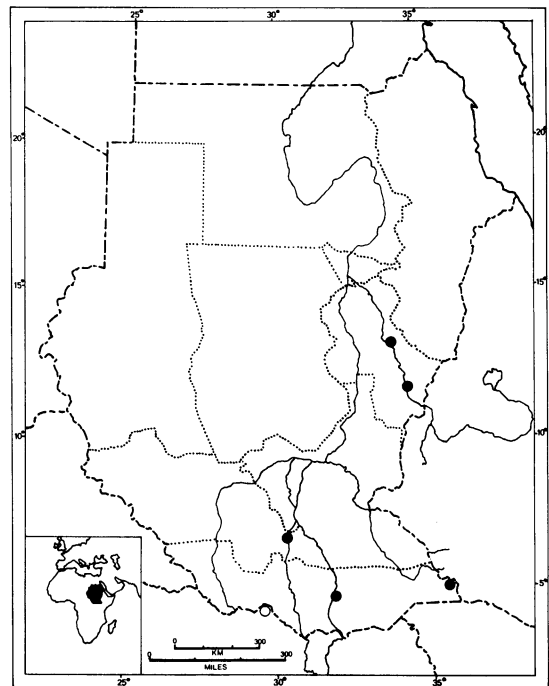


FIG. 57. Distribution of *Tadarida condylura* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Mongalla (one in alcohol with extracted skull in BM), Kibish Wells (one skin and skull in DH); *Bahr-el-Ghazal*: Lake Nyibor (two skins and skulls in AMNH); *Blue Nile*: Suki (five in alcohol with extracted skulls in SMF, mentioned by Kock, 1969, p. 152), Rosieres (one in alcohol with extracted skull in BM, mentioned by Wroughton, 1911, p. 458).

Measurements. Forearm length, four adult males (46-51), five adult females (45-47); condylobasal length, five adult males (17.9-19.4), five adult females (18.2-19.0); zygomatic width, five adult males (13.4-13.8), four adult females (12.6-13.2); interorbital width, five adult males (4.5-4.8), five adult females (4.5-4.8); maxillary tooth-row length, five adult males (7.0-7.9), five adult females (7.1-7.7).

Other Sudan Records. None.

Remarks. This is a common and widespread species in the savanna regions of Africa, but appears to be rather rare in the Sudan, possibly due to competition with the closely related *T. demonstrator*. This, together with its frequent confusion with other species, is probably responsible for the fact that it was only recently recorded from the Sudan. I have examined the Rosieres specimen and it is clearly *T. condylura* and not *T. major* (with which *emini* is synonymous). In view of the confused status of recognized subspecies in *T. condylura*, I do not choose to allocate the Sudanese material to any subspecies.

Tadarida (Mops) demonstrator (Thomas)

Nyctinomus demonstrator Thomas, 1903c, p. 504 (Mongalla, Equatoria Province, Sudan).

Mops (Allomops) faradjius J. A. Allen, 1917, p. 476 (Faradje, Oriental Province, Zaire).

Chaerephon emini: G. M. Allen, 1914, p. 352 (specimen from Aradeiba [not *Nyctinomus emini* De Winton]).

Chaerephon bivittatus: G. M. Allen, 1914, p. 352 (specimens from El Garef [not *Nyctinomus bivittatus* Heuglin]).

Specimens Examined. 62 from *Equatoria*: Torit (12 skins and skulls, two in ZMK, one skin only in ZMK, 17 in alcohol, one in ZMK, four with extracted skulls, one in ZMK), Magwe (four in alcohol, one with extracted skull), Mongalla (one in alcohol with extracted skull in BM, type of *demonstrator*), Gemeiza (one skin and skull in

BM); *Bahr-el-Ghazal*: Yirol (two skins and skulls in AMNH), Lake Nyibor (14 skins and skulls in AMNH); *Upper Nile*: Tonga (one in alcohol with extracted skull in BM); 25 miles east of Lake No (two in alcohol, one with extracted skull, both in BM), Khor Attar (two in alcohol in NMW, mentioned by Sassi, 1908, p. 159); *Blue Nile*: El Garef (two skins and skulls in MCZ, mentioned by G. M. Allen, 1914, p. 352), Aradeiba (one skin and skull in MCZ, mentioned by G. M. Allen, *ibid.*), Wad Medani (one in alcohol with extracted skull), Bunzuga (one skin and skull in SMF, mentioned by Kock, 1969, p. 154).

Measurements. Forearm length, 20 adult males (40-44), 31 adult females (39-43); condylobasal length, 14 adult males (18.1-19.4), 17 adult females (17.6-18.5); zygomatic width, 15 adult males (12.2-13.7), 16 adult females (12.1-12.6); interorbital width, 15 adult males (3.7-4.2), 19 adult females (3.6-4.2); maxillary tooth-row length, 15 adult males (7.2-7.9), 19 adult females (6.9-7.5).

Other Sudan Records. None.

Remarks. The known distribution is rather

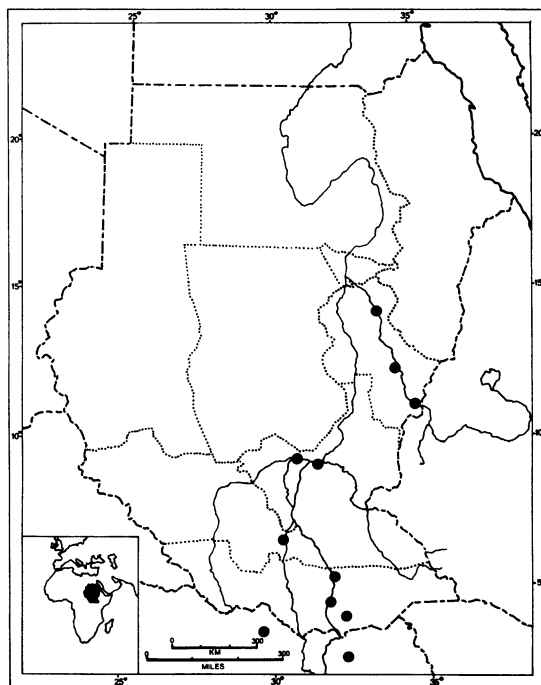


FIG. 58. Distribution of *Tadarida demonstrator* in the Sudan.

restricted, being confined to southern and eastern Sudan, extreme northeastern Zaire, and northwestern Uganda. The actual range could be much more extensive in two directions. Kock (1969, p. 155) suggested that it probably occurs in West Africa, on the basis of similar vegetation zones. If so, specimens may have been confused with *T. condylura* or possibly other species. In my opinion, *T. demonstrator* is most closely related to *T. niveiventer* with a fairly restricted range in central Angola, Zambia, southwestern Tanzania, and southern Zaire, north to Rwanda. Hayman, Misonne, and Verheyen (1966, p. 64) also suggested that many of the specimens they identify as *T. condylura* (including some from northeastern Zaire) may actually be *T. niveiventer*. If they are, careful study of these specimens may reveal intergradation between *niveiventer* and *demonstrator*. G. M. Allen misidentified *T. demonstrator* under two different names. The explanation for this probably is because the Aradeiba specimen is immature and the El Garef specimens are adults. All three are clearly *T. demonstrator*.

Tadarida (Mops) midas (Sundevall)

Dysopes midas Sundevall, 1843, p. 207 ("Bahr el Abiad" [=White Nile], Sudan; Kock, 1969, p. 154, suggested on the basis of later evidence, that the type was collected on the "Jebel el Funj" between the White Nile and Blue Nile; I therefore restrict the type locality of *midas* to the west bank of the White Nile in the neighborhood of latitude $11^{\circ} 45' N$, longitude $33^{\circ} 30' E$, Blue Nile Province, Sudan).
Nyctinomus (Dysopes) ventralis Heuglin, 1861, pp. 4, 17 (Anseba, near Keren, Eritrea [now in Ethiopia]).

Specimens Examined. 33 from *Equatoria*: Mongalla (one in alcohol with extracted skull in AMNH); *Bahr-el-Ghazal*: Lake Nyibor (six skins and skulls in AMNH); *Upper Nile*: Fashoda (one in alcohol with extracted skull in BM, mentioned by Kock, 1969, p. 154); *Blue Nile*: Wad Medani (one skin and skull in BM, mentioned by Kock, *ibid.*), Fazogli (one skin and skull in MCZ, mentioned by G. M. Allen, 1914, p. 351), "Bahr-el-Abiad" (one skin and skull in BM, cotype of *midas*); *Khartoum*: Shambat (one skin only in BM), Khartoum (21 in alcohol, 15 in BM, one with extracted skull).

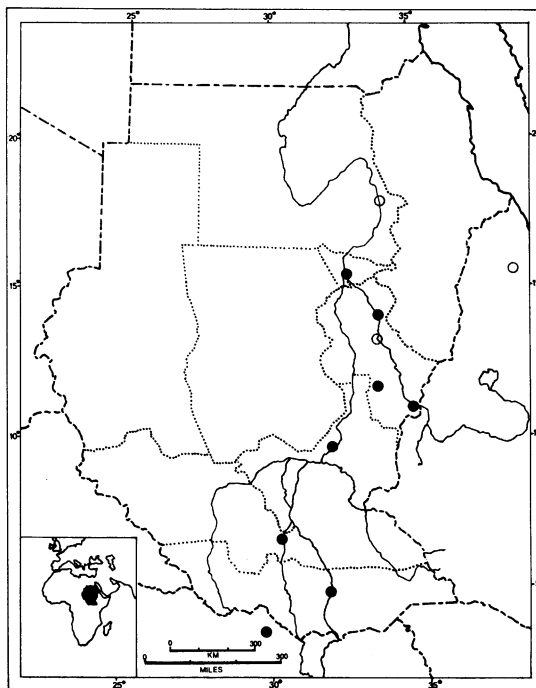


FIG. 59. Distribution of *Tadarida midas* in the Sudan. Localities from which specimens have been examined shown solid, other records hollow.

Measurements. Forearm length, 16 adult males (57-65), 10 adult females (59-63); condylobasal length, six adult males (23.5-25.0), three adult females (23.9-24.8); maxillary tooth-row length, six adult males (9.8-10.3), three adult females (9.9-10.3).

Other Sudan Records. Kock, 1969, p. 154, listed a few other localities including *Blue Nile*: Senaar; and *Northern*: Berber.

Remarks. Although this species has an extensive African savanna distribution from Senegal east to Ethiopia and south to Botswana and Transvaal, actual records are relatively few. There has been some confusion in the past between this species and large members of *T. (Tadarida)* such as *teniotis* and *africana*, but there is really no special resemblance except for large size. Thus the specimen from Ethiopia identified by Thomas (1928, p. 302) as "*Mops ventralis*" is actually the specimen correctly identified as *T. africana* by Hill and Morris (1971, p. 47).

Platymops setiger (Peters)

Mormopterus setiger Peters, 1881, p. 483 (Taita, Kenya).

Platymops macmillani Thomas, 1906, p. 500 (between Addis Ababa and Lake Rudolph, Ethiopia; valid as a subspecies).

Platymops barbatogularis Harrison, 1956, p. 549 (Lokomarinyang Marsh, Equatoria Province, Sudan; synonym of *P. s. macmillani*).

Platymops barbatogularis parkeri Harrison and Fleetwood, 1960, p. 269 (Lualeni Borehole, Maktau, Kenya; synonym of *P. s. setiger*).

Specimens Examined. Nine from *Equatoria*: Lokwi (five in alcohol, one with extracted skull), Loelli (one in alcohol), Lokomarinyang (three skins and skulls, two in BM, including type of *barbatogularis*, one in DH).

Measurements. Forearm length, four adult males (31-34), two adult females (30, 31); condylobasal length, three adult males (14.1-15.6), one adult female (14.4); width across lacrimals, three adult males (7.7-8.6); maxillary tooth-row length, three adult males (5.2-6.0), one adult female (5.4).

Other Sudan Records. None.

Remarks. The specimens from Lokwi and Loelli were all seen by Peterson (1965, pp. 19-21) and I see no reason to disagree with his conclusion that only one species is represented. The species has a surprisingly small recorded distribution, being known only from southeastern Sudan, southwestern Ethiopia, and in southern

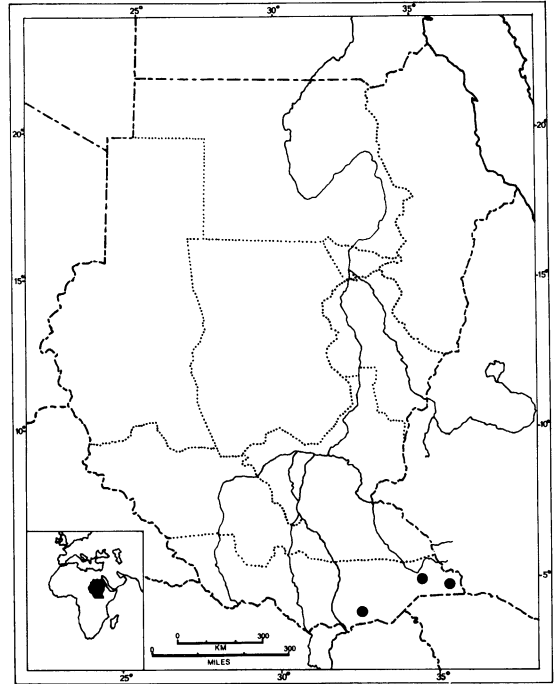


FIG. 60. Distribution of *Platymops setiger* in the Sudan.

and western Kenya. A specimen in the American Museum of Natural History from Lake Baringo in western Kenya lies within a previous gap in the known distribution.

ZOOGEOGRAPHICAL SUMMARY

I have discussed the zoogeography of the various species in the above systematic accounts. However, a summary of geographical patterns and a rough geographical classification of Sudan bats seems in order. It should be emphasized that this is distinctly tentative as future collections will undoubtedly extend the known distributions, especially in the western part of the country. I have classified the strictly Ethiopian region elements into forest, forest-savanna, savanna, and east African elements (the last of uncertain ecological significance). I emphasize that these categories refer to the distribution north of

the Equator, the ecological distributions in southern Africa sometimes being different. Then I take up several categories of distributions that are at least partly Palearctic and finally several distributions that do not fit into any clear pattern. For each distribution pattern, I consider both the overall distributions and the known distributions in the Sudan.

I have classified 12 species as forest forms. Of these, 10 do not extend far beyond the forest borders, whereas the other two (*Micropteropus pusillus* and *Eptesicus rendalli*) do invade the savanna to a limited extent and are therefore some-

what transitional to the forest-savanna category. Six species (*Hypsignathus monstrosus*, *Nycteris nana*, *N. arge*, *Rhinolophus alcyone*, *Hipposideros beatus*, and *H. abae*) are known only from eastern forest outliers in western Equatoria Province. The number of these is probably considerably greater, as collecting in this region has been relatively poor. *Hipposideros cyclops* occurs in western Equatoria, but also reaches two localities in or near the mountain forests of the Imatong Mountains. Two species (*Rousettus angolensis* and *Mimetillus moloneyi*) are known in the Sudan only from this region, but probably also occur in western Equatoria, as both are known from the lowland forests of northeastern Zaire. *Hipposideros abae* is known from western Equatoria Province and also from Bahr-el-Ghazal Province. *Epomops franqueti* is known in the Sudan only from a single locality in Bahr-el-Ghazal Province. It is not clear what ecological factors have enabled these forest species to extend so far from the areas indicated as forest in Keay's (1959) map. *Micropteropus pusillus* and *Eptesicus rendalli* each occur far to the north of areas mapped as forest in the Nuba Mountain region and the upper Blue Nile Valley respectively. In the latter case, it probably occurs in gallery forest, and in the former case it is evident from Keay's map that the Nuba Mountains are more mesic than many of the lower surrounding areas.

I put 14 species in the forest-savanna category. All are widespread forms in tropical Africa, and although most of them probably originated in the forest, all have invaded savanna habitats so extensively that they can no longer be classified as forest elements. As indicated above, *Micropteropus pusillus* and *Eptesicus rendalli* show the beginnings of this invasion and in the systematic treatments, I have discussed the progressive occupation of dryer habitats in *Nycteris*. Of the 14 species, *Hipposideros caffer* is a special case to be considered after the others. *Scotophilus gigas* is known from too few localities over its extensive range for much to be said about its distributional pattern. The only Sudan record is from southern Kordofan. Of the remaining 12 species, all but *Chalinolobus variegatus* are known from Equatoria Province and the distribution of this species in the Sudan is poorly known. Eight of these species (*Eidolon helvum*, *Nycteris hispida*, *N.*

macrootis, *Lavia frons*, *Rhinolophus landeri*, *Scotophilus nigrata*, *Tadarida pumila*, and *T. condylura*) reach Blue Nile Province and, as collections there have been fairly extensive, the species that are not known from this province are probably genuinely absent. Two of the last (*Taphozous mauritanus* and *Eptesicus somalicus*) have been recorded from Khartoum. Both are based on old records and are suspect. All except *Tadarida condylura* (and including *Pipistrellus nanus*) reach Kordofan Province. In view of Kock's extensive collections, *T. condylura* is probably genuinely absent. Three species (*Taphozous mauritanus*, *Nycteris hispida*, and *Scotophilus nigrata*) are known from Darfur and four from southern Kassala (*Nycteris macrootis*, *Lavia frons*, *Rhinolophus landeri*, *Tadarida pumila*). Besides the two dubious records noted above, five species (*Eidolon helvum*, *Nycteris hispida*, *N. macrootis*, *Lavia frons*, and *Scotophilus nigrata*) are known from Khartoum Province. Only *Nycteris macrootis* and possibly *N. hispida* reach Northern Province. As is clear from the systematic account, *Hipposideros caffer* is a complex of two groups of populations that behave like separate species in the Sudan. Of these, the *ruber* group is basically a forest type with savanna outliers. Although only common in Equatoria Province, it extends as far north as southern Kordofan. The basically savanna *caffer* group, on the other hand, reaches southern Kassala, Khartoum, Kordofan, and Darfur. *Hipposideros caffer* is also peculiar in its overall distribution, as it reaches Morocco (but not Egypt) and therefore does reach the Palearctic.

I have classified 11 species as savanna forms, although there is considerable diversity shown in overall distribution patterns. All but *Epomophorus gambianus* and *Eptesicus floweri* are known from Equatoria Province, and in the case of the former the distribution is too poorly known for any conclusions to be drawn. *Eptesicus floweri*, however, is reasonably common within its restricted range and seems confined to dry savanna. On the other hand, two species (*Eptesicus capensis* and *Tadarida ansorgei*) appear to be confined to wetter savannas because in the Sudan they are not known to occur north of Equatoria Province in the Sudan. Nine species (*Epomophorus gambianus*, *E. labiatus*, *Coleura*

afra, *Rhinolophus fumigatus*, *Eptesicus guineensis*, *E. floweri*, *Scotoecus hirundo*, *Tadarida major*, and *T. midas*) are known from Blue Nile and/or Kordofan provinces. Only five of these (*E. labiatus*, *C. afra*, *E. floweri*, *T. major*, and *T. midas*) are known from Khartoum, Northern, or Kassala provinces and only *E. labiatus* from poorly collected Darfur.

I have set up an East African category for six species, which are confined to eastern Africa and reach their northern limits in Sudan or Ethiopia. All extend at least to southern Kenya, and all but *Platymops setiger* to Tanzania or even farther south. Ecologically they are probably a heterogeneous lot, but for most the ecology is not well known. Four are known in the Sudan only from eastern Equatoria, three of which (*Rhinolophus hildebrandti*, *Tadarida africana*, and *T. bivittata*) occur only in mesic areas in and near the Imatong Mountains. *Platymops setiger*, however, occurs in dry savanna farther east as well. *Rhinolophus eloquens* has a somewhat wider range in western as well as eastern Equatoria and north to extreme southern Upper Nile Province. *Cardioderma cor* occurs at several localities in eastern Equatoria as well as in southeastern Kassala.

Before going on to species with a significant portion of their range outside Africa, mention should be made of the only Sudan species with a range confined to the Sahara Desert. Unless *aero* is conspecific with it, *Pipistrellus deserti* reaches its southern limits in the extreme northern part of Northern Province.

I have classified eight species as savanna-Palearctic. All have an extensive distribution in the savanna belt of northern tropical Africa, but also occur north of the desert in northern Africa and southwestern Asia. Although all but *Miniopterus schreibersi* occur in Egypt, they tend to avoid the desert. All but *Rhinopoma microphyllum* (which is known only from Kordofan, Blue Nile, and Khartoum) occur in Equatoria Province, although *Nycticeius schlieffeni* may be confined to its dry eastern end. Of these seven species, five (*Taphozous perforatus*, *T. nudiventris*, *Nycteris thebiaca*, *Pipistrellus rueppelli*, and *Nycticeius schlieffeni*) occur in Kordofan and Blue Nile as well as Khartoum, Northern, or Kassala provinces. Only one of these (*N. schlieffeni*)

is known from Darfur, probably owing to inadequate collecting. Of the two species known from Equatoria but not Kordofan or Blue Nile (*Miniopterus schreibersi* and *Tadarida aegyptiaca*), both occur in Upper Nile Province and *T. aegyptiaca* also from Darfur.

Two species, *Rhinopoma hardwickei* and *Asellia tridens*, I regard as desert-Palearctic forms. Both occur in Egypt and have extensive distributions in southwestern Asia. Neither avoids the desert and both occur in Northern, Khartoum, and Blue Nile provinces. *Rhinopoma hardwickei* also occurs in Kordofan, *A. tridens* also in Kassala and Darfur. However, *R. hardwickei* also occurs in the southeastern desert of extreme eastern Equatoria, where *Asellia* is unknown.

Three species (*Rhinolophus hipposideros*, *Otonycteris hemprichi*, *Plecotus auritus*) are considered Palearctic without qualification. All three occur in southwestern Asia as well as Egypt and all tend to avoid the desert and do not really occur south of it. All are rare in the Sudan, *Otonycteris hemprichi* and *Plecotus auritus* being confined to Northern province and *Rhinolophus hipposideros* being known from a single old record from Blue Nile province.

For nine species, I can discern no real pattern as far as the overall distribution is concerned. Four of these (*Rousettus aegyptiacus*, *Rhinolophus clivosus*, *R. simulator*, and *Pipistrellus kuhli*) have a wide, albeit spotty, distribution in Africa, and except for *R. simulator* also in southwestern Asia. The other five (*Taphozous hamiltoni*, *Pipistrellus rusticus*, *P. ariel*, *Tadarida bembelini*, and *T. demonstrator*) are much more localized and are confined to Africa. Both *Rhinolophus clivosus* and *Pipistrellus kuhli* occur in both northern and southern Sudan, but probably with large real gaps in both cases. Six species in the Sudan are known only from the south, *Rousettus aegyptiacus*, *Rhinolophus simulator*, and *Tadarida bembelini* being known only from Equatoria Province, *Taphozous hamiltoni* also from Kordofan, *Tadarida demonstrator* north to Blue Nile Province, and *Pipistrellus rusticus* to Blue Nile, Kordofan, and Darfur provinces. Finally, *Pipistrellus ariel* is confined to the northern half of the country, being known in the Sudan only from Kassala and Kordofan.

The geographical classification of Sudan bats may be summarized as follows:

Forest—12 species

Rousettus angolensis
Hypsignathus monstrosus
Epomops franqueti
Micropteropus pusillus
Nycteris nana
Nycteris arge
Rhinolophus alcyone
Hipposideros beatus
Hipposideros cyclops
Hipposideros abae
Eptesicus rendalli
Mimetillus moloneyi

Forest-savanna—14 species

Eidolon helvum
Taphozous mauritanus
Nycteris hispida
Nycteris macrotis
Lavia frons
Rhinolophus landeri
Hipposideros caffer
Pipistrellus nanus
Eptesicus somalicus
Chalinolobus variegata
Scotophilus nigrata
Scotophilus gigas
Tadarida pumila
Tadarida condylura

Savanna—11 species

Epomopholus gambianus
Epomopholus labiatus
Coleura afra
Rhinolophus fumigatus
Eptesicus guineensis
Eptesicus capensis
Eptesicus floweri
Scotoecus hirundo
Tadarida ansorgei

Tadarida major
Tadarida midas

East African—6 species

Cardioderma cor
Rhinolophus eloquens
Rhinolophus hildebrandti
Tadarida africana
Tadarida bivittata
Platymops setiger

Desert—1 species

Pipistrellus deserti

Savanna-Palearctic—8 species

Rhinopoma microphyllum
Taphozous perforatus
Taphozous nudiventris
Nycteris thebiaca
Pipistrellus rueppelli
Nycticeius schlieffeni
Miniopterus schreibersi
Tadarida aegyptiaca

Desert-Palearctic—2 species

Rhinopoma hardwickei
Asellia tridens

Palearctic—3 species

Rhinolophus hipposideros
Otonycteris hemprichi
Plecotus auritus

Unclassified—9 species

Rousettus aegyptiacus
Taphozous hamiltoni
Rhinolophus clivosus
Rhinolophus simulator
Pipistrellus kuhli
Pipistrellus ariel
Pipistrellus rusticus
Tadarida bennettii
Tadarida demonstrator

GAZETTEER

[To supplement the gazetteers of Setzer (1956) and Kock (1969).]

Abd el Quadir—10 mi. S of Wadi Halfa on west
 bank of Nile
 Abu Doleib—ca. 9°20'N, 31°35'E

Abu Haraz—ca. 14°30'N, 33°30'E
 Abukika—ca. 6°55'N, 31°E
 Abu Zeit—opposite Kosti

Abu Zor—*ca.* 12°20'N, 34°20'E
 Akona—*ca.* 11°30'N, 32°40'E
 Amadi—*ca.* 5°30'N, 30°20'E
 Arashkool (probably = Arashkol)—14°15'N, 32°10'E
 Bados—*ca.* 12°10'N, 34°20'E
 Bahr el Zeraf, km. 189—measured from the mouth along the bends of the river
 Bahr el Zeraf, mouth—9°25'N, 31°10'E
 Barakat—*ca.* 14°20'N, 33°30'E
 Batn el Hadjar—*ca.* 21°30'N, 31°E
 Bir Abu Gulud (probably = Wadi Gulud)—*ca.* 17°20'N, 31°15'E
 Birra, 2500'—not located
 Buluku—4°33'N, 29°50'E
 Buram—*ca.* 10°50'N, 25°10'E
 Chalamani, 30 mi. E of Torit
 Dad Majok (= Dud Majok)
 Disa—12°N, 34°20'E
 Duggu—*ca.* 6°40'N, 29°05'E
 Duk Fadiat—7°45'N, 31°25'E
 Dulaba—not located
 Ed Dueim—14°N, 32°20'E
 El Serifa (= Sereifa)—11°28'N, 34°32'E
 Fifth Cataract of the Nile—*ca.* 18°20'N, 33°45'E
 Fora—not located, but somewhere in the Zalingei area
 Fula rapids—5 mi. N of Nimule
 Gemeiza—5°50'N, 31°50'E
 Goz Abu Gomer (= Goz Abu Guma)—*ca.* 13°15'N, 32°40'E
 Ingessana Hills—11°30'N, 34°E
 Isoke, 40 mi. ESE of Torit
 Jebel El Azraq, 10 mi. NW of Omdurman
 Jebel el Funj—*ca.* 11°45'N, 33°30'E
 Jebel Ghulfan—11°42'N, 29°48'E
 Jebel Goumia, Acholi Mts., 6500', *ca.* 4°N, 32°40'E
 Jebel Kau—10°35'N, 31°35'E
 Jebel Maba—*ca.* 11°35'N, 34°30'E
 Jebel Moya—13°30'N, 33°20'E
 Jebel Otoro—*ca.* 11°N, 30°25'E
 Jebel Tozi, 10 mi. W of Wadi el Nail—*ca.* 12°30'N, 34°E
 Jebel Zeraf—9°20'N, 31°10'E
 Kagelu—4°5'N, 30°35'E
 Kaitherin—4°45'N, 35°15'E
 Kapoeta—*ca.* 4°45'N, 33°35'E
 Karshawal—*ca.* 12°N, 32°45'E
 Katuluru, 20 mi. W of Torit
 Kerripi, 30 mi. N of Nimule

Khor Attar, mouth—*ca.* 9°20'N, 31°25'E
 Khor Mallum—60 mi. SSW of El Fasher, 2900'
 Kibish Wells—5°15'N, 35°50'E
 Kidj district—west bank of the Nile in the general vicinity of Shambe
 Kiriba—"On the east bank of the Bahr el Jebel, 10 miles south of Gondokoro" (Hollister, 1918, p. 21)
 Kojali—*ca.* 6°10'N, 27°45'E
 Kongor—7°10'N, 31°20'E
 Kosti—*ca.* 13°10'N, 32°40'E
 Lake Nyibor—6°55'N, 30°10'E
 Latome, 60 mi. ESE of Torit—4°5'N, 33°35'E
 Lawudo, 13 mi. N of Torit
 Ledgus—"On the east bank of the Bahr el Jebel between Gondokoro and Nimule" (Hollister, 1918, p. 21)
 Li Rangu—*ca.* 4°40'N, 28°20'E
 Liwan—*ca.* 4°55'N, 35°40'E
 Lobira, 2100'—*ca.* 4°25'N, 33°E
 Lodwara—*ca.* 4°15'N, 33°13'E
 Loelli—*ca.* 5°5'N, 34°40'E
 Lofi, 30 mi. ESE of Torit
 Logot, near Issore, Imatong Mts.
 Logurun, 30 mi. E of Torit
 Lokomarinyang, Ilemi Triangle—5°2'N, 35°35'E
 Loqutor, 30 mi. ENE of Torit
 Lowai, 25 mi. W of Torit
 Luem, 2100'—not located
 Madâl (= Madol)—9°03'N, 27°45'E
 Madial, 2500'—*ca.* 3°50'N, 33°25'E
 Magangani—*ca.* 12°N, 34°20'E
 Meroe pyramids—*ca.* 16°55'N, 33°45'E
 Meshra er Req—8°25'N, 29°15'E
 Mnyouri Jardin—"On the east bank of the Bahr el Jebel between Gondokoro and Nimule, and just south of Ledgus" (Hollister, 1918, p. 22)
 Moimoi—not located
 Molongori, 25 mi. SE of Torit (Eastern Imatong Mts.), 2200'
 Mount Otego—*ca.* 3°55'N, 30°35'E
 Mundiri—5°23'N, 30°21'E
 Musran Island, north end—*ca.* 12°55'N, 32°50'E
 Ngangala—4°40'N, 31°55'E
 Ngop—*ca.* 6°15'N, 30°10'E
 Nubbaka—*ca.* 12°35'N, 29°55'E
 Nuri pyramids—18°40'N, 31°55'E
 Old Dongola—18°10'N, 30°45'E
 Palotaka—*ca.* 4°N, 32°30'E
 Parajok, 45-50 mi. S of Torit
 Rahad—*ca.* 12°45'N, 30°40'W
 Rashad—*ca.* 11°50'N, 31°E
 Renk (= Er Renk)

Sabaloka Hills—*ca.* 16°20'N, 32°40'E
 Seriba Ghatta—7°24'N, 28°36'E
 Shambat—*ca.* 15°40'N, 32°35'E
 Sheikh el Akaba—area W of Arashkol, *ca.* 14°10'N, 32°E
 Sherkeila—*ca.* 12°50'N, 31°25'E
 Shukole, 30 mi N of Nimule, on Nile
 Sim Sima—*ca.* 5°25'N, 31°45'E
 Soudan River—4°35'N, 29°45'E
 Taufikia—*ca.* 9°25'N, 31°35'E
 Telaweit, near Kassala—*ca.* 16°N, 36°W
 Teretainia, 2500'—*ca.* 3°50'N, 33°10'E
 Terraka (=Terakeka)—5°25'N, 31°45'E

Tonj—7°15'N, 28°45'E
 Tori—4°20'N, 29°50'E
 Tungu—4°22'N, 29°58'E

Umbarbit (= D. Marbeit)—*ca.* 10°55'N, 32°35'E
 Um Berembeita—*ca.* 11°50'N, 30°40'E
 Um Dona, Koalib Hills—*ca.* 11°40'N, 30°25'E
 Um Esheishat well, 100-104 mi. E of El Fasher, 2000'-2200'

Wad Akona—11°30'N, 32°42'E
 Wad Marium—*ca.* 15°25'N, 32°25'E
 Wisco—*ca.* 11°20'N, 34°10'E

Yirol—6°35'N, 30°30'E

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