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Dedicated to Duane A. Schlitter,
who introduced me to the study of
African bats

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The Bats of Egypt

Mazin B. Qumsiyeh

Egypt occupies the northeastern portion of Africa and provides the major connection between the land masses of Africa and Asia. As such, this area is an important connection between the Palearctic and Ethiopian faunas and a study of the composition of this fauna can prove very important.

This report reviews the systematics, zoogeography, and ecology of the bats of Egypt (including Sinai) based on the examination of available museum specimens, original field work, and literature review. The Medical Zoology Department of the U.S. Naval Medical Research Unit Number Three (NAMRU-3) in Egypt collected much of this material as part of other collections made on parasites and their mammalian hosts in Egypt. Most of the bat material collected by NAMRU-3 was preserved in alcohol and is deposited in the U.S. National Museum, Washington, D.C., and the Field Museum of Natural History, Chicago. Collectors for NAMRU-3 included H. Hoogstraal, Ibrahim Helmy, Sobhy Gaber, Sayed Metwally, Hassan Touhamy, W. H. Wells, G. M. Malakalis and various local field assistants particularly from the village of Abu Bawash. The land mammals observed or collected by NAMRU-3 were studied by Osborn and Helmy (1980). The present paper is intended to complement that study by focusing on the bats.

Numerous old reports exist dealing either in part or in total with the bats of Egypt. Several species of bats have been described by É. Geoffroy Saint-Hillaire in 1810, 1813, and in the monumental "Description de la Egypte" of 1818. Many of Geoffroy's original descriptions were augmented with figures and most of his names are still used. Later reports on bats of northeast Africa include those of Rüppel (1842) and Heuglin (1861, 1877). Dobson's (1878) Catalogue of the Chiroptera at the British Museum includes many specimens from Egypt and presents an update of the taxonomic work at that time. The earliest and most exhaustive treatment of the bats of Egypt is Anderson's (1902) Zoology of Egypt: Mammalia. This work also covered much of what is now the Sudan and treated specimens obtained by Anderson himself and the growing collection of the British Museum (Natural History) from the Nile Valley made by R. H. Brown, A. L. Butler, W. E. de Winton, S. S. Flower, W. Innes, J. Rogers, N. C. Rothschild, and others.

In 1932, S. S. Flower updated and reviewed Anderson's work, but restricted his discussion to Egypt in the modern sense (without Sudan). The section on Chiroptera in Flower's work was based on additional specimens acquired by the British Museum (Natural History) mainly through the efforts of the previously mentioned collectors, and those of L. W. Bough, A. M. Mackilligin, M. J. Nicoll, and W. H. Witherby, among others.

Professor Kamal Wassif of Ain Shams University in Cairo made extensive collections of mammals in Egypt and published several reports dealing with bats (1949, 1953, 1959*a*, *b*, 1962). Contributions to the morphology of Egyptian bats were made by Madkour (1961, 1975, 1976*a-e*, 1977*c*, *d*, 1978, 1982), Wassif (1969) and Wassif and Madkour (1963, 1969, 1971, 1972*a*, *b*, *c*, 1973, 1974). The collections made by NAMRU-3 were studied by Setzer (1952) for the Nile Delta region and later by Hoogstraal (1962). In addition, Sanborn and Hoogstraal (1955) presented a key to the identification of Egyptian bats. The most recent report is that of Gaisler, Madkour, and Pelikan (1972) who listed 21 species of bats for Egypt, including Sinai.

The taxonomy of Egyptian bats has been included in larger regional works such as Allen (1939), Ellerman and Morrison-Scott (1951), Hayman (1967), Hayman and Hill (1971), and Corbet (1978). Special reference must also be made to Kock's (1969) "Die Fledermaus-Fauna des Sudan" and Koopman's (1975) "Bats of the Sudan." Both of these excellent works extend their taxonomic and zoogeographical discussions to bats occurring in the Nile Valley.

The material examined is the largest collection of Egyptian bats available for a single review, and most of it has been little examined in the previous works. Though the present work is not intended to be a final answer to even some of the basic questions of chiropteran taxonomy in Egypt, it seems timely to review the available knowledge and to summarize previous contributions. Egyptian bats do not seem to play a role in the transmission of rabies (El Sabban *et al.*, 1967) or any other human disease (Dr. Harry Hoogstraal, personal communication). Only one species, *Rousettus aegyptiacus*, is suspected of becoming an economic menace (Madkour, 1977*a*). Inasmuch as all Egyptian bats but this one are insectivorous, it would be ecologically and economically harmful to apply such control measures as fumigating caves and ruins. In Israel, this kind of treatment resulted in the almost complete extinction of many useful insectivorous bats and the target species, *Rousettus*, still survives in large numbers. Much field work remains to be done, especially from an ecological perspective, and it is hoped that the present review at least would spark an interest in this fast-developing country, especially in nature protection and management.

Materials and Methods

For this work, I examined 2684 specimens from Egypt and an additional 296 from adjacent territories. That material is housed in many collections, which are listed below, with museum abbreviations used in text, and the person or persons who facilitated this examination. To those individuals and institutions mentioned, I am greatly indebted. Some specimens from my field work are not yet catalogued and the field numbers, prefixed with the initial MQ, are used. The abbreviations used are those preferred by the museum curators or they are those listed in Choate and Genoways (1975) and Genoways and Schlitter (1981).

AMNH—American Museum of Natural History, New York (Karl F. Koopman)
BMNH—British Museum (Natural History), London (John E. Hill)
CM—Carnegie Museum of Natural History, Pittsburgh (Duane A. Schlitter and Hugh H. Genoways)
FMNH—Field Museum of Natural History, Chicago (Robert Izor)
HZM—Harrison Zoological Museum, Sevenoaks, Kent, England (David L. Harrison)
HUJ—Hebrew University, Jerusalem (E. Werner and E. Tchernov)
MCZ—Museum of Comparative Zoology, Harvard University (John Kirsch)
MHNG—Museum d'Histoire Naturelle, Geneva (V. Aellen)
MQ—Mazin Qumsiyeh field numbers. Specimens are deposited at CM and SAM
MSNG—Museo Civico di Storia Naturalle, Genova (Gianna Arbocco)
MVZ—Museum of Vertebrate Zoology, University of California, Berkeley (James L. Patton)
NHMB—Naturhistorische Museum, Basel (G. Stocker and U. Rahm)
ROM—Royal Ontario Museum, Ontario, Canada (Randolph L. Peterson)
SAM—Sana Atallah Private Museum (including author's private collection), Beit Sahur, West Bank of Jordan
SMNS—Staatlische Museum fur Naturkunde, Stuttgart (Fritz Dieterlen)
TAU—Tel Aviv University, Zoology Dept. Museum (H. Mendelssohn)
USNM—National Museum of Natural History, Washington, D.C. (Charles O. Handley, Jr., and Michael Carleton)
UCONN—University of Connecticut Museum of Natural History, Storrs (Ralph M. Wetzel)
ZFMK—Zoologisches Forschunginstitut und Museum Alexander Koenig, Bonn (Rainer Hutterer)
ZMUC—Zoologische Museum Universitatsparken, Copenhagen (Hans Baagøe)

In the species accounts that follow this section, families, genera, and species are listed in the order they appear in Corbet (1978). Sanborn and Hoogstraal (1955) presented a key to the identification of Egyptian bats that covered most of the species known in Egypt at that time. At the end of this section is a key to the families of bats occurring in Egypt. Under each family account, I give a key to the genera and species known to occur in Egypt. However, these keys should be used with caution because of the relatively small number of species known and the possibility of the presence in Egypt of species that are not included in this work. Published keys for bats of nearby areas cover most of the species known from Egypt and should be consulted for additional verification (Harrison, 1964; Atallah, 1977; DeBlase, 1980). The abbreviations used in this work are listed in Appendix B. For each species or subspecies the following information is given:

Species and subspecies synonymy.—I give the senior synonym, junior synonyms different from or not listed by Ellerman and Morrison-Scott (1951), Kock (1969), and Corbet (1978), and the first use of the combination used in this work.

Type specimen(s).—The type locality, holotype or type series are indicated, and their museum locations are given. The specimen number is cited without reference to source of information if I have examined the type material.

Common name(s).—Any bat is referred to in Arabic as Watwat, Khafash, Teir El Leil, or Bouchleida (=Boujleida) depending on the area of the Arab world. A few additional Arabic names were listed by Zein ed Din and Hafez

(1959). Thus, I mainly include the more restricted English names and the original (not translated) Arabic names.

General distribution.—This is taken mainly from the works of Corbet (1978) for the Palearctic region and Hayman and Hill (1971) for the Ethiopian region. Additional sources were consulted for more restricted regional work, and those are indicated when used.

Distribution in Egypt.—For the distribution in Egypt, the reader is referred to the maps and localities listed under the "specimens examined" and "literature records." Traditionally Egypt has been divided into "Upper" and "Lower" areas in respect to the Nile River. The definitions of those areas has not been by any means stable. Flower (1932) recognizes as Upper Egypt the areas of Egypt south of Cairo, whereas Kock (1969) delimits this area as south of Qena. Both terms are of Pharaonic origin, and historically Lower Egypt referred to only the Nile Delta and Upper Egypt to the Nile Valley and El Fayum south from the apex of the Delta (Osborn and Helmy, 1980:8). Kock's (1969) areas refer to zoogeographically unique areas and I will use the terms "Northern Nile Valley" or "Northern Egypt" and "Southern Nile Valley" or "Southern Egypt" for those areas. Some comments are given in this section regarding patterns of distribution of the subspecies in Egypt.

Comparisons and diagnosis.—Most species of bats occurring in Egypt have been described morphologically by Harrison (1964), Rosevear (1965), Wassif (1969), Wassif and Madkour (1963, 1970, 1971, 1972*a*, *b*, *c*, 1973, 1974), and Madkour (1961, 1975, 1976*a-e*, 1977*c*, *d*, 1978, 1982). Those papers describe the morphology of the species of bats occurring in Egypt, except for *Pipistrellus deserti (=P. aegyptius)* and *P. ariel*. These two species were discussed morphologically in the original descriptions.

In all species accounts, a short diagnostic description is given to aid in identification. To describe colors, I used the names of Ridgway (1912) and the recent update of Ridgway's colors and names by Smithe (1974, 1975, 1981). The colors are generally referred to in the remarks on the geographic variation and subspecies identifications. General form and structure of the baculum and, when possible, the glans penis are given because of the importance of those characters in the taxonomic treatment of the species.

Measurements and nonlinear characters are here discussed where the data may have bearing upon geographic variation, sexual dimorphism, and individual variability. The various characters used in the analysis and their abbreviations as used in the text are listed in Appendix B. The measurements are displayed in appropriate tables and/or graphs in millimeters and so are the scales on the figures. When numerous specimens were available for study, the mean, standard deviation, range, and number for each variate measured are given. The measurements were obtained from specimen tags (measured by a ruler in the field) for total length, tail length, hind foot length, and ear length. All other measurements were obtained with dial calipers to the nearest 0.1 millimeter.

Remarks.—The information of the other sections is here analyzed to identify systematic and possible evolutionary trends at the species and subspecies level.

Biology.—Field data are summarized when available concerning behavior, reproduction, roosting sites, age and seasonal variation, sexual dimorphism, and general habitat preference. Some information was obtained from the field notes accompanying the collection of NAMRU-3 (Harry Hoogstraal and other collectors). Any information obtained as such is indicated as being from "field notes" in this section. This information, though scarce, is used whenever possible for analysis of distributional patterns presented in the section on zoogeography following the species accounts.

Specimens examined.—In this section the localities are listed by country and province or governorate, and are separated by subspecies for the species with more than one subspecies in Egypt. Following the province or governorate, the specific localities, the number of specimens examined, and, in parentheses, the abbreviation of the museum holding them are given. Following is a list of the governorates of Egypt arranged as they would appear in the text, from north to south and east to west: Sinai, Port Said, Ismailia, Suez, Red Sea, Sudan Administrative, Dagahliya, Damietta, Kafr El Sheikh, Beheira, Sharqiya, Gharbiya, Qalyubiya, Minufiya, El Tahreer, Cairo, Giza, Faiyum, Beni Suef, Minya, Asiut, Sohag, Qena, Aswan, Alexandria, Matruh, El Wadi El Gedeed.

In addition to those from Egypt I list specimens that I examined from nearby areas, particularly Palestine (the geographic area that includes Israel, West Bank of Jordan, and Gaza strip), Jordan, and adjoining areas of the Sudan and Libya, which are relevant to the taxonomic discussion. The distributions of bats in Jordan and Palestine are plotted for areas appearing on the maps provided.

Literature records of Egyptian specimens not examined.—This includes the records in Egypt based on specimens not available for my study.

Key to Families of Egyptian Bats

1. Ear simple, with margin forming a complete ring; tragus and antitragus absent; second finger clawed; skull large (GLS greater than 40); molar and premolar teeth low crowned ..... (Megachiroptera) Pteropodidae
   Ear margin not forming complete ring; tragus or antitragus present; second finger not clawed; skull size medium to small (GLS less than 40); molar and premolar teeth high crowned ..... (Microchiroptera) 2

2. Muzzle with cutaneous growth forming an elaborate noseleaf structure; tragus absent but antitragus well developed; nasal branches of premaxilla absent, palatal branches fused medially and free of maxilla laterally ..... Rhinolophidae
   Muzzle with no elaborate noseleaf structure; tragus present; nasal branches of premaxilla present or absent; palatal branches present or absent, if not as above 3

3. Tail protrudes from dorsal surface of uropatagium; premaxilla with nasal branches only, palatal branches absent ..... Emballonuridae

Tail either completely enclosed by, or protrudes from posterior end of uropatagium; premaxilla always with palatal branches; nasal branches present or absent 4

4. Uropatagium short, enclosing less than one-third of the long, thin tail; dental formula 1/2 1/1 1/2 3/3=28; nasal region of skull inflated ..... Rhinopomatidae
Uropatagium long, enclosing more than one-half of the tail; teeth more than 28; nasal region of skull not inflated 5

5. Muzzle with longitudinal groove; nasal branches absent; skull with deep concavity on anterior surface between the orbits ..... Nycteridae
Muzzle simple; nasal branches present; no deep concavity on anterior surface of the skull 6

6. Tail scarcely or not protruding beyond posterior edge of the wide uropatagium .....
..... Vespertilionidae
Tail projecting conspicuously beyond posterior edge of narrow uropatagium ..... Molossidae

Suborder MEGACHIROPTERA

Family PTEROPODIDAE

Genus ***Rousettus*** Gray, 1821

Rousettus represents a group of fruit-eating bats with a relatively large skull, low-crowned teeth, and bifid lower incisors. The dental formula is 2/2 1/1 3/3 2/3 = 34.

Rousettus aegyptiacus aegyptiacus (É. Geoffroy St.-Hilaire, 1810)

Pteropus egyptiacus É. Geoffroy St.-Hilaire, 1810:96. Emended as *aegyptiacus* in É. Geoffroy St.-Hilaire, 1818:134, pl. 3, fig. 2.
Rousettus aegyptiacus, Allen, 1939:62.

Type specimen.—MNHN A.70; adult female; in alcohol, with skull removed; Great Pyramids, Giza, Egypt. Holotype.

Common names.—Egyptian fruit bat, Khafash El Fawakeh, Khafash Masri.

General distribution.—Extreme southern Turkey, Iran, and Pakistan, south and west through the Eastern Mediterranean, Cyprus, Arabia (Nader, 1975), the Nile Valley, and most of Africa south of the Sahara. The nominate subspecies occurs in Egypt, Cyprus, Turkey, the Eastern Mediterranean region (Atallah, 1977), Saudi Arabia (Nader, 1975), and perhaps Eritrea (Senna, 1905). The latter record possibly refers to *R. aegyptiacus arabicus* (Anderson, 1902) described from Lahej, near Aden, southern Arabia (holotype examined in BMNH). This last subspecies and other named forms from Africa south of the Sahara desert (*leachi* Smith, *unicolor* Gray, or *occidentalis* Eisenstraut) are extralimital.

Distribution in Egypt.—Most cultivated areas of Nile Valley and Delta (Fig. 1). The southernmost record for the nominate subspecies in Egypt is Aswan (Kulzer, 1958; Maser, 1966, *fide* Kock, 1969).

Diagnosis.—Largest of the Egyptian bats (Table 1); forearm 84-99; easily distinguished from insect-eating bats by ear margin with complete ring, tragus absent; second finger clawed. Skull large (GLS 41.4-46.4), the absence of a bony external auditory capsule; cheek teeth relatively low-crowned (Madkour, 1976*e*). Glans penis with corpora cavernosa prominant (absence of the accessory corpora distinguishes this bat from those of Egyptian Microchiroptera). Os penis relatively small, measuring approximately 2.4 in length and 1.1 in proximal width (Madkour, 1976*c*).

I concur with Nader (1975:333) that males appear larger than females in most measurements (Table 1). Because of the small sample size of specimens with measurements available, I could not statistically test this hypothesis. The hairs are uniform in color from base to tips. Dorsally the color is between Drab and Brown; ventrally the color is usually Drab. The glans penis and baculum have been described by Harrison (1964) and Madkour (1976*c*).

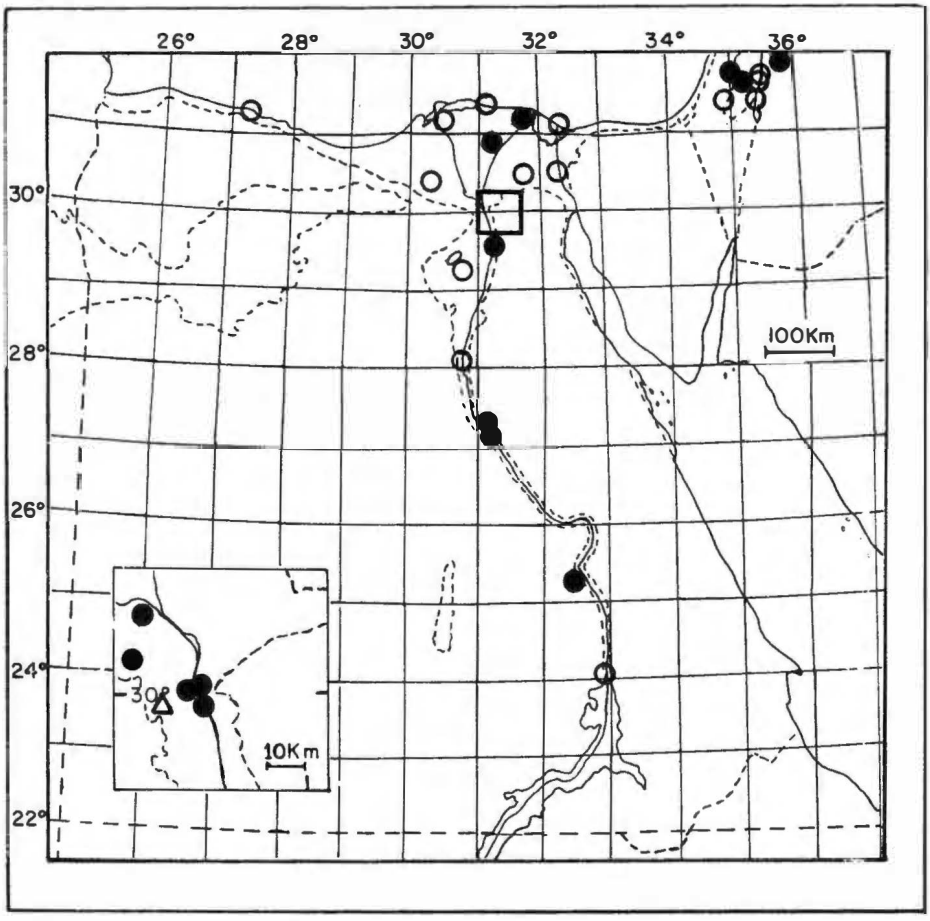

FIG. 1.—Distribution of *Rousettus aegyptiacus*. Solid symbols indicate specimens examined; open ones, literature records. Triangle represents type locality.

Biology.—Lewis and Harrison (1962) reported that in Lebanon this species prefers relatively humid caverns that also receive some reflected light. In Egypt, the Egyptian fruit bat roosts in large colonies in mosques, wells, old ruins, tombs, and deserted houses. Egyptian fruit bats become active shortly after dusk and have another peak of activity in the early morning hours. At Giza pyramids, I observed colonies leaving the roosts between 1800 and 1845 hrs. on 28 July 1981, and all bats headed in the same direction, northeast, towards the Nile River. In Egypt, these bats feed on sycamore, mulberries, dates, and figs (Anderson, 1902; Madkour, 1977*a*). Kaisila (1966) observed fruit bats visiting flowers of *Bombax malabaricum* in the streets of Cairo.

Besides farmers who kill fruit bats because of their reputed harm to farm crops (Atallah, 1977), the natural enemies of this bat include falcons

TABLE 1.—Rousettus aegyptiacus: *mean ± one standard deviation followed by extremes in parentheses and sample size. Individual measurements are given when sample size is less than three.*

Variate	Males	Females
TL	150.7 ± 10.0(140-167)8	139.8 (119-160)5
T	15.4 ± 2.2(12-18)8	15.4(14-17)5
HF	24.2 ± 1.7(22-27)9	23.4(20-27)5
E	23.3 ± 1.6(21-27)9	24.0(22-27)5
FA	94.9 ± 2.3(90-97)12	91.0(84-94)6
GLS	44.8 ± 1.2(42.8-46.4)9	42.6(41.4-44.0)4
CCL	40.4 ± 1.4(38.7-42.4)9	39.2(38.4-40.0)4
BBC	18.1 ± 0.6(17.4-18.7)9	17.1(17.0-17.2)4
IOC	8.9 ± 0.5(8.3-9.7)9	8.4(7.6-8.9)4
ZYGB	27.5 ± 1.3(25.1-28.7)8	25.3, 26.7
C-M3	16.8 ± 0.5(15.8-17.5)8	16.0, 17.2
BCD	12.9 ± 0.4(12.1-13.6)8	12.4, 12.4
M	33.4 ± 1.0(31.3-34.5)8	30.5, 32.7
CORH	18.4 ± 0.6(17.4-19.2)8	17.5, 18.5

(Thomas, 1900) and owls (I found fragments of skulls in pellets of the Eagle Owl, *Bubo bubo*, in Wadi El Kelt, Palestine). Their presumed harm to fruit crops notwithstanding, these bats are disliked in Egypt because they disfigure the monuments and ancient Egyptian decorations with their feces (Madkour, 1977*a*).

Atallah (1977) indicated that in Lebanon young are born from June to August. In Egypt, suckling young were observed from March to May (Field Notes), and inasmuch as the gestation period is approximately four months (Kulzer, 1958), copulation is estimated to occur from November to January. Additional information on the biology of this species can be found in Kulzer (1958, 1963, 1966) and Mohres and Kulzer (1956).

Specimens examined (137).—EGYPT: *Damietta*: Damietta 1(BMNH), 1(USNM); *Gharbiya*: Mehalla El Kubra 2(BMNH); *Cairo*: Cairo 4(BMNH), 36(USNM), 25(FMNH); El Gezira 1(USNM), 1(MVZ); Maadi 1(BMNH): *Giza*: Giza 9(BMNH), 1(HZM); Pyramids of Giza (Geoffroy St.-Hilaire, 1810, sight record of MQ); 1 km SE El Manashi 3(CM); El Mansuriya 2(FMNH); El Aiyat 2(FMNH); *Asyut*: Asyut 1(BMNH); El Walidiya 1(FMNH); *Qena*: Luxor 18(FMNH); Wadi Nassim 1(USNM); *No exact locality*: 4(BMNH), 1(SMNS). PALESTINE: *Central*: Bitan Aharon 13(MQ); *Haifa*: Mt. Carmel 1(SAM), 3(HZM); *Jerusalem*: Hartuv 1(HZM); Jerusalem 1(FMNH); *Northern*: Wadi Kern 1(BMNH). JORDAN: *Amman*: Al Mahatta 2(SAM).

Records of Egyptian specimens not examined.—Port Said: Port Said (Flower, 1932); *Ismailia*: Ismailia (Flower, 1932); *Kafr El Sheikh*: Baltim (Anderson, 1902:82); *Beheira*: Fuwa (Brehm, 1863, *fide* Kock, 1969; Madkour, 1977*b*); Sharqiya: Negroom (Flower, 1932); Tel El Kabir (Flower, 1932); *El Tahreer*: Wadi El Natrun (Hoogstraal, 1962); *Faiyum*: Medinet El Faiyum (Anderson, 1902:85); *Minya*: El Minya (Anderson, 1902:85); *Aswan*: Aswan (Kulzer, 1958; Maser, 1966); *Matruh*: Mersa Matruh (Flower, 1932).

Suborder Microchiroptera

Family Rhinopomatidae

Key to Species in Egypt

1. Larger, FA 62-71, GLS 18.7-22.1; tail usually shorter than forearm; lacrymal region of skull relatively shallow; males show significant development of sagittal crest; posterior edge of palate forms an acute angle, never with parallel sides ..... *Rhinopoma microphyllum*
   Smaller, FA 48.3-61, GLS 16.0-18.5; tail usually longer than forearm; lacrymal region of skull inflated; males do not show significant development of sagittal crest; posterior edge of palate forms with rounded profile, sides almost or are parallel ..... *Rhinopoma hardwickei*

Genus *Rhinopoma* É. Geoffroy St.-Hilaire, 1813

The nomenclature uncertainty about the contents of this genus has been largely summarized by Kock (1969) and Hill (1977). Anderson (1902) did not distinguish the two species from Egypt, and used the name *R. microphyllum* É. Geoffroy St.-Hilaire (=*R. hardwickei*) for all Egyptian specimens that he examined. Two species occur in Egypt for which the names *Rhinopoma microphyllum* (Brunnich) and *R. hardwickei* Gray are applied. Wassif and Madkour (1963) gave a detailed description of the osteology of the two sympatric forms in Egypt.

Rhinopoma microphyllum microphyllum (Brunnich, 1782)

Vespertilio microphyllus Brunnich, 1782:50, pl. 6, figs. 1-4.
Rhinopoma microphyllum microphyllum, Harrison, 1964:53.

Type specimen.—ZMUC; "Arabia and Egypt"; restricted to Giza Pyramids in Egypt (Kock, 1969).

Common name.—Larger rat-tailed bat.

General distribution.—Africa, including Morocco (USNM specimen), Mauritania, Senegal, Nigeria, Sudan, Egypt, east through Arabia, Iran, Pakistan, to India, Thailand, and Sumatra. For detailed notes on the distribution see Hill (1977).

Distribution in Egypt.—Nile Valley, particularly around Cairo, and Delta region (Fig. 2).

Diagnosis.—Hard palate with posterior margin triangular; sagittal crest well developed in males (Fig. 3); lacrymal region of skull almost flat; large in size (FA 62-71, GLS 18.7-22.1).

Rhinopoma microphyllum differs from *R. hardwickei* in its larger size, relatively shorter tail (generally not exceeding forearm length), lacrymal regions almost flat, and heavier, more robust skull (Table 2). The baculum in this species is identical in shape to that of *R. hardwickei* but is slightly larger (Wassif and Madkour, 1963).

Remarks.—The large rat-tailed bat is known from several areas in northern Egypt where the type is believed to have originated and thus all specimens from that area are referred to the nominate subspecies. Southern Egyptian populations may represent *R. m. tropicalis* described from Sudan

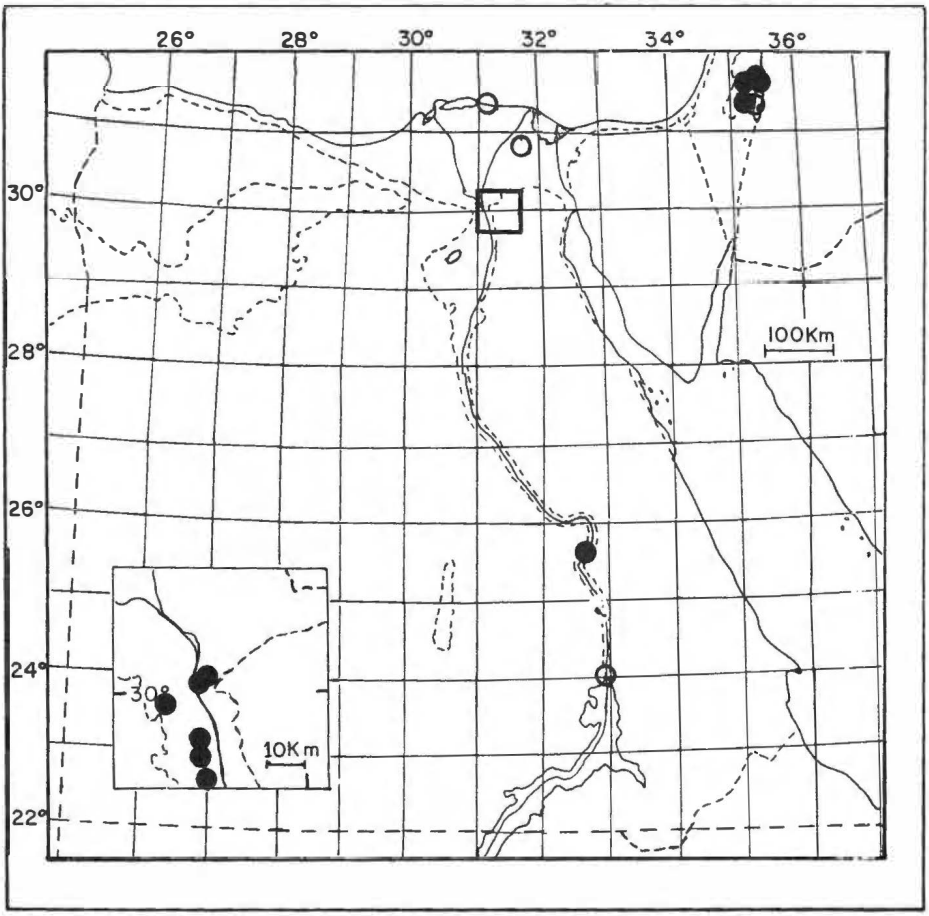

FIG. 2.—Distribution of *Rhinopoma microphyllum*. Solid symbols indicate specimens examined; open ones, literature records.

by Kock (1969:58) or the nominate subspecies. Only three old mummies from Luxor in Southern Egypt collected by N. C. Rothschild were available to me for study, and those could not be allocated to subspecies due to their condition. Although Anderson (1902) recorded this species from Philae and Aswan in Southern Egypt, I could not locate any specimens from those localities in the British Museum (Natural History), where most specimens seen by Anderson are deposited, and it is possible that the reference was to *Rhinopoma hardwickei*.

Biology.—Most older reports on *R. microphyllum* refer to the smaller, more common species (*R. hardwickei*). Consequently, little is known of the biology of *R. microphyllum*, but it is presumed to have similar habits to the smaller species. The two often share the same roost (Harrison, 1964:56). Brosset (1962:32) reported that Indian males and females occur together in early April and that parturition probably takes place in June.

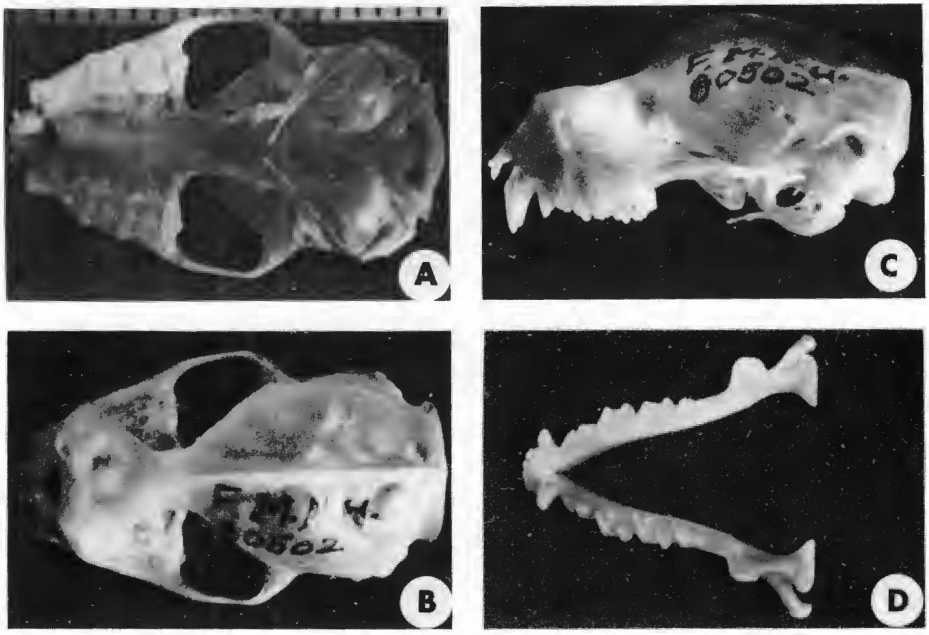

FIG. 3.—Ventral (A), Dorsal (B), lateral (C) views of skull and mandible (D) of a male *Rhinopoma microphyllum* (FMNH 90502). Note the shape of the posterior edge of the hard palate and the development of the sagittal crest.

Specimens examined (67).—EGYPT: *Cairo*: Cairo 3(NHMB); Abassiya 1(USNM); *Giza*: Abu Rawash 1(BMNH), 2(FMNH), 2(USNM); Abu Sir 2(FMNH), 1(USNM); Giza Pyramids 2(BMNH), 2(FMNH), 6(USNM); Saqqara 4(FMNH), 1(MVZ), 17(USNM); *Qena*: Near Luxor 3(BMNH); *No exact locality*: Egypt 2(BMNH), 2(NHME), 1(SMNS), 1(USNM). PALESTINE: *Northern*: Hanita 1(ROM); Kineret 1(TAU); Tiberias 2(FMNH), 1(HUJ); Wadi Amud 2(TAU): *Jerusalem*: Jerusalem 1(HUJ); Mar Jiryis, Wadi Kelt 1(TAU); Mt. Karantal 1(BMNH); *Southern*: Wadi Khabra 1(HUJ); *No exact locality*: "Israel" 1(TAU).

TABLE 2.—Rhinopoma microphyllum: *measurements as in Table 1.*

	Egypt		Palestine	
Variate	Males	Females	Males	Females
TL	136.8 ± 7.5(127-146)11	137.4 ± 7.8(124-146)8	132(130-135)4	127, 117
T	61.5 ± 4.4(54-69)13	60.1 ± 3.8(52.2-65)10	54.3(53-55)3	57, 52
HF	16.4 ± 0.5(16-17)11	15.9 ± 1.2(13-17)8	13.0(10-17)4	14, 8.5
E	20.6 ± 1.0(19-22)11	20.5 ± 0.9(19-22)8	19.8(18-22)4	20, 20
FA	68.6 ± 1.8(66-71)14	67.2 ± 1.8(64.2-69.3)10	64.5(58-69)4	64, 63
GLS	20.7 ± 0.5(20.0-21.5)11	20.0 ± 0.6(18.7-20.8)8	21.3(20.6-22.1)3	20.5, 20.0
CCL	18.5 ± 0.6(17.2-19.2)11	18.0 ± 0.4(17.5-18.5)8	19.0(18.5-19.7)3	18.4, 18.2
BBC	9.4 ± 0.3(9.0-9.8)11	9.2 ± 0.3(8.7-9.6)8	9.2(9.0-9.4)3	8.5, 8.4
IOC	2.7 ± 0.1(2.6-2.8)11	2.7 ± 0.2(2.5-2.9)8	2.9(2.8-3.0)3	2.6, 2.8
ZYGB	12.1 ± 0.3(11.6-12.6)11	12.0 ± 0.4(11.2-12.4)8	12.5(11.9-13.3)3	11.6, 11.7
RBCA	5.3 ± 0.3(4.8-5.7)13	5.2 ± 0.2(4.9-5.6)8	5.3(4.9-5.7)4	5.3, 5.0
C-M3	7.4 ± 0.2(7.1-7.7)13	7.2 ± 0.1(7.0-7.4)8	7.4(7.2-7.8)4	7.2, 6.9
BCD	6.4 ± 0.3(6.0-6.9)11	6.4 ± 0.3(6.1-6.9)7		5.7
M	13.9 ± 0.4(13.2-14.6)13	13.5 ± 0.4(13.0-14.2)8	14.0(13.1-14.5)3	14.0, 13.8
c-m3	8.4 ± 0.3(8.1-8.9)13	8.2 ± 0.3(7.6-8.6)8	8.3(8.1-8.4)3	7.9, 8.0
CORH	7.0 ± 0.4(6.4-7.6)13	6.9 ± 0.2(6.6-7.2)8	6.8(6.7-7.0)3	6.9, 6.7

FIG. 4.—Facial appearance of *Rhinopoma hardwickei* from Saqqara, Giza Governorate. Drawn from color slide of live specimen by author.

Records of Egyptian specimens not examined.—The following records from Anderson (1902) possibly refer to the smaller *R. hardwickei*. Anderson's (1902:146) measurements for Aswan specimens clearly represent the smaller species, except for one male with a forearm of 71. No measurements were given for specimens from other localities. *Aswan*: Aswan, Philae; *Sharqiya*: Beni Hassan; *Kafr El Sheikh*: Baltim.

Rhinopoma hardwickei Gray, 1831

Rhinopoma microphyllus É. Geoffroy St.-Hilaire, 1818:123, pl. 1, No. 1; Junior homonym of *R. microphyllus* Brunnich, 1782.
Rhinopoma hardwickii, Gray, 1831:37.

Type locality.—Bengal, India.

Common names.—Lesser rat-tailed bat, mouse-tailed bat.

General distribution.—This is a widespread species, which occurs from north of Lake Turkana in East Africa through Somalia, Ethiopia, Socotra Islands, Sudan, and through most of the drier regions of North Africa south to southern Niger, Mali (Vogel, 1977), and Mauritania. From Arabia and Iran, the range extends through Pakistan and India to Thailand. For distribution in Egypt, see Fig. 5 and remarks under subspecies.

Diagnosis.—Posterior margin of hard palate rounded; skull delicately built; small in size (FA 48.3-61, GLS 16.0-18.5); tail usually longer than forearm (Table 3).

Rhinopoma hardwickei differs from *R. microphyllum* in being smaller in size, with a much smaller and more delicately built skull. The lacrymal

TABLE 3.—Rhinopoma hardwickei: *measurements as in Table 1.*

	Rhinopoma hardwickei arabium		*Rhinopoma hardwickei cystops*	
	Males	Females	Males	Females
TL	131.7 ± 7.5(114-140)19	130.5 ± 6.6(120-140)14	108.2(106-113)3	115.5 ± 3.0(112-120)8
T	65.4 ± 5.9(54.6-77)25	64.4 ± 7.8(50-75)18	55.8(54-58.5)3	58.9 ± 3.2(51-63)12
HF	13.3 ± 0.9(11-15)19	13.5 ± 0.9(12.2-16)18	12.6(11.5-13.4)3	12.4 ± 0.5(11.5-13.3)11
E	18.9 ± 1.1(17-21)24	18.7 ± 0.9(18-21)14	17.5	18.2 ± 0.6(17-19)8
FA	57.5 ± 2.2(53-61)24	55.7 ± 2.8(50-58.9)14	51.5(48.8-53.2)3	54.3 ± 1.9(50.8-58.5)12
GLS	18.1 ± 0.2(17.7-18.5)12	17.6 ± 0.2(17.3-18.0)10	17.0	16.8(16.6-16.9)6
CCL	16.0 ± 0.3(15.6-16.5)12	15.5 ± 0.2(15.2-15.8)10	14.9	14.7(14.5-15.0)6
BBC	8.1 ± 0.1(7.9-8.2)12	7.9 ± 0.2(7.7-8.2)11	7.4	7.6(7.5-7.8)6
IOC	2.7 ± 0.2(2.5-3.0)14	2.6 ± 0.2(2.3-3.0)13	2.7	2.4(2.2-2.5)6
ZYGB	10.5 ± 0.2(10.1-10.8)11	10.3 ± 0.3(9.9-10.8)10	9.9	9.8(9.7-10.0)6
RBCA	4.5 ± 0.2(4.1-4.7)13	4.4 ± 0.1(4.2-4.6)12	4.2	4.1(3.8-4.3)6
C-M3	6.1 ± 0.1(5.8-6.2)14	5.9 ± 0.1(5.8-6.0)12	5.6	5.6(5.4-5.8)6
BCD	5.7 ± 0.1(5.5-5.9)12	5.6 ± 0.2(5.4-5.9)10		5.3(5.2-5.5)6
M	11.6 ± 0.3(11.0-11.9)14	11.3 ± 0.3(10.6-11.6)12	10.6	10.8(10.5-10.9)6
c-m3	7.0 ± 0.1(6.8-7.2)14	6.8 ± 0.2(6.4-7.1)12	6.2	6.3(6.2-6.6)6
CORH	5.7 ± 0.2(5.3-5.9)14	5.5 ± 0.2(5.0-6.0)12	5.2	5.1(4.9-5.2)6

regions in specimens of this species are more inflated and thus separated by a narrow gap as compared to skulls of specimens of the larger species (Wassif and Madkour, 1963).

Biology.—The species was often collected from dry caverns, ruins, ancient temples, underground tunnels, mosques, and old buildings. Individuals appear to stay active most of the winter, drawing on the large amount of stored abdominal fat (Vogel, 1977). Madkour (1977*b*) mentioned that colonies remain in the Cairo area throughout the year. In Palestine, Dor (1947) reported pellets of the owl, *Tyto alba*, as containing three skulls of "*R. microphyllum*," which possibly refers to the smaller species and not the larger one. Prakash (1960) reported that young are born in June and July in India. Brosset (1962:27) found remains of Diptera in the guano of this species in India.

Rhinopoma hardwickei cystops Thomas, 1903

Rhinopoma cystops Thomas, 1903:498.
Rhinopoma cystops cystops, Allen, 1939:64.
Rhinopoma hardwickei cystops, Ellerman and Morrison-Scott, 1951:102.

Type specimen.—BMNH 2.1.17.2; adult female; skin and skull; Luxor, Egypt, N. C. Rothschild. Holotype.

Distribution in Egypt.—Kock (1969) designated the range of *R. h. cystops* Thomas (1903) as "Mittelagypten" (Upper Egypt south of Qena), Hoggar, and Air mountains. The Egyptian material I refer to this subspecies includes specimens from Luxor, Qena, Dandara, Aswan, Philae, Edfu, Abu Simbel, Wadi Nassim, and Gebel Drunka (Fig. 5). All other material examined is referred here to *R. h. arabium*.

Comparisons.—The populations of *R. hardwickei* from southern Egypt (south of Qena), northern Niger, southern Algeria, and northern Mauritania are smaller in body measurements than are the surrounding

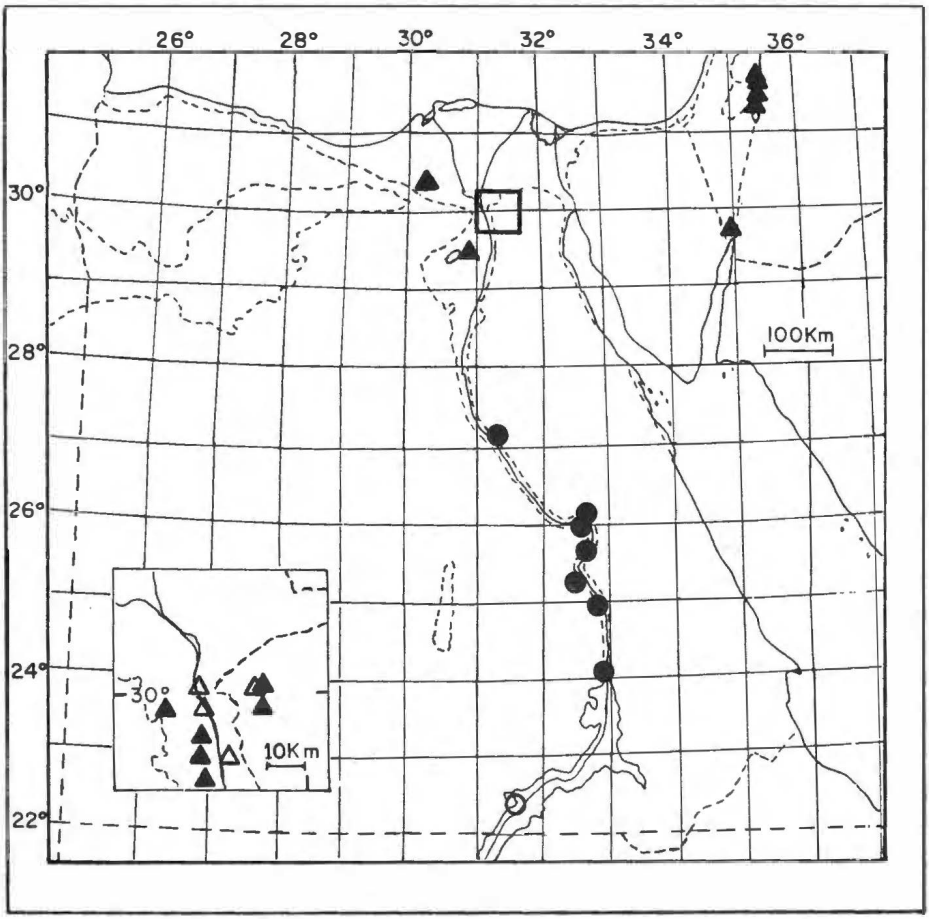

FIG. 5.—Distribution of *Rhinopoma hardwickei cystops* (circles and dots) and *R. h. arabium* (triangles). Solid symbols indicate specimens examined; open ones, literature records.

ones (Table 3). Specimens of this subspecies are paler than those from northern Egypt. The color of a specimen from Dandara is Glaucous on the mid-dorsal region and Pearl Gray ventrally.

Remarks.—Harrison (1964:61) and Atallah (1977:288) considered the Eastern Mediterranean populations to represent *R. h. cystops*, but Kock (1969:51) suggested that they are more closely related to the northern Egyptian and Iraqi populations, and he concluded that they should be assigned to *R. h. senaariense* (=*R. h. arabium*). The specimens from northern Egypt and the eastern Mediterranean are rather small in body size but are still larger than the southern Egyptian specimens. They are somewhat intermediate between *R. h. cystops* and *R. h. arabium*.

Specimens examined (107).—EGYPT: *Asiut*: Gebel Drunka 4(FMNH); *Qena*: Dandara 2(AMNH), 16(MQ), 2(ZFMK); Luxor 2(BMNH), 18(FMNH); Qena 1(SMNS); Wadi Nassim

8(FMNH); *Aswan*: Aswan 1(BMNH); Idfu Temple 11(CM); Philae 1(NHMB); *No exact locality*: Egypt 1(SMNS), 34(USNM), 2(ZMUC); "N. Africa" 1(ZMUC).

Records of Egyptian specimens not examined.—Aswan: Abu Simbel (Lehman, 1964, *fide* Kock, 1969).

Rhinopoma hardwickei arabium Thomas, 1913

Rhinopoma senaariense Fitzinger, 1866:547; as *R. h. sinaariense*, Kock, 1969; *nomen nudum* Koopman, 1975.

Rhinopoma cystops arabium, Thomas, 1913:89; Laurent, 1941*a*, *b*.

Rhinopoma hardwickei cordofanicum, Koopman, 1975 (not Heuglin, 1877:27, a synonym of *R. microphyllum*).

Rhinopoma hardwickei arabium, Harrison, 1964; Hill, 1977:33.

Type specimen.—BMNH 13.6.19.5; adult male; skin and skull; Wasil, Yemen, Arabia; E. M. Dury; 6 March 1913. Holotype.

Distribution in Egypt.—Northern Egypt in the governorates of El Tahreer, Cairo, Giza, and El Faiyum (Fig. 5).

Comparisons.—The overall size, especially of the forearm, is larger (see above) in members of this subspecies in contrast to the Saharan subspecies. The color of specimens in this subspecies is usually Drab on the dorsal side and Light-Drab on the ventral side. Setzer (1952:347) described specimens from Giza area as having "upper parts Light Mouse Gray shading to whitish below." See account of *R. h. cystops* for more detailed comparisons between the two subspecies.

Remarks.—Setzer (1952) recognized that specimens from northern Egypt are larger in body size than are those from south Egypt referred to *R. h. cystops*. Kock (1969) classified specimens from Mauritania, northwestern Africa, northern Egypt, the Arabian peninsula, and tentatively Iran under the subspecies *R. h. senaariense* (Fitzinger, 1866).

Koopman (1975) pointed out that *R. h. senaariense* is a *nomen nodum* and used *R. h. cordofanicum* (Heuglin, 1877) instead. However, this latter name was created by Heuglin (1877) for the larger species (=*R. microphyllum*), because he thought that the name "*microphyllus*" applied to the smaller species, *R. hardwickei* (see, for example, Thomas, 1903:496; Allen, 1939:64; Hill, 1977:33). The valid name for the subspecies of *R. hardwickei* in northern Egypt thus is *R. h. arabium* Thomas (1913), first recognized in North Africa (in Tunisia and Sudan) by Laurent (1941*a*).

Specimens examined (225).—EGYPT: *El Tahreer*: Wadi El Natrun 10(FMNH); *Cairo*: Cairo 1(NHMB), 1(ZMUC); Gebel El Ahmar 1(FMNH); Wadi Digla 2(FMNH); *Giza*: Abu Rawash 1(BMNH), 2(CM), 31(USNM); Abu Sir 3(FMNH); Giza Pyramids 1(AMNH), 6(BMNH), 27(FMNH), 11(MCZ), 23(USNM); Saqqara 20(FMNH), 5(MQ), 15(USNM); *El Faiyum*: Kom Oshim 1(USNM); PALESTINE: *Northern*: Arbel 2(HZM); Dan 1(HZM); Hanita 1(ROM), 1(TAU); Kineret 2(HUJ); Tiberias 7(HUJ); Wadi Amud 2(HZM); Wadi Dalam 5(TAU); *Jerusalem*: Ain Faschkha 6(SAM), 2(UCONN); Mar Jiryis, Wadi Kelt 2(TAU); Mt. Karantal 3(BMNH), 1(HZM), 12(SAM); *Southern*: Ein Geddi 1(HZM), 5(HUJ), 1(TAU); Nahal Amram 1(TAU); JORDAN: *Irbid*: Jerash 1(HZM), 3(SAM), 6(UCONN).

Records of Egyptian specimens not examined.—Cairo: Gebel El Mukattam, Helwan, Maadi (Wassif and Madkour, 1963); *No exact locality*: Gebel El Tayr, Egypt (Madkour, 1961).

Family EMBALLONURIDAE

Four genera of sheath-tailed bats are recognized from the Old World. Other than the genus *Taphozous* treated below, another African genus, *Coleura*, may prove to occur in Egypt; the form *Coleura afra* (Peters) was recorded from Suakin and Port Sudan in Kassala Province of Sudan (Kock, 1969; Koopman, 1975:368).

Key to Species in Egypt

1. Fur extends to base of uropatagium both dorsally and ventrally; smaller animal, FA 59-64, GLS 19.8-21.1; skull smooth with rounded braincase..... *Taphozous perforatus*
   Fur does not extend to base of uropatagium dorsally nor ventrally; larger, FA 67-82.5, GLS 24.8-31.8; skull rugose with distinct sagittal and lambdoidal crests (see Fig. 7).. *T. nudiventris*

Genus *Taphozous* É. Geoffroy St.-Hilaire, 1818

The distribution of this widespread genus includes most Old World tropics and subtropics. Two of the five African species (Koopman, 1975:369, excluding *peli*, which is included in the genus *Saccolaimus*), occur in Egypt and are treated below.

Taphozous perforatus perforatus É. Geoffroy St.-Hilaire, 1818

Taphozous perforatus É. Geoffroy St.-Hilaire, 1818:126.
Taphozous maritimus, Heuglin, 1877:2526. (Suakin, Kassala Provinvce, Sudan).
Taphozous perforatus, Allen, 1939:66.

Type specimen.—MNHN A.372; adult of undetermined sex; in alcohol; Egypt (Dobson, 1878; Andserson, 1902:138; Rode, 1941:243). Holotype. É. Geoffroy St.-Hilaire (1818) indicated that this species occurs in Ombos (=Kom Ombo) and Thebes (=Luxor). Kock (1969:74) restricted the type locality to Kom Ombo.

Common names.—Geoffroy's tomb bat, Khafash Abu Bouz.

General distribution.—Subsaharan Africa from Mauritania (Qumsiyeh and Schlitter, 1981), through Mali, Ghana, south to Zaire and Botswana, north through Tanzania, Kenya, Somalia, Sudan to Egypt, and from southern Arabia through Iran to northwestern India.

Distribution in Egypt.—Mainly in Nile Valley from the Delta and Faiyum and south to Bahr El Zaraf in Sudan (Kock, 1969:75-81; Fig. 6).

Diagnosis.—Small (FA 61-66, GLS 19.9-21.1); fur extends dorsally and ventrally to base of uropatagium; tragus broad, but lacks a well developed basal lobule as occurs in *T. nudiventris* (Fig. 8).

Skull is smooth, slender, and lacking the well developed crests of the larger species (Fig. 7). The baculum forms a minute spicule lying in the distal half of the glans (Wassif and Madkour, 1972*b*). Males are slightly smaller than females (Table 4).

Remarks.—Kock (1969:75-81) discussed the confused taxonomy of this species group (including *sudani*) in Africa and Arabia. The name *T.*

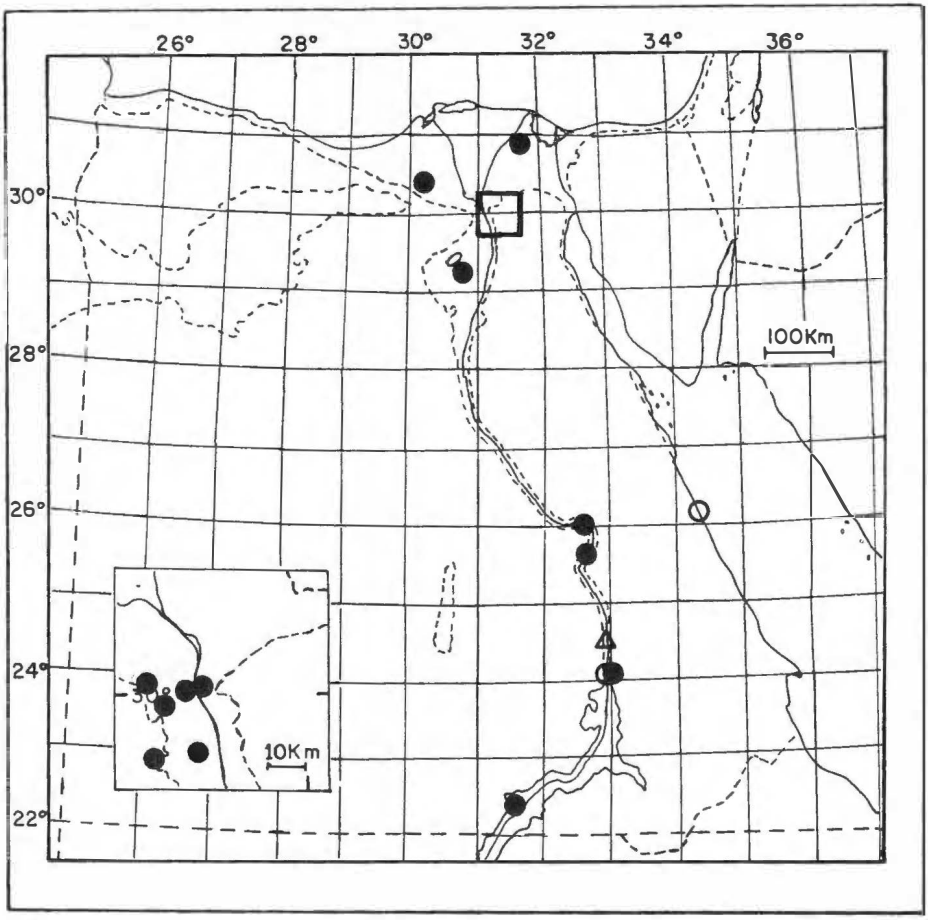

FIG. 6.—Distribution of *Taphozous perforatus*. Solid symbols indicate specimens examined; hollow ones, literature records. Triangle indicates type locality.

maritimus Heuglin from Suakin was considered a *nomen oblitum*, being largely forgotten in early literature. I have referred to the nominate subspecies all material examined from Egypt and northern Sudan.

Biology.—Large numbers are found in limestone caves, ancient monastery buildings, ruins, and other structures, sometimes hanging close to the ground (Anderson, 1902:139; Hoogstraal, 1962; Gaisler *et al.*, 1972). Prakash (1960) noted that young are born in May in India. Gaisler *et al.* (1972) collected 16 pregnant females, each containing one large embryo (13.5-21.5), in Luxor on 30 April 1969.

Specimens examined (218).—EGYPT: *Sharqiya*: Beni Hassan 1(BMNH); *El Tahreer*: Wadi El Natrun 9(FMNH); *Cairo*: Cairo 6(FMNH); 16 miles SW Cairo 1(USNM); *Giza*: Abu Rawash 1(FMNH), 1(HZM), 1(MVZ), 1(NHMB), 29(USNM); Giza 2(BMNH); 2 km from Giza City 15(USNM); Saqqara 29(FMNH), 40(USNM); *Faiyum*: Faiyum 3(USNM); *Qena*: Dandara 1(MQ); Luxor 2(BMNH), 32(USNM); Luxor, Kurna 7(FMNH); *Aswan*: Abu Simbel 1(BMNH);

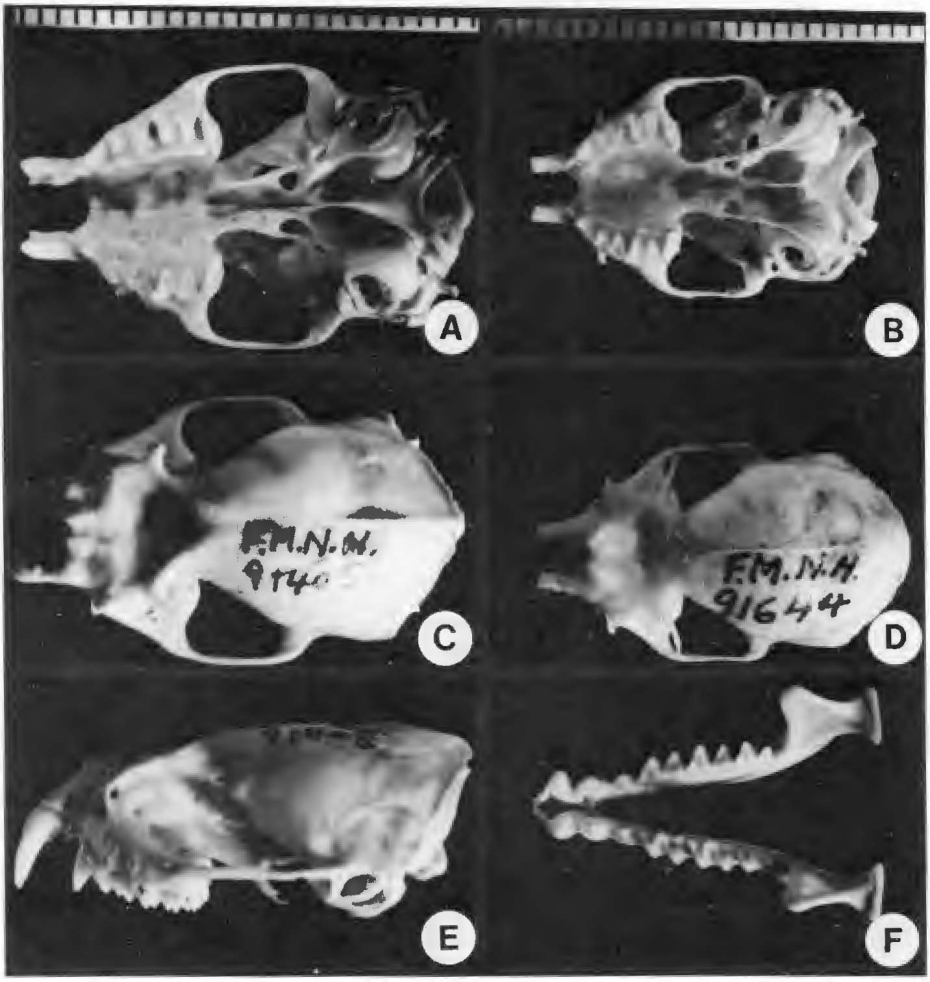

FIG. 7.—Ventral (A), Dorsal (C), and lateral (E) views of skull and mandible (F) of *Taphozous nudiventris* compared with a ventral (B) and dorsal (D) views of skull of *T. perforatus*.

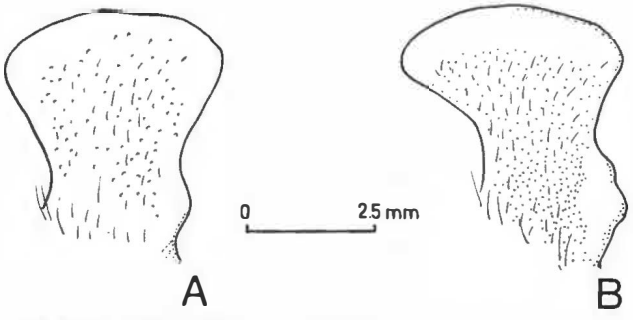

FIG. 8.—The left tragi of two *Taphozous* from Egypt. A. *T. perforatus* (NHMB 1663, Abu Rawash), B. *T. nudiventris* (NHMB 1661, Giza Pyramids).

TABLE 4.—Taphozous perforatus: *measurements as in Table 1. Measurements of Sudan specimens from Kock (1969:76).*

	Egypt		Nuba Mt., Sudan, 4 males, 9 females
	Males	Females	
TL	100.3 ± 4.1(94-110)14	102.9 ± 4.6(95-112)17	75.8(70-80)*
T	23.3 ± 1.1(22-25)14	23.9 ± 2.1(20-27)17	27.0(25.5-29.8)
HF	13.7 ± 0.9(12-15)14	13.6 ± 1.0(11-15)17	12.0(10.8-13.0)
E	17.8 ± 1.0(17-20)14	17.5 ± 0.9(16.5-20)16	20.1(18.3-21.3)
FA	62.9 ± 1.3(61-65)13	60.3 ± 3.6(61.5-66)18	61.5(59.8-65.2)
GLS	20.7 ± 0.2(20.4-21.1)14	20.5 ± 0.3(20.2-20.9)8	
CCL	18.7 ± 0.5(17.9-19.2)14	18.9 ± 0.4(18.6-19.4)8	18.7(18.2-19.5)
BBC	9.6 ± 0.4(8.2-10.0)14	9.7 ± 0.2(9.6-10.0)8	9.6(9.3-10.1)
IOC	5.9 ± 0.2(5.5-6.5)14	5.8 ± 0.2(5.7-6.1)8	6.0(5.7-6.3)
ZYGB	11.7 ± 0.2(11.3-12.0)14	11.6 ± 0.1(11.5-11.9)7	11.8(11.5-12.4)
C-M3	8.3 ± 0.1(8.2-8.5)14	8.4 ± 0.1(8.3-8.5)8	8.3(8.0-8.5)
BCD	7.5 ± 0.2(7.2-7.7)14	7.4 ± 0.2(7.1-7.6)8	
M	14.4 ± 0.1(14.2-14.6)14	14.4 ± 0.2(14.2-14.6)8	15.8(15.2-16.1)
c-m3	9.3 ± 0.4(8.2-9.7)14	9.4 ± 0.2(9.3-9.7)8	9.6(9.2-9.8)
CORH	6.3 ± 0.2(6.0-6.6)14	6.1 ± 0.3(5.5-6.5)8	

*Head and body length.

Philae 3(BMNH); *No exact locality*: Egypt 15(BMNH), 1(SMNS), 1(ZMUC); "Nile" 1(USNM); Upper Nubia 2(BMNH). SUDAN: *Kassala*: Suakin 3(BMNH), 1(SMNS); *Northern*: Kerma 5(BMNH), 1(MCZ); Nuri Pyramids 3(BMNH).

Records of Egyptian specimens not examined.—Red Sea: Quseir (Klunzinger, 1878, *fide* Kock, 1969); *Aswan*: Aswan (Anderson, 1902:137); Kom Ombo (É. Geoffroy St.-Hilaire, 1818).

Taphozous nudiventris nudiventris Cretzchmar, 1830

Taphozous nudiventris Cretzchmar, 1830:70, fig. 27*b*.
Taphozous nudiventris nudiventris, Harrison, 1964:64.

Type specimen.—Senckenberg Museum, Frankfurt a.M., number 4310; adult male; Giza, Egypt; E. Rüppell 1824 (Sanborn and Hoogstraal, 1955; Kock, 1969:83). Lectotype.

Common names.—Egyptian sheath-tailed bat, naked-bellied tomb bat, naked-rumped bat, Khafash Abu Bouz.

General distribution.—Senegal, Mauritania and Algeria (Anciaux de Faveaux, personal communication) south and east to Zaire and most of East Africa north through Sudan, Egypt, and most of the Arabian peninsula, and east through southwestern Asia to Burma.

Distribution in Egypt.—Nile Valley (Fig. 9).

Diagnosis.—Tail projects through the dorsal surface of the uropatagium. Fur does not extend to the base of uropatagium, dorsally nor ventrally, and thus the lower body appears naked (hence *nudiventris*). There is a small but distinct gular sac in males, which is absent in females. This is a large species with the forearm measuring 67-76 in Egypt and over range 64.9-80.2 (Table 5). The skull has well-developed sagittal and lambdoidal crests (Fig. 7). The baculum is small, rodlike, with the basal plate not distinguished

TABLE 5.—Taphozous nudiventris: *measurements as in Table 1.*

	Egypt		Palestine
	Males	Females	2 males, 1 female
TL	121.4 ± 3.9(119-125)7	124.0(112-136)6	133, 122, 132
T	29.9 ± 2.5(25-32)7	28.8(22-34)6	37, 31.5, 32
HF	16.4 ± 2.5(14.5-18.0)7	15.8(11-18)6	16.5, 18, 18
E	21.7 ± 0.5(21-23)5	20.5(17-22)6	19, 18, 22
FA	71.2 ± 2.5(68-76)9	71.6 ± 2.8(67-75)7	76, 74, 70
GLS	27.0 ± 0.8(26.0-28.5)9	26.8 ± 0.7(25.7-28.1)7	28.8, 29.5, 27.3
CCL	23.6 ± 0.8(22.4-24.8)9	23.3 ± 0.8(22.3-24.4)7	24.9, 23.5, 23.5
BBC	11.9 ± 0.7(10.8-12.8)9	11.7 ± 0.5(11.3-12.5)7	11.5, 11.7, 11.5
IOC	7.8 ± 0.8(7.1-9.0)11	7.7 ± 0.3(7.3-8.1)7	7.8, 8.3, 7.7
ZYGB	15.5 ± 0.5(14.7-16.6)10	15.0 ± 1.2(12.4-15.8)7	17.0, 16.8, 15.5
C-M3	11.0 ± 0.4(10.2-11.6)10	10.8(10.6-11.1)4	11.3, 10.9, 11.6
BCD	7.8 ± 0.2(7.4-8.1)7	7.8 ± 0.2(7.6-8.0)7	8.1, 8.2, 7.8
M	19.4 ± 0.4(18.7-20.1)10	19.4(18.5-20.2)4	21.0, 20.4, 18.8
c-m3	12.6 ± 0.3(12.3-13.2)10	12.8(12.4-13.3)4	13.2, 12.8, 12.0
CORH	9.2 ± 0.4(8.6-9.9)9	9.2(8.4-10.0)4	10.5, 10.4, 9.9

from the style (Wassif and Madkour, 1972*b*). Males are slightly larger than females in all measurements except total length and forearm (Table 5).

Remarks.—The three available specimens from Mt. Karantal in Palestine are slightly larger than the average Egyptian specimens and may represent intergrades with *T. n. magnus* of Iraq.

Biology.—This species roosts in old ruins, mosques, and wells. Gaisler *et al.*, (1972) and NAMRU-3 personnel found this bat in crevices between the stone blocks of the temple at Karnak. Specimens also have been taken in Egypt from crevices in sandstone hills. In north and south Iraq, the numbers of the animals diminish in their summer quarters rapidly from the end of October until the end of the first week of November (Robaae, 1966). They are found hibernating in southern Iraq, and thus Harrison (1964:69) suggested that they possibly migrate south during that time. The species was reported from pellets of an owl, *Tyto alba*, in Palestine (Dor, 1947). Madkour (1977*b*) mentioned that they are common in Gharbiya Province throughout the year but are more numerous in July and August when the cotton leaf worm, *Spodoptera littoralis*, is invading cotton leaves; he found large quantities of moth scales in the stomachs of these bats.

Specimens examined (124).—EGYPT: *Red Sea*: Quseir 1(SMNS); *Giza*: Abu Rawash 1(BMNH), 4(FMNH), 5(USNM), 2(MVZ); Dashur Pyramids 1(ZFMK); Giza Pyramids 2(BMNH), 1(FMNH), 1(NHMB), 20 (USNM); Giza City 1(AMNH), 1(BMNH), 28(CM); Saqqara 3(BMNH), 4(FMNH), 4(USNM); *Faiyum*: Lake Qarun 21(FMNH). PALESTINE: *Jerusalem*: Mt. Karantal 2(AMNH), 4(MCZ), 12(SAM); *Northern*: Galilee 3(BMNH); Wadi Amud 1(HZM), 1(TAU); *Haifa*: Sha'ar Ha'amarqim 1(HZM).

Records of Egyptian specimens not examined.—Gharbiya: Tanta (Madkour, 1977*b*); *Cairo*: Cairo (Anderson, 1902:140; Gaisler *et al.*, 1972); *Faiyum*: Kom Oshim (Hoogstraal and Traub, 1963, *fide* Kock, 1969); *Qena*: Luxor (Anderson, 1902:142; Gaisler *et al.*, 1972).

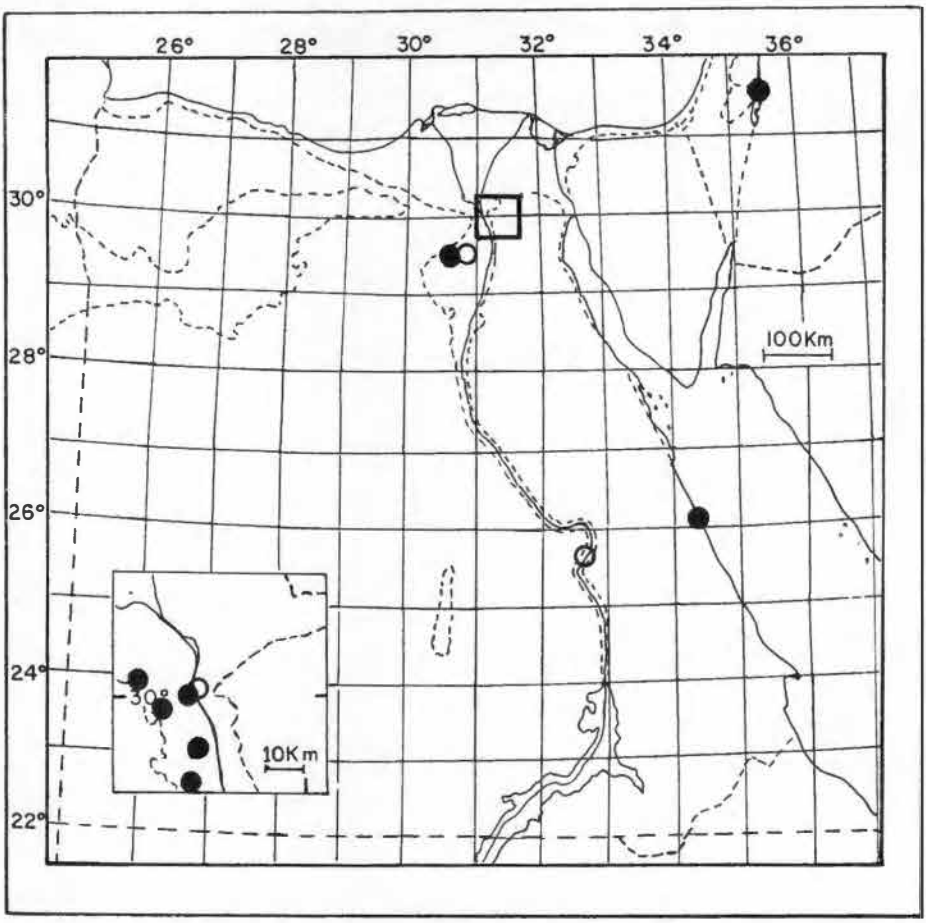

FIG. 9.—Distribution of *Taphozous nudiventris*. Solid symbols indicate specimens examined; open ones, literature records.

Family NYCTERIDAE

Genus *Nycteris* É. Geoffroy St.-Hilaire, 1803

Slit-faced bats comprise a monogeneric family of primarily African distribution with a single Indomalaysian representative. *Nycteris thebaica*, the only member of the genus occurring in Egypt, was probably derived from forest-dwelling ancestors, which gradually became independent of trees and now occurs widely even in semi-arid regions (Koopman, 1975:375), and roosts gregariously in caves (Rosevear, 1965). Another species, *Nycteris hispida*, might prove to exist in southern Egypt since there is a report, although unconfirmed, from Dongola, Sudan (Peters, 1871, *fide* Kock, 1969:89).

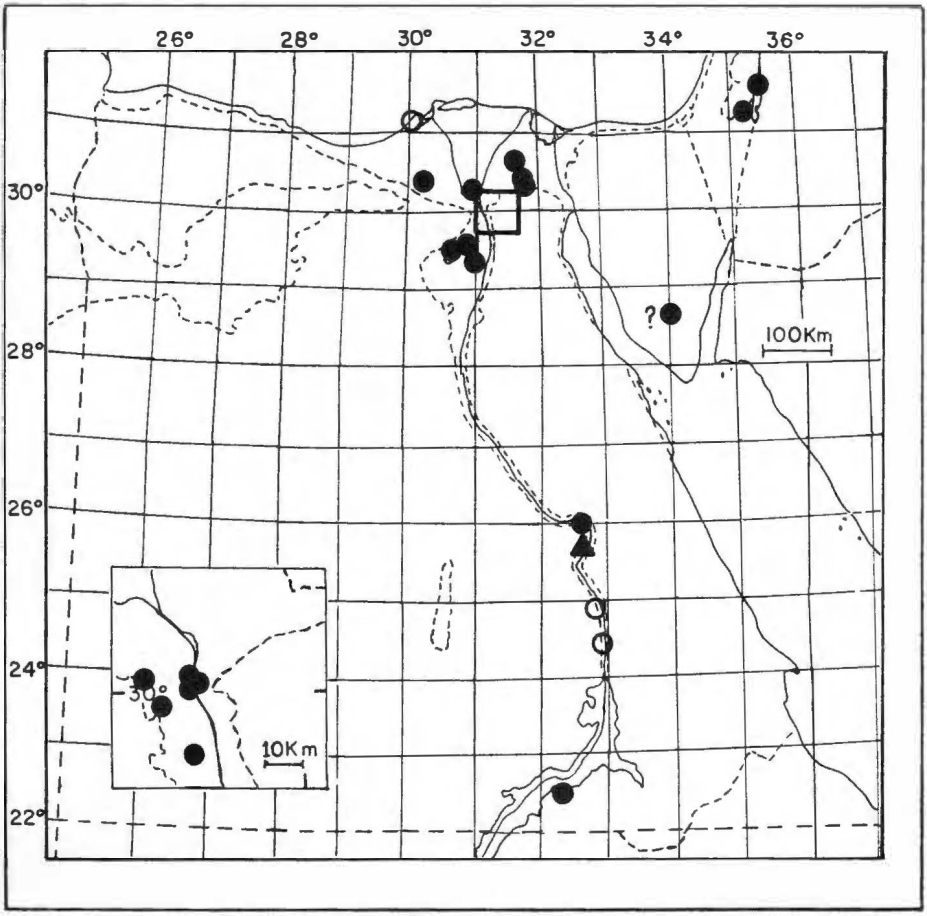

FIG. 10.—Distribution of *Nycteris thebaica*. Solid symbols indicate specimens examined; open ones, literature records. Triangle indicates type locality.

Nycteris thebaica thebaica É. Geoffroy St.-Hilaire, 1813

Nycteris thebaica É. Geoffroy St.-Hilaire, 1813*a*:20; É. Geoffroy St.-Hilaire, 1818:119, pl. 1, No. 2.

Nycteris thebaica thebaica, Allen, 1939:70.

Type specimen.—NHMN 889; adult (female?); skin, skull not removed; Egypt (Rode, 1941:235). Holotype. As indicated by Anderson (1902), the locality can be fixed to Thebes (=Luxor) by virtue of the name.

Common names.—Egyptian slit-faced bat, Khafash Teiba.

General distribution.—Morocco south and east through most of the Savannah belt of Africa from Senegal to Gambia and south to the Cape and north through Sudan and Egypt to western Arabia and Palestine.

Distribution in Egypt.—The nominate subspecies occurs in the Nile Valley and north to the Sinai Peninsula (Fig. 10).

TABLE 6.—Nycteris thebaica: *measurements as in Table 1.*

Variate	Egypt	
	Males	Females
TL	102, 118	105.7 ± 9.7(84-126)13
T	45, 52	51.4 ± 2.8(47-56)13
HF	10	11.5 ± 1.2(10-13)13
E	32, 31	30.6 ± 1.4(26.5-32)13
FA	46, 45	45.0 ± 1.6(43-49)13
GLS	19.0(18.3-19.6)6	19.1 ± 0.3(18.7-19.6)14
CCL	16.7 ± 0.4(16.5-17.1)7	17.0 ± 0.3(16.5-17.7)13
BBC	8.5 ± 0.2(8.3-9.0)7	8.8 ± 0.2(8.4-9.1)10
IOC	5.2 ± 0.2(4.8-5.4)7	5.2 ± 0.2(5.0-5.5)10
ZYGB	11.0 ± 0.2(10.8-11.3)7	11.0 ± 0.3(10.5-11.4)14
C-M3	6.4 ± 0.1(6.2-6.5)7	6.4 ± 0.1(6.2-6.5)11
BCD	6.3 ± 0.1(6.2-6.5)7	6.5 ± 0.2(6.1-6.7)10
M	12.0 ± 0.2(11.7-12.3)7	12.1 ± 0.2(11.7-12.4)10
c-m3	6.8 ± 0.3(6.3-7.0)7	7.0 ± 0.1(6.8-7.2)10
CORH	4.1 ± 0.1(4.0-4.3)7	4.0 ± 0.2(3.8-4.4)10

Diagnosis.—This slit-faced bat has long ears (28-37), and pyriform tragus with the base of its posterior margin slightly notched. The body size is medium (Table 6) with the forearm measuring 42-52. The skull is separated easily from other Egyptian bats by the presence of a deeply concave frontal shield and absence of nasal branches of the premaxilla. The baculum has a wide oval base plate, which is at an obtuse angle with a long and slightly curved style (Wassif and Madkour, 1972*b*).

In specimens from Dandara, immatures have a dark Neutral Gray color dorsally, whereas in adult females, the color is Drab dorsally and pale

TABLE 7.—*Year-round change in composition of roosting* Nycteris thebaica *in Egypt, as represented by dates of collection for museum specimens.*

Month	Day	Locality	Adult		Young	Nursing Young
			Males	Females		
Jan	1	Abu Rawash	2	1		
Mar	1	Wadi Natrun		4		
Mar	12	Abu Rawash	8	7		
Mar	15	Lake Qarun	1			
Jun	4	Wardan	7	19		
Jun	14	Giza pyramids	4	4		4
Jun	16	Kafr Dawud	4	17		8
Jun	18	Kom Hamada	1	14		10
Jul	18, 19	Dandara		7	2F, 2M	3
Aug	1	Giza		1F		
Aug	2	Kom Oshim		2		
Sep	10	Giza		1		
Sep	29	No locality	4	13		
Oct	2	Seila	5	3		
Dec	10	Cairo		1		

Neutral Gray ventrally. It is possible that individuals become paler with age.

Remarks.—The Egyptian specimens examined all belong to the nominate subspecies described from Egypt. Sanborn and Hoogstraal (1955) and Hoogstraal (1962) included Minufiya Province in the distribution of this species in Egypt. The specimens they were referring to come from Wardan (marked on labels: "Wardan, Minufiya"), a locality in Giza Governorate.

Biology.—Maternity colonies were observed on 26 April 1969 by Gaisler *et al.* (1972:16). At a cave near Dandara, I found lactating females and young slit-faced bats roosting with many *Asellia tridens* and one *Taphozous perforatus*. In Dandara temple, at the same time (18-19 July 1981), the bats were roosting in separate areas from *Asellia tridens*, *Rhinopoma hardwickei*, and *Plecotus austriacus*. *Nycteris thebaica* was found to feed on various species of Orthoptera in the Aden area (Yerbury and Thomas, 1895). In Egypt, the number of males in the roosts (as estimated by the proportion of individuals captured) decreases after the first week of March, and nursing young are noticed from April to July at which time the maternity colonies have few males (Table 7).

Specimens examined (267).—EGYPT: *Beheira*: El Khatatba 35(FMNH); Kafr Dawud 8(FMNH), 21(USNM); Kom Hamada 1(FMNH), 40(USNM); *El Tahreer*: 12 mi W Wadi El Natrun 4(USNM); *Cairo*: Bulaq El Dakrur 1(BMNH); Cairo 1(USNM); *Giza*: Abu Rawash 18(FMNH), 1(HZM), 14(USNM); Giza 5(BMNH), 2(SMNS); Giza Pyramids 12(FMNH); Saqqara 2(FMNH), 17(USNM); Wardan 26(FMNH); *Faiyum*: Kom Oshim 2(USNM); Lake Qarun 1(BMNH); Seila 8(BMNH); *Qena*: Dandara 16(MQ); Luxor 1(BMNH), 1(NHMB); *Aswan*: Korosko 1(MSNG); *No exact locality*: Egypt 1(FMNH), 17(USNM); "Mt. Sinai" 2(BMNH); PALESTINE: *Jerusalem*: Jericho 1(USNM); *Northern*: Merhavia 5(TAU); *Southern*: Ain Yahav 1(TAU); SUDAN:*Kassala*: Erkowit 2(BMNH).

Records of Egyptian specimens not examined.—Aswan: Edfu; Kom Ombo; Wadi Sibaa, N of Korosko (Hartmann, 1868); *Alexandria*: Alexandria (Stresemann, 1954, *fide* Kock, 1969).

Family RHINOLOPHIDAE

The family of horseshoe bats, Rhinolophidae, is widespread in areas of Africa, Europe, Asia, and Australia. They are characterized by the prominent development of the noseleaf and by the elongation and fusion of the anterior palatal emarginations.

Key to Species in Egypt

1. Noseleaf with three dorsally projecting leaflets and without sella or connecting process; only two pairs of lower premolars ..... *Asellia tridens*
   Noseleaf with one dorsally projecting leaflet (lancet) and with a distinct sella and connecting process; three pairs of lower premolars present ..... (RHINOLOPHINAE) 2

2. Size small, FA 33.5-38.6, GLS 14.5-16.0 ..... *Rhinolophus hipposideros*
   Size larger, FA more than 41, GLS more than 18 3

3. Dorsal connecting process of sella blunt; PM2 displaced labially from toothrow or absent ..... *Rhinolophus clivosus*
   Dorsal connecting process of sella long and pointed; PM2 in toothrow and clearly separating canine and PM4 ..... *Rhinolophus mehelyi* (and *R. euryale*)

Genus *Rhinolophus* Lacepede, 1799

Rhinolophus clivosus clivosus Cretzschmar, 1828

Rhinolophus clivosus Cretzschmar, 1828:47.
Rhinolophus acrotis Heuglin, 1861:4. From Keren, Eritrea.
Rhinolophus antinorii Dobson, 1885:16, from Shoa, Ethiopa; Trouessart, 1897:95; Anderson, 1902:96.
Rhinolophus andersoni Thomas, 1904:156; Holotype: BMNH 4.11.4.2, immature male collected from Wadi Alagi, eastern Egyptian Desert (Sudan Administrative area).
Rhinolophus acrotis andersoni, Andersen, 1904:454; Allen, 1939:72.
Rhinolophus acrotis acrotis, Allen, 1939:72.
Rhinolophus clivosus clivosus Harrison, 1964:81.

Type specimen.—Senckenberg Museum, number 4371; Mohila, Coast of Arabia [=Muwaila, Saudi Arabia, *ca.* 27° 49′N 35° 30′E] (Kock, 1969:113). Lectotype.

Common names.—Arabian horseshoe bat, Khafash Abu Hadwah.

General distribution.—Algerian Sahara through most of the subdesert and savanna areas of North Africa and south through most of East and South Africa. Occurs in western and southwestern Arabia to southwestern Asia.

Distribution in Egypt.—The nominate subspecies occurs in Egypt in Sinai and the Eastern Desert governorates (Fig. 11).

Diagnosis.—*Rhinolophus clivosus* is a medium sized horseshoe bat with a forearm of 43.5-50.0, and greatest length of the skull of 17.8-20.5. The connecting process of the sella is not pointed as is that of *R. mehelyi.* The small second upper premolar can be absent or present. The nominate subspecies can be characterized only by its large size, FA 43.0-52.1, GLS 19.1-21.9 in adult individuals (Table 8). Color varies from Smoke Gray in Sinai specimens to Drab Gray in Libyan specimens and dark Drab in Sudanese specimens. Ventrally the color is usually Drab Gray.

Remarks.—Five subspecies have been reported in North Africa and are pertinent under this study. The nominate subspecies reported from Sinai (Harrison, 1964) is large and pale in color; *R. acrotis* Heuglin (1861), described from Keren, Eritrea, occurs in southwestern Arabia and the mountain areas of eastern and northeastern Africa (Harrison, 1964, as *R. c. acrotis*); *R. acrotis brachygnathus*(=*R. clivosus brachygnathus* Andersen, 1905) described from Giza, Egypt is common in the Nile Valley; *R. a. schwarzi* described from Tamanrasset, Algerian Sahara, by Heim de Balsac (1934) is reported to occur in Libya (Setzer, 1957); and *R. andersoni* Thomas, 1904, described from Wadi Alagi, occurs in the eastern Egyptian desert (Sudan Administrative area). This last form was described from a series of immature specimens, and as such its taxonomic status was not clear.

The specimens from Sinai clearly belong to the nominate subspecies. As pointed out by Koopman (1975), the specimens from Erkowit, Kassala, Sudan, in the British Museum (Natural History) are slightly smaller than specimens of *R. c. acrotis* from other areas of the Sudan and Ethiopia. The specimens from the eastern Egyptian desert and northern Sudan, as well as

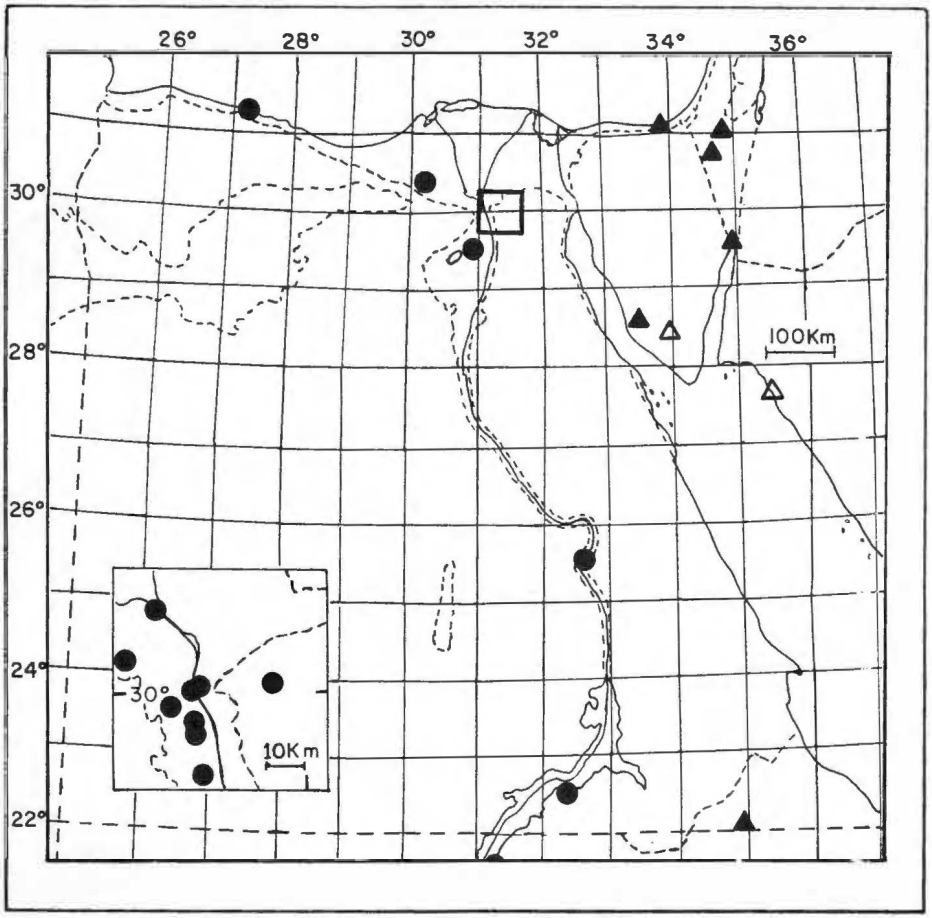

FIG. 11.—Distribution of *Rhinolophus clivosus clivosus* (triangles) and *R. c. brachygnathus* (open and closed circles). Solid symbols indicate specimens examined; open ones, literature records.

specimens from eastern Arabia (Nader, 1975), are slightly smaller than those specimens further to the north and south (Fig. 12 and Tables 8-9). This condition is expected by virtue of the change in climates; smaller body size is characteristic of a hotter and possibly drier climate. Until further specimens from southeastern Egypt, northeastern Sudan, or eastern Saudi Arabia become available, I prefer to consider the changes observed as rather clinal and do not, at the present time, justify separating the population around the Red Sea into different subspecies.

Kock (1969:114) suggested that *andersoni* is consubspecific with *brachygnathus*. Koopman (1975:386) tentatively allocated the type series of the former to *R. c. clivosus*. The size of specimens of the type series of *andersoni*, even as immatures, are above the average of *R. c. brachygnathus* especially in C-M^3. The female specimen of this type series is larger also

TABLE 8.—Rhinolophus clivosus clivosus: *measurements as in Table 1.*

	El Arish N Siani Female	Feirna, Sinai Male & Female	Kuf National Park Libya 4 Males	Wadi Alagi, Sudan Administrative (types of *andersoni*)	Suakin, Sudan 2 Males	Port Sudan, Sudan Female	Megangonia Blue Nile Prov. Sudan Male
TL	73	75, 82	76.8(74-79)	69.2(62-81)	——, 73	80	
T	25	29, 32	26.1(22.5-29)	24.0(21-28)	30, 24	30	
HF	10	8, 10	10.1(10-10.5)	9.2(8-10)	——, 8.2	10.3	
E	19	21, 20	18.8(18-20)	19.2(15-22)	19, 19.2	17.9	
FA	48	48, 50	48.5(47-50)	45.4	43, 45.8	48.1	
GLS	19.1	19.5, 20.1	20.3(19.7-20.6)	18.9(18.5-19.1)	20.0, 20.0	20.5	21.9
CCL	17.4	16.4, 16.6	17.7(17.3-18.3)	16.4(16.0-16.8)	17.0, 17.2	18.1	18.5
BBC	8.6	8.0, 8.0	9.2(8.9-9.5)	8.0(7.7-8.4)	8.2, 8.2	8.9	9.6
IOC	2.2	2.3, 2.3	2.5(2.5-2.6)	2.8(2.5-3.0)	2.7, 2.6	2.8	2.8
ZYGB	9.8	10.1, 10.4	10.8(10.6-11.1)	9.3(8.4-9.9)	10.0, 10.2	11.7	11.2
C-M3	7.2	7.4, 7.3	7.4(7.2-7.6)	7.4(7.2-7.6)	7.5, 7.4	7.8	7.6
BCD	5.6	5.4, 6.0	5.9(5.7-6.1)	5.6(5.3-5.8)	5.9, 5.8	5.8	5.8
M	12.8	12.8, 12.9	13.1(12.9-13.4)	12.5(12.2-12.9)	13.1, 13.0	15.1	14.1
c-m3	8.1	8.5, 8.2	8.2(8.1-8.6)	7.7(7.4-8.1)	7.9, 8.2	9.1	8.3
CORH	4.0	3.6, 3.9	4.2(4.0-4.9)	3.7(3.5-4.1)	4.2, 3.9		4.9

than a comparably aged female from Giza (Tables 8-9). It is thus suggested that *andersoni* is not consubspecific with *R. c. brachygnathus*. In size, the type series approach the size of specimens from Kassala Province in Sudan, and in color, are close to *R. c. acrotis*. As suggested above, *R. c. clivosus* and *R. c. acrotis* possibly intergrade around the Red Sea and so they are here synonymized. Until satisfactory evidence appears to separate those last two forms I refer the specimens from Wadi Alagi (*andersoni*) to the nominate subspecies.

TABLE 9.—Rhinolophus clivosus brachygnathus *from northern Egypt and Abd el Quadir, Northern Provice, Sudan (Bauer, 1963:497). Measurements as in Table 1.*

Variate	Northern Egypt Adult males	Giza Adult female	Giza Young female	Abd el Quadir (Bauer, 1963) females
TL	78.4 ± 6.9(68-89)15		75	
T	29.0 ± 3.1(24-35)15		29	
HF	9.4 ± 0.8(8-11)15			
E	18.1 ± 1.1(16-20)16		19	
FA	46.6 ± 1.4(45-49)14		45	45.0(43.3-45.7)18
GLS	19.1 ± 0.4(18.4-19.7)12		17.8	19.0(18.5-19.3)9
CCL	16.2 ± 0.4(15.4-16.7)12			16.8(16.3-16.9)9
BBC	8.2 ± 0.4(7.6-9.1)12	7.9	7.7	
IOC	2.5 ± 0.1(2.4-2.7)12	2.5	2.9	2.4(2.2-2.6)9
ZYGB	9.8 ± 0.3(9.4-10.4)12	9.2	8.3	9.9(9.4-10.1)9
C-M3	6.9 ± 0.1(6.7-7.0)14	7.0	6.8	7.0(6.8-7.2)9
BCD	5.9 ± 0.1(5.7-6.1)13	5.6	5.5	
M	12.0 ± 0.2(11.7-12.4)13	12.2	11.9	12.7(12.3-13.7)9
c-m3	7.6 ± 0.3(7.0-8.1)13	7.7	7.2	7.5(7.0-7.9)9
CORH	3.6 ± 0.1(3.4-3.8)13	3.8	3.6	

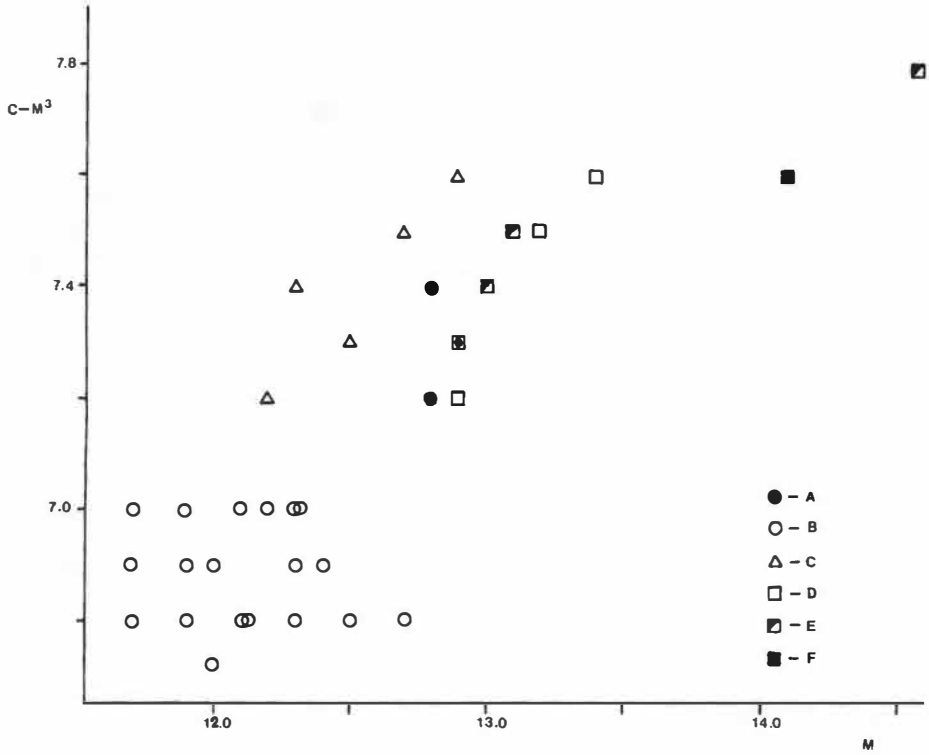

FIG. 12.—Scatter diagram of upper toothrow (C-M³) and mandible lengths in North African *Rhinolophus clivosus*. A. Sinai, B. Giza, Cairo, and Faiyum governorates, C. Wadi Alagi, Sudan Adm. (type series of *andersoni*), D. Jabal Akhdar, Libya, E. Kassala Province, Sudan, and F. Blue Nile Prov., Sudan. All adult except *andersoni* series.

Specimens examined (28).—EGYPT: *Sinai*: Al Arish 3(USNM); Feiran Oasis 9(FMNH); *Sudan Administrative Area*: Wadi Alagi 5(BMNH). PALESTINE: *Southern*: Abde 1(TAU); Eilat 1(TAU); Revivim 1(HUJ). LIBYA: *Jabal Akhdar*: Roman Aquaduct, Kufanta 3(MQ); Ruins, 6 km SE Qasr Magdam 2(MQ). SUDAN: *Kassala*: Erkovit 2(BMNH); *Blue Nile*: Megangonia 1(MCZ).

Records of Egyptian specimens not examined.—Sinai: Wadi Talaah, near St. Katherine Monastery (Wassif and Hoogstraal, 1954).

Rhinolophus clivosus brachygnathus Andersen, 1905

Rhinolophus acrotis brachygnathus Andersen, 1905:73; Bonhote, 1912; Allen, 1939:72.
Rhinolophus antinorii Anderson, 1902:96.
Rhinolophus acrotis, Flower, 1932:377.
Rhinolophus clivosus brachygnathus, Sanborn and Hoogstraal, 1955:113.

Type specimen.—BMNH 92.9.9.7; adult male; Giza, Egypt; J. Anderson; 16 December 1891; Holotype. Paratype, an immature female.

Diagnosis.—A small (FA 43.5-49.0, GLS 18.4-19.7), dark-colored subspecies. It differs from the nominate subspecies in having a smaller skull and particularly shorter upper toothrow (Fig. 12). The basal two thirds of

the hair on the back is Pale Drab; tips, Dark Drab. Ventrally, the color is uniform Drab Gray (but see below).

Remarks.—Andersen (1905) described this subspecies as having a shorter upper and lower toothrow and mandible than the holotype and paratypes of *andersoni*. The color of the paratype, an immature female, was also described as grayish drab dorsally and tinged with "mouse-grey" posteriorly, a condition which makes it much darker than the types of *andersoni*. This subspecies occurs in the Nile Valley from the Delta to Abd El Quadir, Northern Province, Sudan (Bauer, 1963:497).

Biology.—Very little is known of the biology of *R. clivosus* in Egypt. The nominate subspecies was collected in north Sinai from an old store-house (Wassif, 1953). Hoogstraal (1962) further reported that in Al Arish and Feiran oasis in Sinai, the species also occurs in store-houses, stone huts, and hillside caves. Specimens of the smaller subspecies were collected from caves, and ruins near areas of cultivation in the Nile Valley.

Specimens examined (269).—EGYPT: *Qalyubiya*: Delta Barrage 1(BMNH); *El Tahreer*: Wadi El Natrun 2(FMNH), 1(USNM); *Cairo*: Cairo 1(HZM), 1(NHMB); Gebel Mukattam 1(SMNS); *Giza*: Abu Rawash 45(FMNH), 5(ZFMK), 85(USNM); Abu Sir 29(FMNH); El Mansuriya 3(USNM); 4 km W El Mansuriya 11(FMNH); Giza City 6(BMNH), Giza Pyramids 1(BMNH), 26(FMNH), 1(MVZ), 14(USNM); Saqqara 17(USNM); Serapeum 1(BMNH); *Faiyum*: Kom Oshim 3(FMNH), 1(USNM); *Asiut*: Massarah 1(NHMB; specimen labeled "Massarah, n. Kairo"); *Qena*: Luxor 2(FMNH); *Aswan*: Korosko 1(BMNH); *Matruh*: 20 mi. W Mersa Matruh 4(FMNH); *No exact locality*: "Egypt" 6(USNM).

Rhinolophus hipposideros minimus Heuglin, 1861

Vespertilio hipposideros Bechstein, 1800:629
Rhinolophus minimus Heuglin, 1861:4,6.
Rhinolophus hipposideros minimus, Andersen, 1904:455; Allen, 1939:76.

Type specimen.—SMNS 987; Keren, Ethiopia (Felten *et al*, 1977:12, 13). Holotype.

Common names.—Lesser horseshoe bat, Khafash Abu Hadwah Saghir.

General distribution.—Iberian peninsula and Ireland through southern Europe and the Maghreb (Morocco, Algeria, Tunisia) and from Ethiopia through Sudan, Egypt, the Eastern Mediterranean to Turkestan and Kashmir.

Distribution in Egypt.—The only locality for the species in Egypt is Feiran Oasis in Sinai, where Hoogstraal (1962) reported a single specimen (FMNH 74476) on 21 May, 1953 (Fig. 13).

Diagnosis.—Smallest horeshoe bat in the Palearctic region: FA 33.5-38.6, GLS 14.5-16.0; sella with tapering sides; connecting process of the sella is low and blunt in side view.

Remarks.—The status of the subspecies of *R. hipposideros* in southwest Asia has been discussed by Felten *et al.* (1977) and DeBlase (1980). Two names, *R. h. hipposideros* and *R. h. minimus*, possibly apply to the eastern Mediterranean (incl. Sinai) specimens. Both authors found that the character of the degree of reduction in the second lower premolar was variable. In one

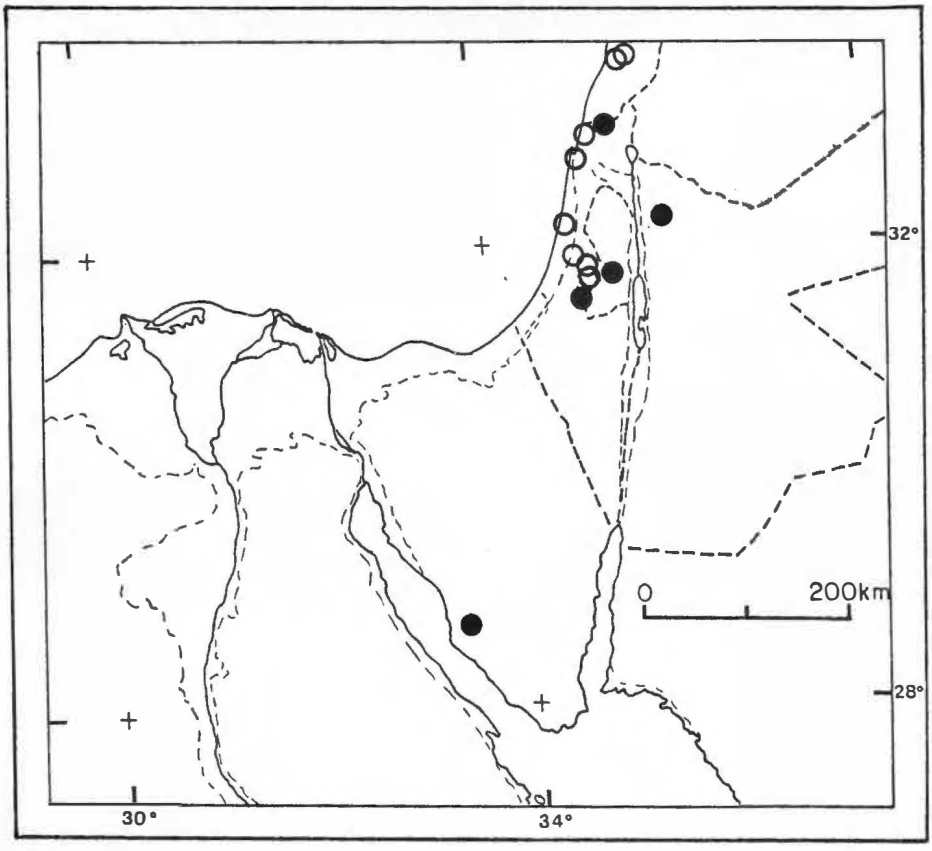

FIG. 13.—Distribution of *Rhinolophus hipposideros*. Solid symbols indicate specimens examined; open ones, literature records.

specimen from Jordan (MQ 327), pm2 clearly separates pml and pm3. Variations occur in other specimens from Jordan and Israel. I extracted the skull of the single specimen from Feiran Oasis, Sinai (FMNH 74476), and found that it has the extreme case of pm2 being absent on both sides (Fig. 14). The shape of the sella is also not significant in the separation of the nominate subspecies from *R. h. minimus* (DeBlase, 1980:101, 102). The only character thus to distinguish the two subspecies is size, and there is much intergradation occurring in Europe (Andersen, 1907*b*; Saint-Girons and Caubere, 1966). Until a critical review of the two subspecies over the range is done, I follow Harrison (1964) and Atallah (1977) in considering the Eastern Mediterranean population as *R. h. minimus*.

Biology.—This is a rare species and individuals usually roost solitarily (Attallah, 1977). In Feiran oasis in Sinai a single specimen was resting deep inside a hillside cave (Hoogstraal, 1962:157). Usually one young is born in June or July (Asdell, 1964:80).

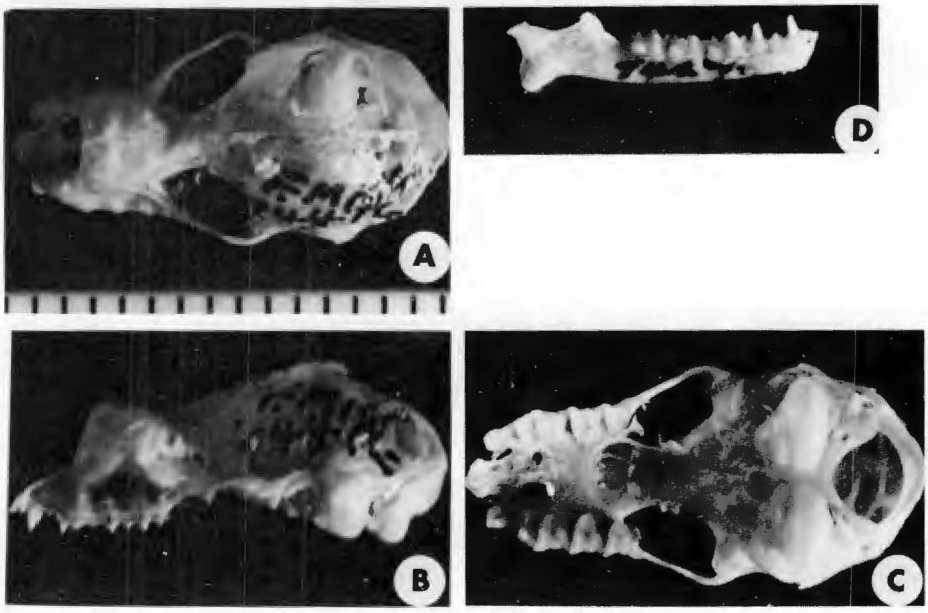

FIG. 14.—Skull of the single specimen of *Rhinolophus hipposideros* known from Egypt: FMNH 74476, from Feiran Oasis.

Specimens examined (11).—EGYPT: *Sinai*: Feiran Oasis 1(FMNH). PALESTINE: *Northern*: Dan 1(HUJ); *Jerusalem*: Jerusalem 2(BMNH); Solomon's Quaries 1(BMNH); *Southern*: Ain Yahav 1(HZM); Beit Guvrin 1(HZM). JORDAN: *Irbid*: Dibbine National Park 4(MQ).

Rhinolophus mehelyi mehelyi Matschie, 1901

Rhinolophus mehelyi Matschie, 1901:225
Rhinolophus euryale judaicus, Allen, 1939:74; not *Euryalus judaicus*, Andersen and Matschie, 1904:80, a junior synonym and subspecies of *R. euryale* (Blasius).
Rhinolophus mehelyi mehelyi, Laurent, 1937:152.

Type locality.—Bucharest, Rumania.

Common name.—Mediterranean horsehoe bat.

General distribution.—Southern Europe, the Mediterranean Islands, North Africa, and the Caucasus through north Arabia to the Zagros Mountains in Iran.

Distribution in Egypt.—Mediterranean zone of Egypt and as far south as Saqqara (Fig. 15). This is the southernmost record of the species in the Palearctic region.

Diagnosis.—Medium sized; relatively pointed connecting process of the sella; sides of sella are almost parallel.

Rhinolophus mehelyi has been frequently confused with *R. euryale*. There is a slight size difference between the two species in favor of *mehelyi*, but this is confused by the considerable geographic variation, particularly in *R. mehelyi*. The shape of the lancet and the connecting process of the sella show some consistent differences. DeBlase (1972) reviewed the

TABLE 10.—Rhinolophus hipposideros *from Feiran Oasis, Sinai (FMNH specimen) and Dibbine National Park, Jordan (MQ collection). Measurements as in Table 1.*

Variate	Sinai (FMNH 74476)Male	Dibbine Forest Park, Jordan	
		Male	3 Females
TL		54	62.3(58-67)
T	26	19	23.0(22-24)
HF	5	7	6.5(6-7)
E	14	14	15.5(15-16)
FA	35.8	33.5	36.5(35.5-37.5)
GLS	14.2		15.3, 15.3
CCL	12.7		13.6, 13.4
BBC	6.3		6.6(6.6-6.7)
IOC	1.6		1.7(1.6-1.8)
ZYGB	7.1		7.2(7.2-7.3)
C-M3	5.0		5.2(5.1-5.4)
BCD	4.6		4.8(4.7-4.8)
M	8.7		9.4(9.3-9.4)
CORH	1.2		2.6(2.5-2.7)

differences between the two species. To those differences listed by him, I can add only that the connecting process of the sella is consistently more blunt and as much shorter in *R. mehelyi* as compared with *R. euryale* (Fig. 16). Only *R. mehelyi* occurs in Egypt. The relatively pointed connecting process of the sella, with almost parallel sides, as well as the size, distinguish it from *R. clivosus* and *R. hipposideros*, the two other rhinolophids occuring in Egypt. Three characters, FA, MB (mastoid breadth), and C-M^3 were found to exhibit significant secondary sexual dimorphism in Tunisia (Baker *et al.*, 1974). Females had longer forearm measurements, whereas males had larger MB and C-M^3.

TABLE 11.—Rhinolophus mehelyi: *measurements as in Table 1.*

Variate	Egypt	
	Males	Females
TL	83.6(81-86)5	83.3(81-85)3
T	23.6(21-26)5	24.0(22-26)3
HF	10.8(10-11)5	11.0(10.5-11)5
E	22.2 ± 2.0(19.4-25)7	19.6 ± 1.9(17.8-22)10
FA	48.3 ± 0.9(46.5-49.5)9	48.1 ± 1.1(46.5-50)17
GLS	19.3(19.1-19.6)6	19.2(18.5-19.6)4
CCL	16.3(15.9-16.8)6	16.5(15.8-17.0)4
BBC	9.1(8.2-9.6)6	9.1(8.6-9.4)4
MB	9.7(9.5-9.8)3	9.8(9.7-10.0)3
ZYGB	10.2(10.1-10.3)6	10.2(10.1-10.3)4
C-M3	6.6(6.4-6.7)6	6.7(6.6-6.9)4
BCD	6.2(6.0-6.5)6	6.1(6.0-6.3)4
M	12.0(11.7-12.1)6	11.9(11.7-12.0)4
c-m3	7.4(7.1-7.9)5	7.5(7.1-7.8)4
CORH	3.4(3.3-3.6)5	3.6(3.4-3.7)4

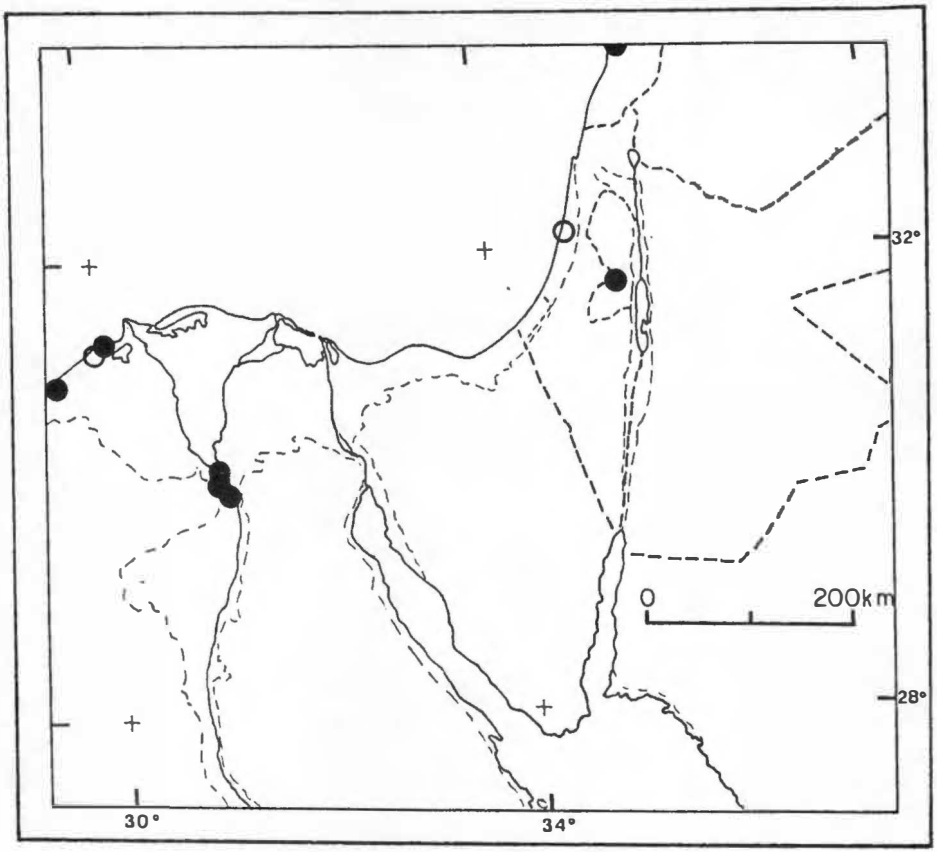

FIG. 15.—Distribution of *Rhinolophus mehelyi*. Solid symbols indicate specimens examined; open ones, literature records.

Remarks.—Contrary to Kahmann's (1958) conclusions, Cockrum (1976) states that the "Tunisian populations of this bat differ sufficiently from Eastern European populations . . . that they warrant subspecific separation," and he used the name *R. mehelyi tuneti*, Deluil and Labbe, for that population. Cockrum (1976), however, did not state what the difference was. I could find no distinctions between European specimens and specimens I examined from North Africa and tend to consider all those as belonging to the nominate subspecies. There is a trend towards a decrease in body size around the Mediterranean from north to south and west to east; the smallest specimens come from Egypt.

Biology.—Nothing is known of the biology of this species in Egypt. DeBlase (1980:116) found a low percentage of adult males in a sample from Iran and he also noted that "the ratio of adult females to immatures suggests a litter size of two in this species."

Specimens examined (241).—EGYPT: *Giza*: Giza Pyramids 1(BMNH), 113(FMNH), 116(USNM); Saqqara 2(BMNH), 1(CM); Serapeum 1(BMNH); *Alexandria*: Alexandria 1(ZMUC); Ramleh 1(BMNH); *Matruh*: Burg El Arab 3(FMNH), 2(USNM).

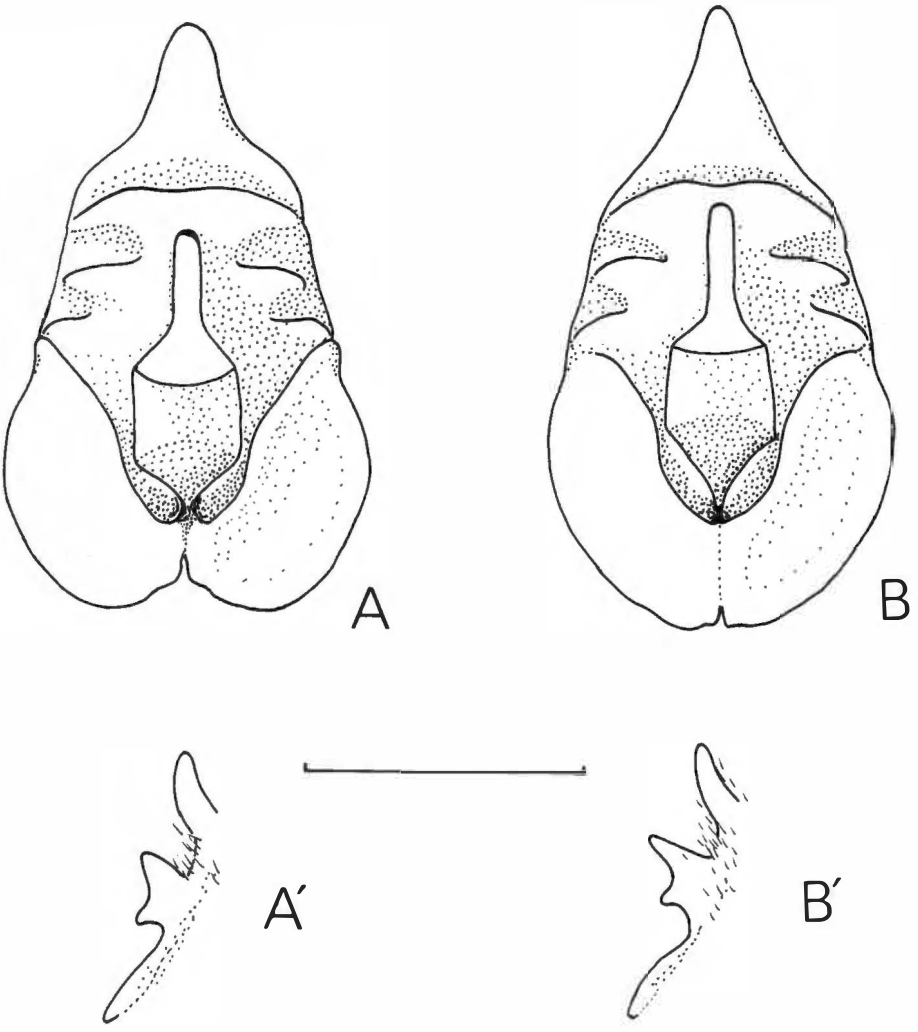

FIG. 16.—Frontal (A, B) and lateral (A′, B′) views of horseshoe of *Left*: *Rhinolophus mehelyi* from Alexandria, Egypt (ZMUC 1203) and *Right*: *R. euryale* from Dibbine Forest Park, Jordan (MQ 760). The horseshoe of the former specimen appears shortened due to long preservation in alcohol. The scale is 5 mm for A and B, and 10 mm for A′ and B′.

Genus *Asellia* Gray, 1838

Asellia tridens tridens (É. Geoffroy St.-Hilaire, 1813)

Rhinolophus tridens É. Geoffroy St.-Hilaire, 1813*b*:265.
Hipposideros tridens, Gray, 1838:493; Yerbury and Thomas, 1895:546; Matschie, 1895:22; Anderson, 1902:99.
Asellia tridens tridens, Allen, 1939:78.

Type specimen.—MNHN A.235; adult male; in alcohol, skull not removed. MNHN 237; female; in fluid, skull not removed; skull figured in Atlas (pl. IV, fig. 2, 2′, 2″). Egypt (Rode, 1941:240). Syntypes. É. Geoffroy

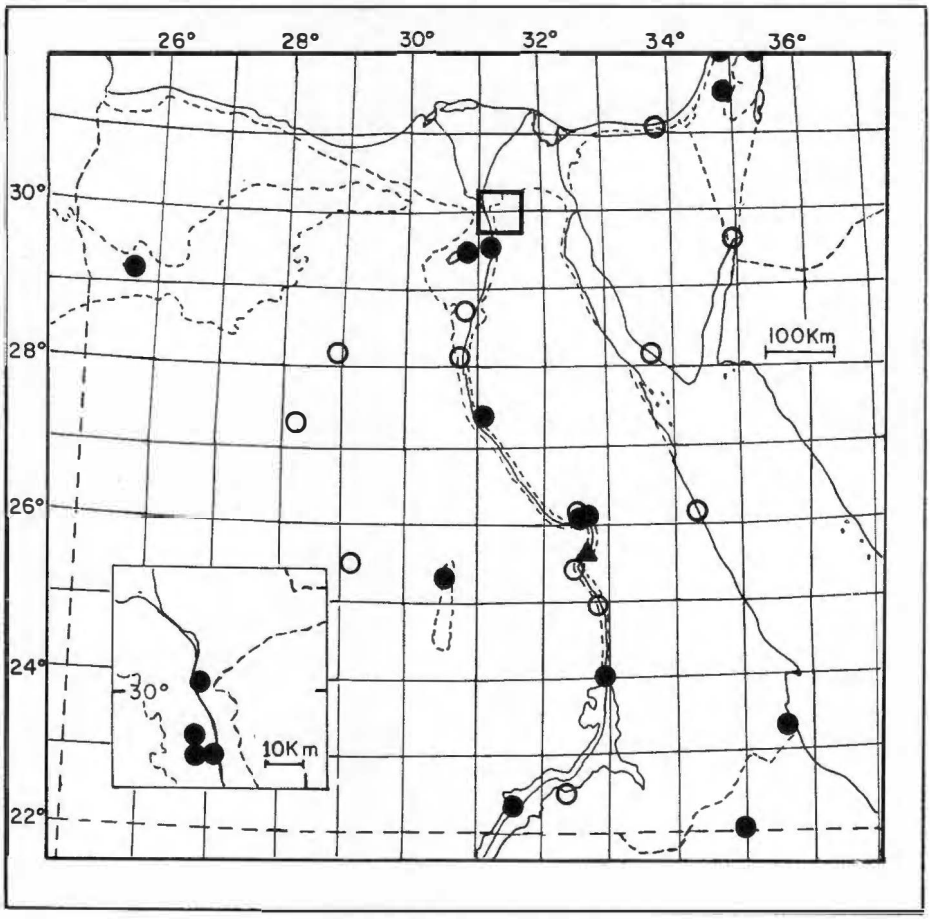

FIG. 17.—Distribution of *Asellia tridens*. Solid symbols indicate specimens examined; open ones, literature records. Triangle indicates type locality.

St.-Hilaire (1818:127) mentioned two localities for this species in Egypt, Tomb of the Kings (Luxor) and Dandara. Kock (1969) restricted the type locality to Thebes (=Luxor).

Common name.—Trident horsehoe bat.

General distribution.—Most of Africa from Morocco to Sudan and Egypt, and from Gambia through Somalia and most of Arabia to Pakistan.

Distribution in Egypt.—A wide ranging distribution in Egypt in desert and subdesert regions (Fig. 17).

Diagnosis.—Wassif (1949) described the morphology of *Asellia tridens* based on specimens from Kharga Oasis in Egypt. This species resembles horseshoe bats in general appearance, but has a noseleaf with three fleshly protrusions (i.e. tridentate posterior margin). The ears are longer than in the other noseleafed bats of the region. An erythrystic phase occurs in this

species but is more frequent in specimens from SW Asia. The average color is light Pearl Grey, but the color varies geographically (see below). The skull is robust, with a well developed sagittal crest (Fig. 18). The small second upper premolar is absent. The baculum is "anchor shaped", small and expanded distally and proximally (Wassif and Madkour, 1972*b*).

Secondary sexual dimorphism is prominent in this species (Baker *et al.*, 1974). In specimens from southern Egypt (Table 12), males are larger than females in all measurements examined. There is a significant ($P < 0.01$) secondary sexual dimorphism in CCL, ZYGB, C-M3, and c-m3 (Table 13).

The nominate form is a pale colored subspecies, specimens from southern Egypt have dorsal fur that is Pearl Gray tipped with Glaucous, and ventrally are entirely Pearl Gray. The color of specimens from Siwa Oasis is pale Gull Gray at the bases and deep Neutral Gray at the tips. Some specimens from Palestine have a Drab dorsal color tipped with Olive Brown and ventrally are Drab. In this they approach the color of the Iraqi specimens.

Remarks.—Kock (1969) recognized two subspecies in Arabia and Egypt; *A. t. tridens* occurring in southern Egypt, southeastern Arabia, northern Sudan, and elsewhere in desert regions and surrounded by the darker and larger *A. t. murriana* in Iraq, southwestern Arabia and most of the Sudan. Harrison (1964:97) suggested that the two "races" intergrade in Palestine, Sinai and northwestern Arabia. In comparing specimens from Iraq, Palestine, and Egypt (Table 12), it is apparent that the Iraqi populations are indeed the largest in body size. Kock (1969) suggested that north Egyptian and Palestinian specimens are identifiable with the Iraqi population. When comparing measurements of specimens from Egypt, Kock (1969:125 and table 25), did not however distinguish between males and females, and this may have affected his conclusions. The material I examined from Palestine is slightly larger than the southern Egyptian material but does not approach the size of *A. t. murriana* of Iraq. Only two specimens with skull extracted were available to me from north Egypt and those agree in size with the Palestinian material (Table 12).

Biology.—This is a colonial species, which possibly migrates in Iraq (Harrison, 1957, 1964:102). At Kom Oshim specimens were caught over a small spring pool in a net near the entrance of a cave in a desert valley. I found the species roosting in large numbers (of 300-1000 or more) in the large rooms of Dandara Temple. The same observations were made by Gaisler *et al.* (1972), who also gave the ambient and outdoor temperatures for the roosts. In Iraq, this species roosts in caves, old houses, and ruins and disperses to hibernating quarters (cellars and tombs) from mid-September to mid-November, returning to their summer quarters in April (Robaae, 1966). Parturition occurs in Iraq starting in early June; pregnancy period is assumed to be 9-10 weeks, with a lactation period of 40 days (Robaae, 1966). Booth (1961) reported that the sooty falcon preys on this species in Libya.

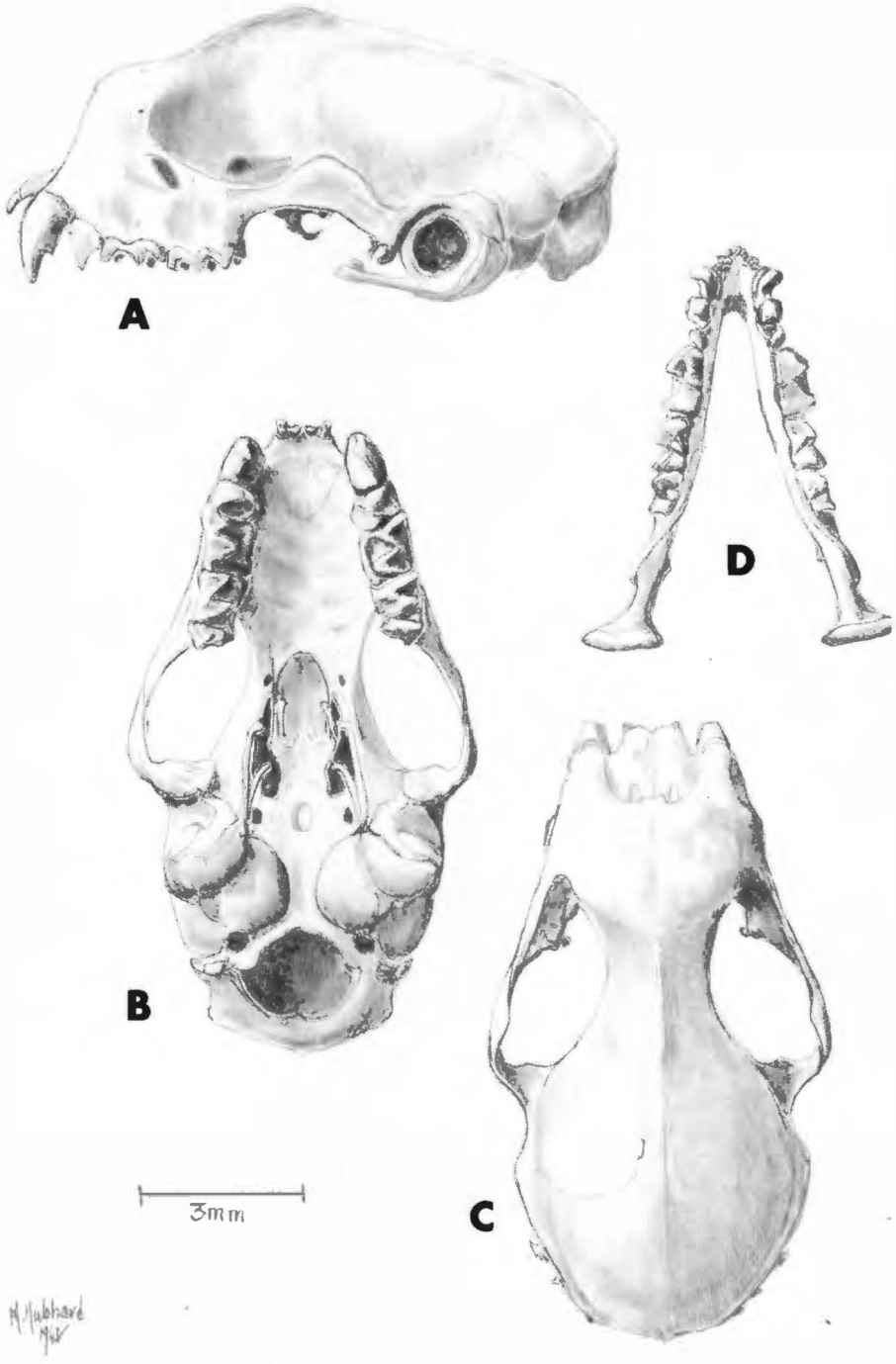

FIG. 18.—Skull of *Asellia tridens*. Dorsal (A), ventral (B) and lateral (C) view of the skull and the mandible (D) of a female specimen (MQ 690) from Dandara Temple.

TABLE 12.—Asellia tridens: *measurements as in Table 1.*

Variate	Southern Egypt		Sinai	Northern Egypt		Israel	Iraq
	Males	Females	2 Females	Faiyum (Male)	Saqqara (Female)	5 Males, 5 females	3 Males, 2 females
TL	77.6 ± 2.9(72-83)24	76.2 ± 4.0(66-82)17		89	73	77.6 ± 6.9(65-85)10	82.6(79-89)
T	22.5 ± 2.0(18-26)24	22.2 ± 2.1(18-26)17		28	23	21.3 ± 3.4(19-25)10	24.8(23-27)
HF	9.2 ± 0.6(8-10)23	8.9 ± 0.4(8.5-10)16		9.2	15	8.1 ± 0.9(6-9)8	8.4(7-10)
E	18.4 ± 1.2(16-20)24	18.2 ± 1.0(16-20)17		19	15	18.4 ± 1.6(15-20)10	18.8(18-19)
FA	49.0 ± 1.4(45.3-52.5)28	48.2 ± 1.5(46-52.2)20		51.0	47.5	50.4 ± 1.4(48.3-52.5)10	53.8(52-56)
GLS	18.4 ± 0.3(17.8-19.0)22	18.0 ± 0.5(16.5-19.0)16	18.4, 19.0	19.2	18.7	19.0 ± 0.4(18.3-19.5)7	19.2(18.5-19.6)
CCL	16.2 ± 0.3(15.7-17.0)22	15.8 ± 0.4(14.9-16.6)15	16.1, 16.6	17.0	16.0	16.1 ± 0.4(15.7-17.0)7	16.3(15.3-16.7)
BBC	7.8 ± 0.2(7.5-8.1)22	7.5 ± 0.3(6.7-8.0)17	7.5, 7.8	8.1	8.2	7.9 ± 0.4(7.3-8.3)7	8.2(7.6-8.5)
IOC	2.3 ± 0.1(2.0-2.5)22	2.3 ± 0.1(2.1-2.5)16	2.2, 2.3	2.4	2.4	2.5 ± 0.2(2.2-2.8)8	2.8(2.5-3.6)
ZYGB	10.3 ± 0.2(10.0-10.8)22	10.0 ± 0.3(9.4-10.4)16	10.1, 10.4	10.9	10.5	10.5 ± 0.4(10.0-11.2)7	10.8(10.2-11.2)
RBCA	5.2 ± 0.1(5.0-5.5)23	5.1 ± 0.3(4.8-6.0)17	5.1, 5.2	5.4	5.0	5.3 ± 0.2(5.0-5.5)7	5.6(5.3-5.8)
C-M3	6.7 ± 0.1(6.5-6.9)23	6.5 ± 0.2(6.2-6.9)17	6.7, 6.6	7.0	6.7	6.9 ± 0.3(6.7-7.7)8	6.9(6.7-7.1)
BCD	5.3 ± 0.2(4.9-5.6)23	5.3 ± 0.2(5.0-5.5)16	5.3, 5.2	5.6	5.2	5.2 ± 0.2(5.0-5.5)7	5.3(5.1-5.5)
M	11.9 ± 0.2(11.5-12.3)23	11.8 ± 0.3(11.4-12.5)17	12.0, 12.3	12.8	12.1	12.4 ± 0.3(11.9-12.8)8	12.4(11.9-12.6)
c-m3	7.7 ± 0.2(7.4-8.0)23	7.5 ± 0.2(7.1-7.9)17	7.7, 7.7	8.0	7.5	7.5 ± 0.3(7.0-8.0)7	8.0(7.6-8.2)
CORH	5.0 ± 0.5(3.1-5.5)22	4.9 ± 0.2(4.6-5.2)17	4.7, 4.9	5.5	4.9	5.2 ± 0.4(4.5-5.5)7	5.5(5.0-6.0)

Specimens examined (505).—EGYPT: *Red Sea*: Bir Abraq 7(FMNH), 1(USNM); *Sudan Administrative*: Wadi Alagi 1(BMNH); *Cairo*: Cairo 11(FMNH), 1(MQ), 10(USNM); *Giza*: Abu Sir 10(FMNH); Bakkari 54(USNM, doubtful locality); El Badrshein 21(FMNH); El Lisht 8(FMNH), 56(USNM); Saqqara 18(USNM), 1(SMNS); *Faiyum*: Kom Oshim 30(FMNH), 1(USNM); *Asyut*: El Maabdeh Cave 1(USNM); *Qena*: Dandara 38(MQ); Luxor 5(BMNH), 34(MQ), 2(NHMB); near Luxor 28(BMNH), 5(FMNH); Qena 1(FMNH); *Aswan*: Aswan 6(BMNH); Abu Simbel 37(BMNH); *Matruh*: Siwa Oasis 17(BMNH), 1(USNM); *El Wadi El Gedeed*: El Kharga Oasis 12(USNM); *No exact locality*: "Probably Luxor" 39(BMNH); Egypt 1(AMNH), 8(BMNH), 1(MCZ); "Nile" 8(BMNH), 3(USNM); "Sinai" 3(USNM); Upper Egypt 2(BMNH); "Ein Urzarki-a" 3(SMNS). PALESTINE: *Northern*: Yarmouk Pumping Station 1(HUJ), 1(TAU); *Coastal*: Jaffa 1(FMNH), 1(HUJ), 8(TAU); Tel Aviv 1(TAU); *Jerusalem*: Jerusalem 1(BMNH); *Southern*: Nahal Amram 2(HZM). SUDAN: *Kassala*: Kassala 2(BMNH), 1(FMNH), 1(USNM); Port Sudan 1(BMNH).

TABLE 13.—*Secondary sexual dimorphism in selected measurements of* Asellia tridens. *A one-way analysis of variance for specimens from Southern Egypt (see Table 12 for degrees of freedom for each variate), is presented for the most dimorphic variates. A probability of less than 0.01 is considered to be significant.*

Variate	*F*-value	*P*
FA	2.53	0.1204
GLS	6.59	0.0144
CCL	10.13	0.0030
ZYGB	12.69	0.0010
RBCA	2.00	0.1655
C-M3	11.05	0.0020
M	3.23	0.0806
c-m3	7.58	0.0091

Records of Egyptian specimens not examined.—Sinai: El Arish (Hoogstraal, 1962); Tor (Anderson, 1902); *Red Sea*: Quseir (Kluzinger, 1878; *fide* Kock, 1969); Tel El Qurna (Hartmann, 1868); *Giza*: Bir Abu Daraig, Mandisha, Beheira Oasis (Wassif, 1959*a*, *b*). *Beni Suef*: Hanna (Setzer, 1952); *Minya*: Minya (Anderson, 1902); *Qena*: *Jabaleyn* (*Flower, 1932*); *Aswan*: Edfu (Kock, 1969); Korosko (De Beaux, 1923, *fide* Kock, 1969); *El Wadi El Gedeed*: Mut, Dakhla Oasis (Wassif, 1959*a*); Farafra Oasis (Wassif, 1959*a*).

Family VESPERTILIONIDAE

Key to Species in Egypt

1. Large, FA greater than 55, GLS greater than 21; ear long measuring 34-42 in Egyptian specimens; one pair of upper incisors ..... *Otonycteris hemprichi*
   Small to medium sized, FA less than 50, GLS less than 20; ear short or long; one or two pairs of upper incisors 2

2. Mandible with three premolars and three molars; ears and tragus elongated ..... *Plecotus austriacus*
   Five or less lower postcanine teeth; ears and tragus not elongated 3

3. One pair of upper incisors ..... *Nycticeius schlieffenii*
   Two pairs of upper incisors 4

4. Four upper postcanine teeth ..... *Eptesicus bottae*
   Five upper postcanine teeth (but PM2 is absent on some specimens of *Pipistrellus kuhlii* on one side) 5

5. Ears connected; skull with a narrow and concave rostrum ..... *Barbastella barbestellus*
   Ears separate; skull with a wider and convex rostrum ..... (*Pipistrellus*) 6

6. Outer upper incisor much less than half length of inner 7
   Outer upper incisor more than half length of inner 8

7. C-M^3 greater than 4.5; GLS greater than 12.0; skull relatively rugose with distinct lambdoidal ridges.....*Pipistrellus kuhlii*
C-M^3 less than 4.5; GLS less than 12.0; skull slender, with braincase rounded; rostrum slightly shortened and hence forehead is more elevated than in *P. kuhlii*.....*P. aegyptius*

8. Inner upper incisor unicuspid; PM2 small and possibly not functional; rostrum flattened.....*P. ariel*
Inner upper incisor bifid or bicuspid; PM2 clearly distinguished and functional; rostrum concave.....9

9. Inner upper incisor deeply cleft; ventral fur whitish.....*P. rueppellii*
Inner upper incisor bifid but not deeply cleft; ventral fur not whitish.....*P. bodenheimeri*

Genus ***Pipistrellus*** Kaup, 1829

Pipistrellus kuhlii marginatus Cretzschmar, 1830

Vespertilio kuhlii Natterer, 1817:58.
Vespertilio marginatus Cretzschmar, 1830:74, pl. 29a.
Pipistrellus kuhlii ikhwanius Cheesman and Hinton, 1924:549.
Pipistrellus kuhli marginatus, Gaisler *et al.*, 1972:24.

Type specimen.—"Arabia Petraea" (=Sinai) and Nubia. Anderson (1902:127) mentioned that on the label of the type specimen, Egypt is given as the locality. Koopman (1975:400) indicated that "since the plate with the original description shows a bat with a narrow white edging on the wing, it is evident that the specimen came from the Nile Valley or eastern desert, rather than the western desert where the white edging is wide."

Common name.—Kuhl's pipistrelle.

General distribution.—*Pipistrellus kuhlii* occurs in Africa except some areas of West Africa and most of the Sahara, and from Spain through southern Europe, Crimea, Caucasus and Turkestan to Pakistan.

Distribution in Egypt.—The Egyptian subspecies is very common especially around human populated areas in northern Egypt (Fig. 19).

Diagnosis.—*P. kuhlii* is the largest of the Egyptian pipistrelles: FA 30.7-37.0, GLS 12.2-14.0 (Table 14). The first upper incisor is unicuspid, the second small, not exceeding the cingulum of the first. Small upper premolar is minute and barely visible from without (Fig. 20). Baculum is similar to many vespertilionines in forming a long slightly curved bone with bifurcations both distally and proximally. In *P. kuhlii* the basal plate is well marked from the style (Wassif and Madkour, 1972*b*). The plagiopatagium has a variable but distinct white border between the foot and the fifth digit. The uropatagium may also have the white edging, but in many pale colored specimens seen, the whole membrane is light in color and the edging is not distinct.

The specimens of this species show considerable variability in both cranial and external features. The small upper premolar is variably reduced and occasionally absent on one side (Anderson, 1902; Setzer, 1952). I have seen specimens in which the premolar is large and clearly separates the canine and PM4 and also specimens in which the inner upper incisor is

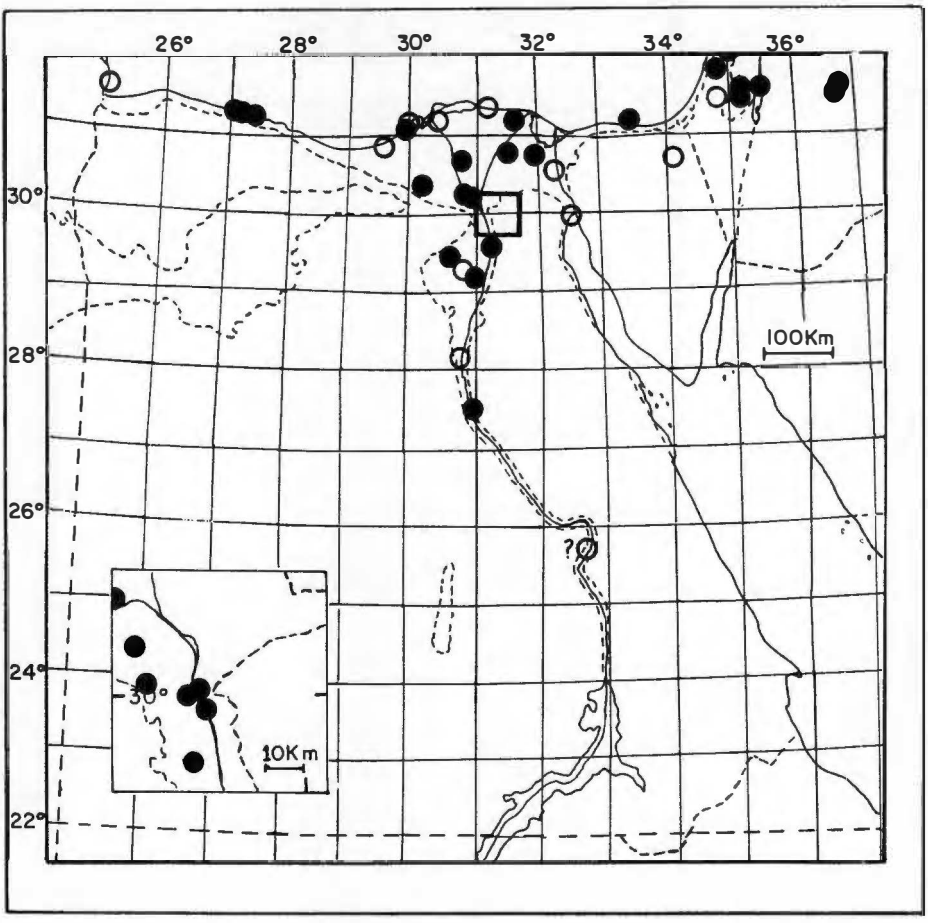

FIG. 19.—Distribution in Egypt of *Pipistrellus kuhlii*. Solid symbols indicate specimens examined: open ones, literature records. Question mark indicates an unlikely literature record (see text for details).

slightly bifid. The color also shows much variation. The white border on the edge of the plagiopatagium is variably developed and is best expressed in animals from desert areas and in adult specimens. Lewis and Harrison (1962) demonstrated the existence of a geographical cline in color in the Eastern Mediterranean region. The Egyptian specimens also show that the color becomes paler with age, a condition already noted for the Arabian bats by Harrison (1964:151). It is possible that much of the geographic separation based on the color was obscured by this individual variation. Gaisler *et al.* (1972:23) even suggested the possibility of migration to explain the coexistence of a light form and a dark form. The color in the Egyptian specimens varies from Russet to Olive Brown to Light Buff.

Remarks.—As discussed above, the characters used to distinguish the Egyptian populations of *Pipistrellus kuhlii* from those from Palestine and

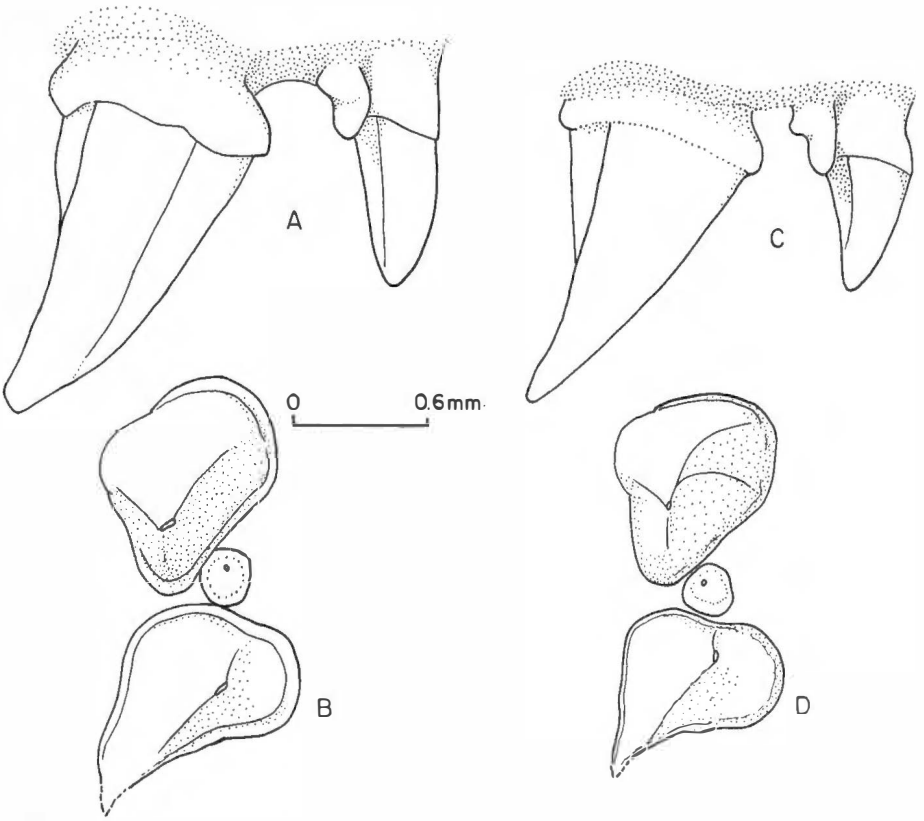

FIG. 20.—Right upper incisors and canine (A and C) and left upper canine and premolars (B and D) of *left, Pipistrellus kuhlii* (MQ 607 from Saqqara); and *right, P. aegyptius* (MHNG 1626.5 from Wadi Halfa, Sudan).

Arabia (*P. k. ikhwanius*) are individually variable. Specimens from northern Egypt and northeastern Mediterranean (Lebanon, Syria, and Turkey) are dark in the color of the fur and the membranes. The specimens from Arabia and Sinai are light in color, but intergrade into the darker forms in the Eastern Mediterranean. The color is correlated with the climate, paler specimens coming from the desert regions. Liekwise, the size is largest in cool, humid climates and smaller in hot, dry climates. In view of the continuity of range and the abundance of this species, it seems likely that the other pale forms (for example, *lepidus*) might prove to be synonymous. With the material available to me, I could only synonymize *ikhwanius* with the Egyptian populations of *P. kuhlii*. The name available for this Egyptian population is not *Vespertilio pipistrellus aegyptius* (Fischer, 1829) but rather *marginatus* Cretzschmar, 1830 (see discussion under *P. aegyptius*).

Biology.— *Pipistrellus kuhlii* is the most common bat in many areas of the southern Palearctic, probably because of its ability to roost in almost any available shelter. These bats frequently use cracks and other roosts in

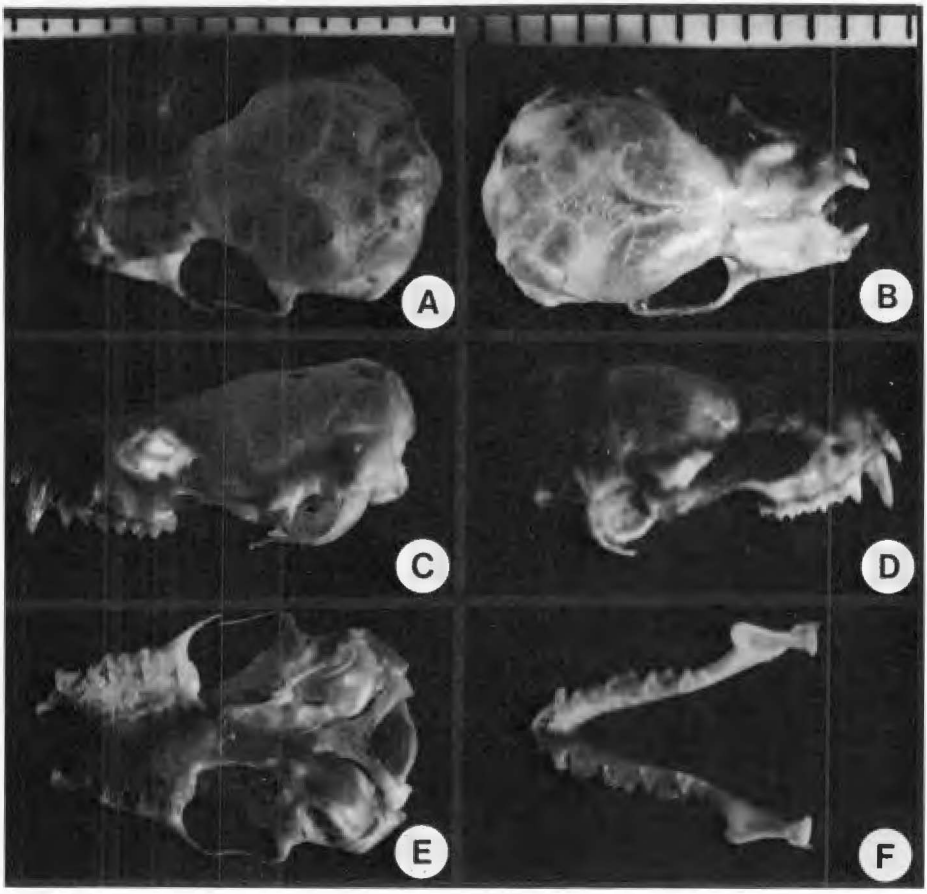

FIG. 21.—Dorsal (A), lateral (C), and ventral (E) views of skull and mandible (F) of *Pipistrellus kuhlii* (MQ 730, Saqqara), to compare with dorsal (B) and lateral (D) views of skull of *P. aegyptius* (NHMG 1626.5, Wadi Halfa).

human dwellings, sometimes in the middle of busy village streets. Specimens from Egypt were secured by removing them from crevices on roofs of buildings on old farms, stables, old Roman tombs, caves, and Pharaonic ruins. Anderson (1902) mentions that parturition occurs in May in Egypt and that usually two young are born. The breeding season seems to be in the spring over many areas of the range of the species (Harrison, 1964:156). Robaae (1966) found that individuals of this species slow down their activity in Iraq during the winter months but do not hibernate. There is no evidence of any migratory behavior in this species in Egypt, as suggested in Gaisler *et al.* (1972; see discussion above). Twenty-four specimens were obtained by Dor (1947) from 6000 pellets of the owl, *Tyto alba*, in Palestine.

Specimens examined (433).—EGYPT: *Sinai*: Zarnikh Is., Sabkhet El Bardawil 1(HZM); *Daqahliya*: 5 mi W Simbilawein 1(MVZ), 6(USNM); *Beheira*: Kom Hamada 1(FMNH);

Sharqiya: El Salhiya 2(BMNH); *Gharbiya*: Sherbin 1(BMNH); *El Tahreer*: Wadi El Natrun 1(BMNH); *Cairo*: El Maadi 2(FMNH), 1(USNM); Cairo 5(BMNH), 1(NHMB); *Giza*: Abu Ghalib 22(MQ); Abu Rawash 11(FMNH), 47(USNM); 4 km W El Mansuriya 32(FMNH); El Aiyat 16(USNM); El Qatta 2(FMNH); Giza 21(BMNH), 4(MCZ), 12 USNM); Saqqara 1(MQ); *Faiyum*: El Lahun 2(FMNH); Lake Qarun 1(BMNH); *Minya*: Tel El Amarnah 1(BMNH); *Alexandria*: Ramleh 1(BMNH); *Matruh*: El Qasr, near Mersa Matruh 3(FMNH), 38(USNM); 1 mi W El Qasr, near Mersa Matruh 6(FMNH), 6(USNM); Zawyet Umm El Rakham 93(FMNH), 1(HZM), 56(USNM); *No exact locality*: "Egypt" 4(BMNH), 3(SMNS), 1(USNM). PALESTINE: *Haifa*: Mt. Carmel 1(BMNH); *Northern*: Yarmouk Valley 4(BMNH); *Central*: Rehovot 1(BMNH); *Jerusalem*: Beit Sahur 10(MQ), 4(SAM), 1(UCONN); Jericho 1(MQ). JORDAN: *Amman*: Azraq ed Druz 1(SAM); Azraq esh Sheishan 1(BMNH), 2(SAM), 1(UCONN).

Records of Egyptian specimens not examined.—Sinai: Maqdabah (Wassif, 1953); *Ismailia*: Between Cairo and Ismailia (Kock, 1969); *Suez*: Suez (Anderson, 1902; Flower, 1932); *Kafr El Sheikh*: Baltim (Anderson, 1902); *Beheira*: Idfina (Heyneman and Macy, 1962); *Faiyum*: El Faiyum (Anderson, 1902; Bonhote, 1909); *Minya*: Minya (Anderson, 1902); *Matruh*: Burg El Arab (Wassif, 1953; Gaisler *et al.*, 1972); *Alexandria*: Alexandria (Kock, 1969).

Pipistrellus aegyptius (Fischer, 1829)

Vespertilio pipistrellus var *aegyptius* Fischer, 1829:105.

Pipistrellus deserti Thomas, 1902:4; Allen, 1939:94; Kock, 1969:172; Gaisler *et al.*, 1972; Koopman, 1975:401; Corbet and Hill, 1980:67. Holotype: BMNH 2.11.4.1 adult male collected by I. S. Wittaker on 30 May 1901.

Pipistrellus kuhli deserti, Corbet, 1978:53.

Type locality.—Fischer (1829:105) lists the locality of his new var B as "in Cryptis Thebarum Aegypti" which refers to Thebes (=Luxor). Type material not available or missing.

Common name.—Desert pipistrelle.

General distribution.—Algeria, Libya, southern Egypt, Upper Volta (Koopman *et al.*, 1978:4), and possibly Kenya (see Koopman, 1975:401).

Distribution in Egypt.—Known only from Luxor and Aswan in Egypt and from Wadi Halfa in Sudan, very near the Egyptian border (Kock, 1969: Fig. 22).

Diagnosis.—This is a small species, the forearm ranges from 25.9 (specimen from Upper Volta in ROM) to 33.0 (specimens from Algeria), greatest length of the skull 11.1-12.7 (Table 15). The forearm measurements of *P. kuhlii* include much of the range of this species but the skull size is considerably smaller and the rostrum is more slender in *P. aegyptius* (Fig. 21). The color of specimens of this species varies from Cinnamon Buff to Clay to Sand dorsally. The bases of the hairs vary from being slightly darker than the tips to almost black. On the average, specimens of *P. aegyptius* are lighter in color than specimens of *P. kuhlii* from the Nile Valley, but darker than specimens from Arabia. The upper inner incisor is unicuspid, outer small, barely exceeding cingulum of inner. PM2 is minute, with canine and PM4 almost in contact (Fig. 20). Gaisler *et al.* (1972) compared the baculum of a single male from Luxor with three of *P. kuhlii* and one of *P. ariel*. They concluded that "the differences are so striking that they fully indicate specific differences" (Gaisler *et al.*, 1972:27). Since only one male specimen of "*deserti*" from Luxor was examined, I feel that little emphasis can be

TABLE 14.—Pipistrellus kuhlii: *measurements as in Table 1. Measurements of eastern Mediterranean specimens from Atallah (1977).*

Variate	Egypt		Eastern Mediterranean
	Males	Females	38 specimens
TL	82.9 ± 4.0(77-89)10	83.6 ± 5.6(75-92)8	81(67-90)
T	37.0 ± 2.2 (33-40)10	35.6 ± 1.7(32-37)8	36(30-43)
HF	7.1 ± 0.7(6-8)8	7.6 ± 1.3(5-9)8	6(5-7)
E	11.8 ± 1.5(10-15)9	12.0 ± 0.1(11.7-12)8	12(10-14)
FA	34.1 ± 1.3(30.7-36.0)12	33.7 ± 1.9(30.7-36.0)14	34(31-37)
GLS	13.3(13.0-13.6)5	13.2(12.9-13.4)6	13.3(12.7-13.9)
CCL	12.2(11.9-12.5)5	12.1(11.8-12.3)6	
BBC	6.7(6.4-6.9)5	6.6(6.3-6.9)6	6.6(6.3-6.7)
IOC	4.3(4.3-4.4)5	4.4(4.2-4.6)3	
ZYGB	8.2(7.9-8.4)5	8.2(8.1-8.3)6	7.7(7.0-8.6)
RBCA	4.0(3.7-4.3)5	4.1(3.8-4.4)3	
C-M3	4.8(4.6-4.9)5	4.7(4.5-4.8)3	
BCD	4.5(4.3-4.7)5	4.5(4.3-4.7)3	
M	9.1(8.9-9.3)5	8.9(8.8-9.2)3	9.7(9.1-10.2)
c-m3	5.3(5.2-5.4)5	5.1(5.0-5.2)3	
CORH	3.1(2.8-3.5)5	3.0(2.9-3.1)3	

placed on the observed difference in the amount of bifurcation in the baculum unless more material becomes available.

Remarks.—Fischer (1829:105) tentatively included his taxon from Thebes under *Vespertilio pipistrellus* Schreber (=*Pipistrelus pipistrellus*), probably because of its small size, but he stated in brackets "An species distincta?". Gaisler *et al.*, (1972) stated that "shortly after capturing the first two

TABLE 15.—*Selected measurements of* Pipistrellus aegyptius *from North Africa. Measurements of the Luxor specimens from Gaisler* et al. *(1972).*

Variate	Holotype *P. deserti*	Wadi Halfa ♀,♂	Aswan ♀,♂	Luxor ♂	Luxor 15♀♀	Beni Abbes, Algeria 2♀♀, 2♂♂
HBL	43	39.1, 38.2		41.5	41.3(37.5-42.5)	43.5(41-45)
T	33	32.6, 21.4		33.5	35.0(31.5-38.0)	35.5(34-37)
HF	6.2	7.1, 6.1		6.0	6.4(6.0-7.0)	6.2(6.0-7.0)
E	10	11.0, 9.8		11.5	11.1(10.2-12.0)	11.8(11.0-12.5)
FA	29.5	30.6, 29.2		31.0	31.8(30.5-33.0)	32.3(31.5-33.0)
GLS	12.2	11.8, 11.7	11.2, 10.9	12.1	11.9(11.5-12.3)	12.6(12.3-12.7)
CCL	11.0	10.6, 10.6	10.7, 10.5	11.5*	11.5(11.1-11.9)*	12.0(11.6-12.4)
BBC	6.1	6.3, 6.1	5.7, 5.6	6.2	6.1(5.9-6.2)	6.5(6.4-6.6)
IOC	3.2	3.1, 3.1	3.1, 2.9	3.2	3.2(3.0-3.4)	4.0(3.9-4.1)
ZYGB	7.8	7.2, 7.3	7.2		7.6(7.3-7.9)	8.0(7.8-8.2)
RBCA	3.7	3.5, 3.4	4.0			3.8(3.7-4.0)
C-M3	4.2	4.0, 4.0	3.9, 3.8	4.4	4.3(4.2-4.4)	4.5(4.3-4.6)
BCD	4.4	4.1, 4.3	4.1, 4.0			4.4(4.4-4.5)
M	8.2	7.9, 7.7	7.7, 7.4	8.6	8.6(8.3-9.0)	8.6(8.6-8.7)
c-m3	4.6	4.5, 4.6	4.4, 4.3	4.6	4.6(4.4-4.8)	4.9(4.7-5.0)
CORH	3.2	2.7, 2.7				3.3(3.1-3.5)

*Condylobasal length.

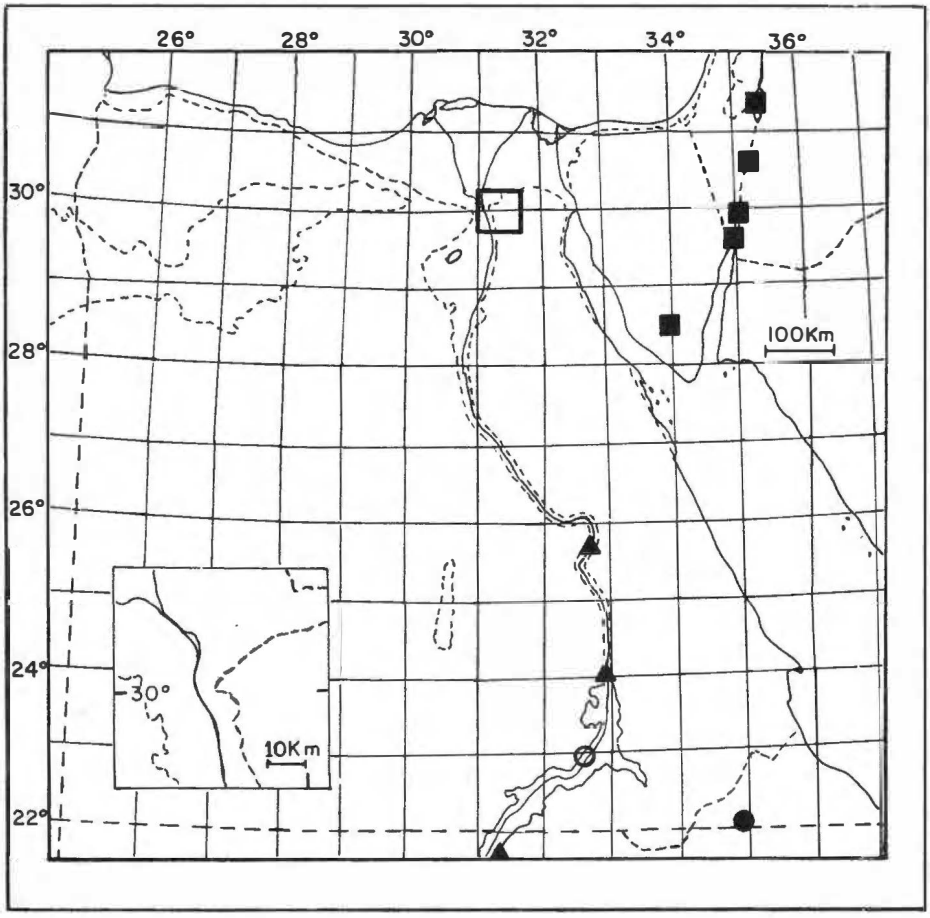

FIG. 22.—Distribution of *Pipistrellus ariel* (circles), *P. bodenheimeri* (squares), *P. aegyptius* (triangles). Solid symbols indicate specimens examined; open ones, literature records.

specimens (from Luxor), it was apparent that it is a case of a species hitherto unknown from Egypt." They referred these specimens from Luxor to *P. deserti* based on a comparison made by J. E. Hill with the holotype of that taxon. Anderson (1902:126) also commented on the "much paler" color of two female specimens in the British Museum (Natural History) from "Luxor and Khayzam." I examined the two fluid-preserved specimens mentioned by Anderson when I was at the British Museum, and Mr. J. E. Hill kindly extracted the skulls of these two specimens (BMNH 92.9.9.23, 92.9.9.24) and two others from Aswan and found them comparable to the holotype of *P. deserti*. There are two other specimens from Luxor, FMNH 49035 and 49036, and both are identical to the holotype of *P. deserti*. Thus, there appear to be three samples of specimens from Luxor, the type locality of *aegyptius*, that agree with the holotype of *deserti*. The previous three collections from Luxor were made at four different times and none yielded

P. kuhlii, and by virtue of the distribution of this latter species in Egypt, it probably does not occur in Luxor. Therefore, it seems that Fischer's (1829) name is a senior synonym of *P. deserti* (Thomas, 1902). Unfortunately, I could not find any information as to the location of Fischer's type, and it probably does not exist. There is nothing in Fischer's short description that contradicts the above arrangement.

There is an isolated record (BMNH specimen) of "*P. kuhlii aegyptius*" from Shereik, Northern Province, Sudan, mentioned by Schwann (1905) and Koopman (1975:400). I have not seen this specimen, but from the measurements given by Koopman (1975), it is possible that it also represents the form occuring in Luxor. If this interpretation is correct, most of the Sahara is likely to be occupied by *P. aegyptius*. There may be other localities for *P. aegyptius* from south of the Sahara (see Koopman, 1975 and Koopman *et al.*, 1978), but the range of measurements sheds doubt on those localities. Until further specimens of the *P. kuhlii* group from areas south of the Sahara become available, little can be said regarding this complex in the Ethiopian region.

Biology.—Gaisler *et al.* (1972) failed to find the roosting site for the bats that they collected. It is interesting to note that *P. aegyptius* was collected only from areas where palm trees occur. I was told by the people in Beni Abbes that the species roosts in hollow palm trees, and I found guano in one of the trees. Twelve out of 15 females collected by Gaisler *et al.* (1972) from 26 April to 3 May 1969 at Luxor were lactating.

Specimens examined (24).—EGYPT: *Qena*: Luxor 2(BMNH), 2(FMNH); *Aswan*: 2(BMNH). SUDAN: *Northern*: Wadi Halfa 2(NHMG). LIBYA: *Fezzan*: Murzuk 1(BNMH, holotype of *P. deserti*). ALGERIA: *Saoura*: Beni Abbes 7(MQ); *Oasis*: "Hoggar Plateau" 2(BMNH); In Saleh 1(MQ); Tamanrasset 4(MQ); 110 km N Tamanrasset 1(USNM).

Pipistrellus ariel Thomas, 1904

Pipistrellus ariel Thomas, 1904:157; Allen, 1939:93.

Type specimen.—BMNH 4.11.4.7; adult female; Wadi Alagi, eastern Egyptian Desert, Sudan Administrative area. A. M. Mackilligan, no. 28; 12 August 1903. Holotype.

Common name.—Pygmy pipistrelle.

General distribution.—Sudan and Egypt (see below).

Distribution in Egypt.—In addition to the type locality from Wadi Alagi, Flower (1932) reported this rare species from Rahad, Kordofan Province, Sudan, and Gaisler *et al.* (1972) tentatively identified a specimen (Naturhistorische Museum Wien No. 10351, not examined) from Sayyala, Aswan Gov., Egypt, as belonging to this species (Fig. 22).

Diagnosis.—The species is distinguished by its small size (Table 16); inner incisor unicuspid and long as in Kuhl's pipistrelle; outer incisor long, reaching almost two-thirds of the length of the inner.

The baculum of a male specimen from Sayyala, southern Egypt, measured 1.54 in length and 0.37 in width at the proximal end (Gaisler *et*

al., 1972). The color of the base of the dorsal fur of the holotype is blackish but the tips are Sandy Gray. Overall dorsal color of the male paratype is between Benzo Brown and Deep Olive Buff.

Remarks.—Because of the paucity of specimens of this species, little can be said regarding its affinities. Koopman (1975) considered it to belong to the *savii*-group of pipistrelles.

Biology.—Nothing is known of the biology of this rare species.

Specimens examined (3).—EGYPT: *Sudan Administrative*: Wadi Alagi, 2(BMNH). SUDAN: *Kordofan*: Rahad, 1(BMNH).

Records of Egyptian specimens not examined.—Aswan: Sayyala (Gaisler *et al.*, 1972).

TABLE 16.—*Selected measurements of holotype, paratype, and specimen from Rahad, Kordofan, Sudan, of* Pipistrellus ariel.

Variate	Holotype	Paratype	Sudan
TL	68	71	68
T	34	33	30
HF	5	6	4.5
E	10	10	9.5
FA	30.7	30.0	28.5
GLS	11.4		
CCL	10.0		
BBC	5.5		
IOC	2.9		
ZYGB	6.8		
RBCA	3.2		
C-M3	3.8		
BCD	4.0		
M	7.4		
c-m3	4.0		

Pipistrellus bodenheimeri Harrison, 1960

Pipistrellus bodenheimeri Harrison, 1960:261.

Type specimen.—BMNH (no number, originally HZM 1.2987); adult female; skin and skull; Yotvata, Southern Israel; D. L. Harrison; 13 October 1959. Holotype.

Common name.—Bodenheimer's pipistrelle.

General distribution.—Aden, southern Israel (Harrison, 1964), and Sinai.

Distribution in Egypt.—Known from Egypt only from St. Katherine monastery, Sinai (Fig. 22).

Diagnosis.—A very small pipistrelle, FA 26.2-31.6, GLS 10.8-12.3 (Table 17). *Pipistrellus bodenheimeri* is distinguished from all other *Pipistrellus* in Egypt by the very small size of skull combined with the bicuspid first upper incisor. The second upper incisor is three-quarters the height of the first (Fig. 23). The color is very distinctive, being very pale whitish buff dorsally and white ventrally contrasting with the blackish plagiopatagium (Harrison, 1960). The tragus is wide at the middle and almost triangular in shape, and as such is distinct from that of other Egyptian pipistrelles (Fig. 24).

Remarks.—This dwarf species is possibly allied to *P. savii* and seems to be limited in distribution by the occurrence of Wadi systems with acacia trees and other shrubs. The specimens from St. Katherine's monastery, Sinai, represent the first record of this species in Egypt.

Biology.—The type was shot "flying shortly after dark...around a line of tamarisk trees in a small area of cultivation surrounded by sandy desert with acacia trees" (Harrison, 1960:264).

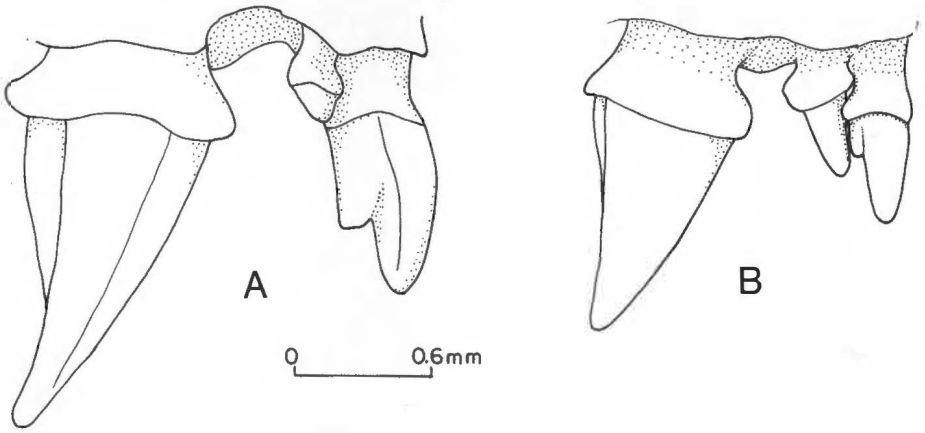

FIG. 23.—Upper canine and incisors of A. *Pipistrellus rueppellii*, FMNH 86885, from Egypt and B. *P. bodenheimeri*, USNM 552396 from Ein Geddi, Israel.

Specimens examined (9).—EGYPT: *Sinai*: Saint Katherine Monastery 2(HUJ). PALESTINE: *Southern*: Ain Yahav 1(TAU); Ein Geddi 1(TAU), 2(USNM); Elat 1(HUJ); Yovata 1(BMNH), 1(HZM).

Pipistrellus rueppellii rueppellii (Fischer, 1829)

Vespertilio temmincki Cretzschmar, 1826 (1826-1830):17, pl. 6, (not of Horsefield, 1824, a *Scotophilus*).
Vespertilio rüppelii Fischer, 1829:109.
Pipistrellus rueppellii rueppelli, Allen, 1939:95.

Type locality.—Dongola, Northern Province, Sudan.

Common name.—Rueppell's bat.

General distribution.—The species has a spotty distribution from Morocco (USNM specimen) through Algeria, Mauritania (Qumsiyeh and

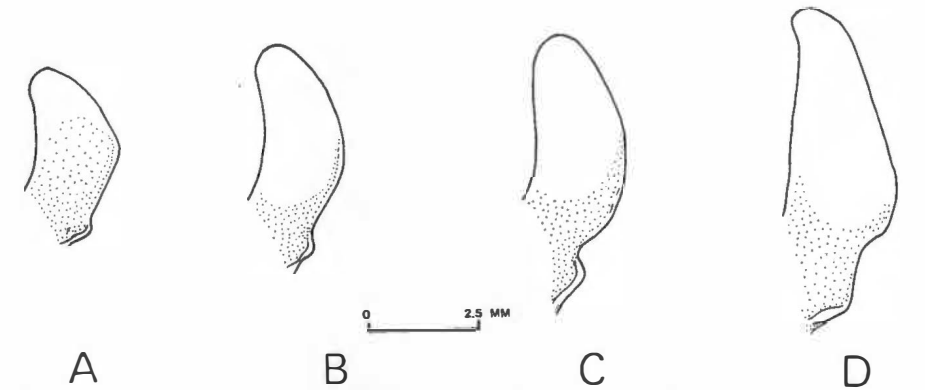

FIG. 24.—Left tragi of four vespertilionines occurring in Egypt: A. *Pipistrellus bodenheimeri*, Ein Geddi, Israel (USNM 552396); B. *P. aegyptius*, Wadi Halfa, Sudan (MHNG 1626.5); C. *P. kuhlii*, Abu Ghalib, Egypt (MQ 737); and D. *Eptesicus bottae innesi*, Ein Geddi, Israel (USNM 552397).

TABLE 17.—*Selected measurements of* Pipistrellus bodenheimeri *from Wadi Araba, Israel, and St. Katherine Monastery, Sinai, Egypt.*

Variate	Israel	Egypt
TL	68.0(63-74.2)5	71, 66.5
T	31.8(28-37)5	36, 34
HF	5.9(5.6-7)5	
E	9.8(8-11.6)5	10.5, 11
FA	29.0(26.2-31.6)5	30.2, 30.8
GLS	11.7(11.2-12.3)4	11.7, 11.7
CCL	10.6(10.2-11.3)4	10.7, 10.6
BBC	5.6(5.5-5.8)4	5.5, 5.7
IOC	2.8(2.8-2.9)4	2.9, 2.8
ZYGB	7.0(6.8-7.3)4	6.6, 7.0
C-M3	3.9(3.7-4.2)4	3.9, 3.9
BCD	4.1(4.0-4.2)4	4.1, 4.0
M	7.5(7.2-8.1)4	7.5, 7.8
c-m3	4.2(4.1-4.5)4	4.3, 4.3

Schlitter, 1981), Senegal, and most of subsaharan Africa north to Egypt and east to Iraq.

Distribution in Egypt.—The nominate subspecies is known only from five localities in northern Egypt (Fig. 25).

Diagnosis.—A medium sized pipistrelle with forearm length of 30.3-34.0, GLS 12.6-13.7 (Table 18). The skull is distinguished by the presence of a strongly bifid inner upper incisor and outer incisor about one-third of length of inner (Fig. 23). Color of fur on mid-dorsal region is "dark brown" at the bases and "light brown" at the tips (Anderson, 1902). In all specimens examined, the fur on the ventral side is pure white, an external character by which this species is easily identified. Baculum exists as in

TABLE 18.—*Selected measurements of* Pipistrellus rueppellii *from Abu Rawash (FMNH 86885♂, 89385♀, 91485?) and Luxor (BMNH 92.9.9.20♂).*

Variate	86885♂	89385♀	91485?	92.9.9.20♂
TL	85	82	77	
T	41	42	37	
HF	6.5	6	7	
E	11	10	9.5	
TR	5	4.5	5.0	
FA		34	31	
GLS	13.1	13.7	13.1	13.4
CCL	12.0	12.2	12.0	12.3
BBC	6.8	7.1	6.7	6.8
IOC	3.6	3.6	3.8	3.7
ZYGB	8.5	8.7	8.3	8.0
C-M3	4.5	4.6	4.5	4.5
BCD	4.6	4.9	4.8	4.7
M	8.6	9.1	8.7	8.8
c-m3	4.9	5.0	5.2	5.2

other pipistrelles, but is rather large, with the basal plate expanded and excavated proximally and distally (Wassif and Madkour, 1972*b*).

Biology.—Little is known of the biology of this species, which probably leads a highly specialized life. The specimens collected in Egypt were mostly obtained from under rocks in desert and semidesert areas "while looking for scorpions, geckoes, etc." (Field Notes).

Specimens examined (21).—EGYPT: *Giza*: Abu Rawash 11(FMNH), 9(USNM); *Qena*: Luxor 1(BMNH).

Records of Egyptian specimens not examined.—Cairo: Cairo (Hoogstraal, 1962); *Giza*: Giza (Flower, 1932); *Faiyum*: El Faiyum (Flower, 1932).

Genus ***Eptesicus*** (Rafinesque, 1820)

Eptesicus bottae innesi (Lataste, 1887*b*)

Vesperus bottae Peters, 1869:406.
Vesperugo (*Vesperus*) *innesi* Lataste, 1887*b*:625.
Vespertilio innesi, Anderson, 1902:121.
Eptesicus innesi, Thomas, 1919:350; Allen, 1939:85; Harrison, 1963*a*:107, 1963*b*:211.
Eptesicus isabellinus innesi, Ellerman and Morrison-Scott, 1951:156; Wassif, 1962:108.
Eptesicus bottae innesi, Harrison, 1964:140.

Type specimen.—BMNH 19.7.7.3528; subadult female; in alcohol, with skull extracted; Cairo, Egypt; Dr. W. Innes; 1885. Lectotype.

Common name.—Botta's serotine.

General distribution.—The species occurs in Egypt, southern Palestine, southern Arabia, Iraq and east to Caucasus, Turkestan, and Afghanistan to lower Balkash.

Distribution in Egypt.—This subspecies was reported from Cairo and Giza in Egypt (Fig. 26).

Diagnosis.—A medium sized serotine with GLS of 16.1-17.1; inner upper incisor bicuspid; pm2 is always absent.

Anderson (1902:122) mentioned that the color of this species is "buff" above and "nearly pure white" ventrally with the membranes reddish brown. Harrison (1964:143) mentioned that in *innesi* the back is "pale buffy clay."

Remarks.—The subspecies *E. b. innesi* has been placed by Ellerman and Morrison-Scott (1951) in the synonymy of *E. isabellinus*. Harrison (1963*a*,*b*) showed that the latter is a subspecies of *E. serotinus* and that *innesi* is specifically distinct, and then he later (Harrison, 1964:140-144) included *innesi* as a subspecies of *E. bottae*.

Biology.—At Yotvata, Wadi Araba, Harrison (1964:143) recorded this species "flying over cultivated fields lined by eucalyptus and tamarisk trees, surrounded by desert." The specimen from Yotvata collected on 22 April was a pregnant female with two embryos.

Specimens examined (5).—EGYPT: *Cairo*: Cairo 2(BMNH; lectotype and topotype). PALESTINE: *Southern*: Ein Geddi 1(HUJ), 1(USNM); Yotvata 1(HZM).

Records of Egyptian specimens not examined.—Giza: Abu Rawash (Wassif, 1962).

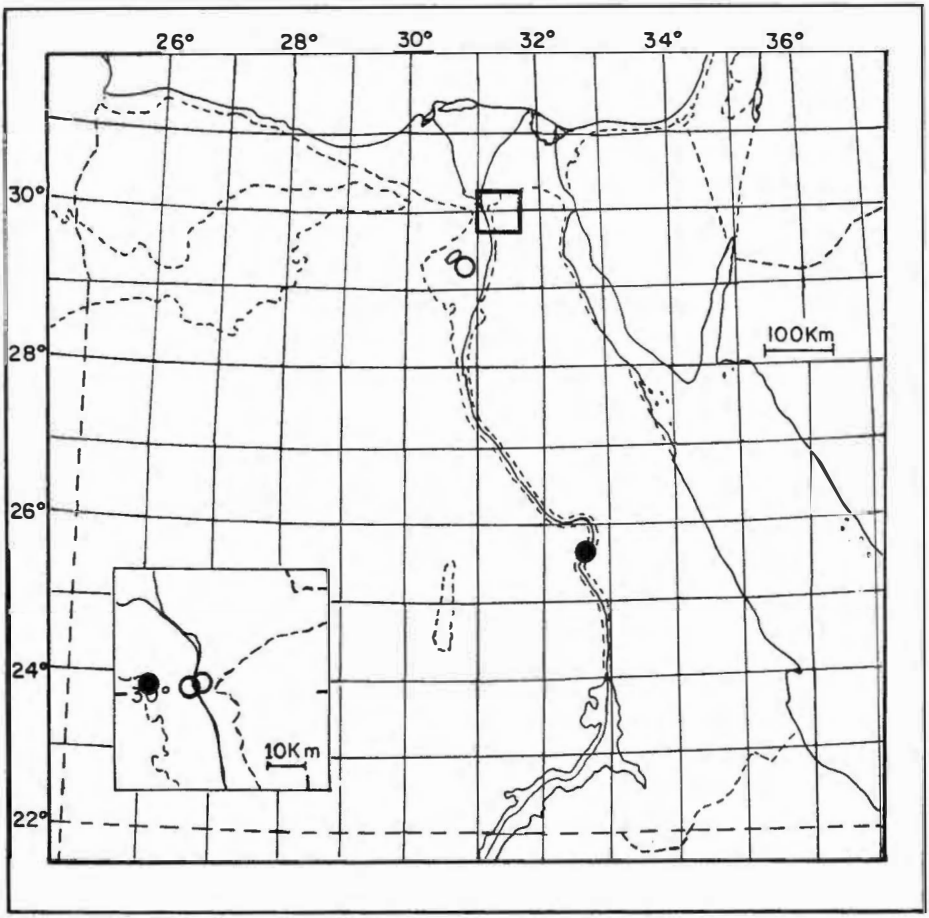

FIG. 25.—Distribution of *Pipistrellus rueppellii*. Solid symbols indicate specimens examined; open ones, literature records.

Genus *Otonycteris* Peters, 1859

Otonycteris hemprichii hemprichii Peters, 1859

Otonycteris hemprichii Peters, 1859:223.

Plecotus ustus Fitzinger, 1866:546. From Wadi Halfa, Northern Province, Sudan, *Nomen Nudum* (Anderson, 1902:118; Allen, 1939:92).

Otonycteris hemprichi hemprichi, Ellerman and Morrison-Scott, 1951:180.

Type locality.—No locality was given by Peters (1859), but the type was collected by Hemprich and Ehrenberg and is deposited in the Berlin Museum. Kock (1969:183-4) restricted the type locality to the Nile Valley between Aswan in Egypt and the Northern Province of Sudan.

Common name.—Hemprich's long-eared bat.

General distribution.—Desert and subdesert regions of North Africa from Algeria to Egypt; the southern most record being Air Mountains (Fairon,

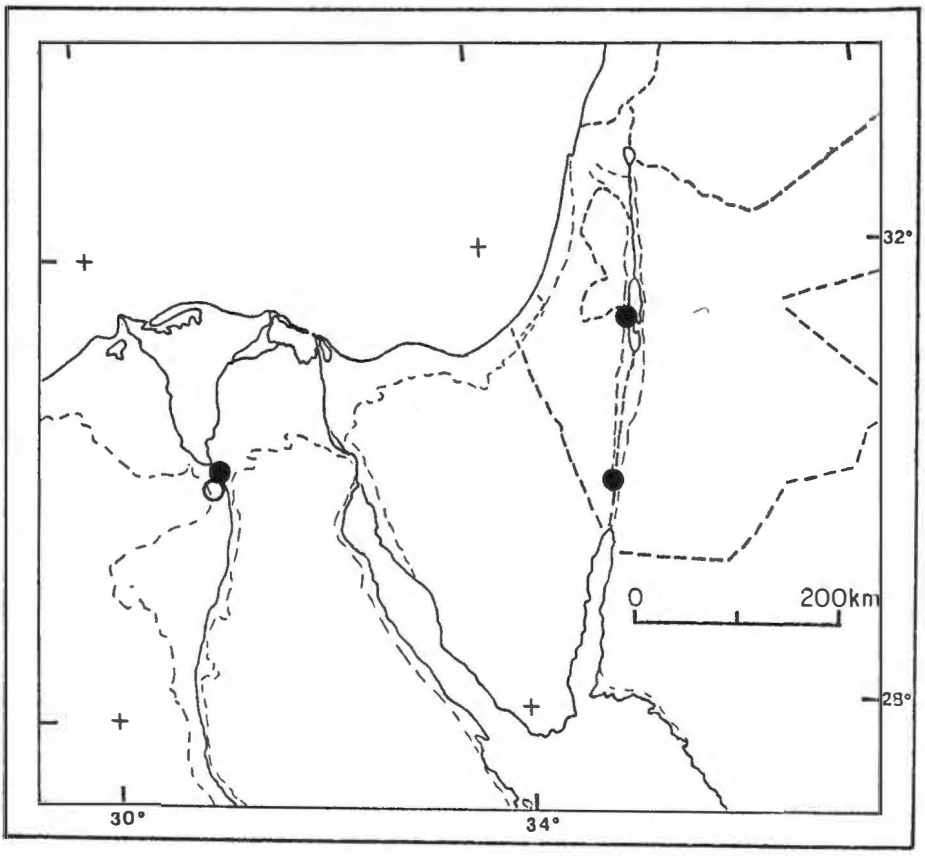

FIG. 26.—Distribution of *Eptesicus bottae innesi*. Solid symbols indicate specimens examined; open ones, literature records.

1980:3). The range further extends from Arabia to Turkestan and Afghanistan.

Distribution in Egypt.—Specimens were obtained from widespread localities in all areas of Egypt (Fig. 27), and the species probably occurs throughout Egypt.

Diagnosis.—A large bat, the forearm measures 55.1-69.0, and the greatest length of the skull measures 21.9-24.9.

The ears are long, measuring 35-42 in adult Egyptian specimens (Table 20). The tragus is long and simple with no nodules at the base as in *Plecotus*. Two pairs of pectoral nipples occur in this species. Wassif and Madkour (1972*b*) gave a description of the baculum for this species in Egypt. Fairon (1980) gave a slightly different description for bacula of specimens from the Air Mountains.

Systematic remarks.—The specimens from Sinai reported by Wassif (1953) may belong to *Otonycteris hemprichii jin* Cheesman and Hinton (1924:180),

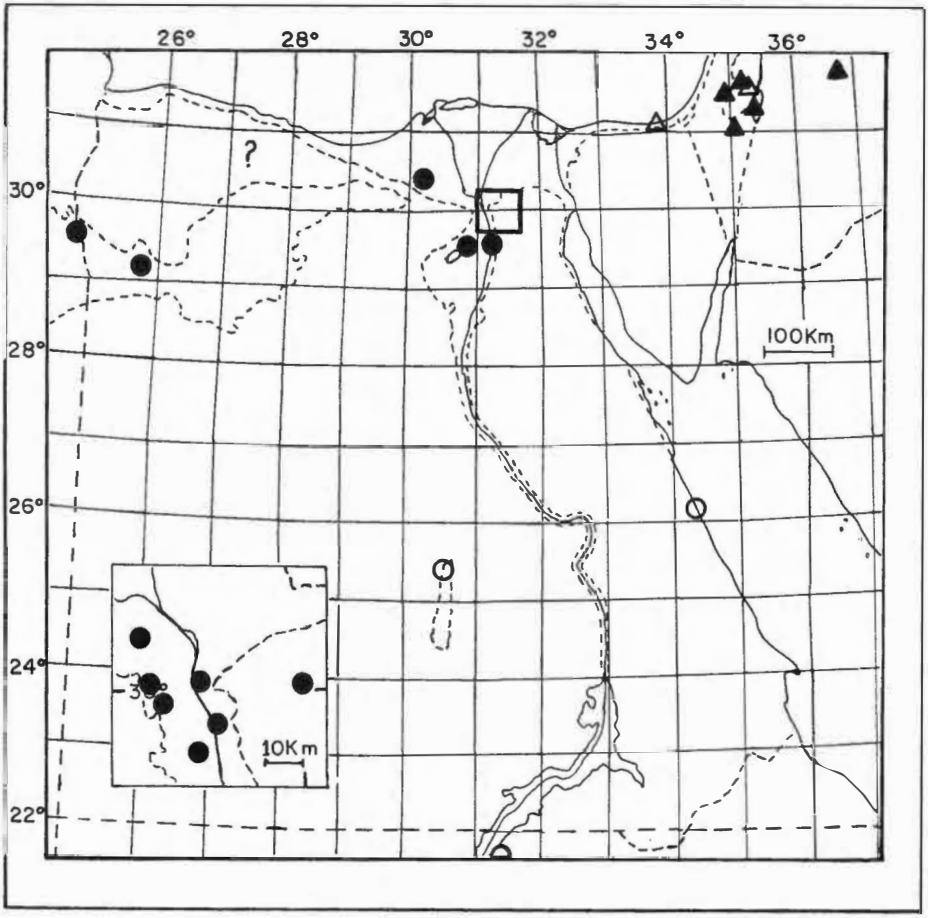

FIG. 27.—Distribution of *Otonycteris hemprichii hemprichii* (circles and dots) and *O. h. jin* (triangles). Solid symbols indicate specimens examined; open ones, literature records.

a larger subspecies occurring in Arabia and Palestine (holotype BMNH 24.8.2.2, adult male from Hufuf, Hasa, Saudi Arabia). All Egyptian specimens that I examined can be referred to the nominate subspecies based on their size.

Biology.—This is a well adapted desert species occurring in very arid regions of North Africa and the Middle East. Atallah (1977:307) reported on three pregnant females, each with one embryo on 2 May 1966, found roosting in an old, deserted hut near Azraq Oasis in Jordan. He estimated the time of birth of the embryos would be early June. Heim de Balsac (1965:310) reported this species from pellets of *Tyto alba* at Djanet, Algeria.

Specimens examined (115): EGYPT: *Red Sea*: 20 miles east of Cairo 1(FMNH); *Cairo*: Cairo 1(NHMB); Tura 5(FMNH); *Giza*: Abu Rawash 29(FMNH), 3(HZM), 34(USNM); El Aiyat 6(USNM); El Mansuriya 1(USNM); Giza 1(BMNH), 4(FMNH), 2(USNM); Saqqara 3(FMNH); *Faiyum*: Kom Oshim 7(USNM); *El Tahreer*: Wadi El Natrun 1(FMNH); *Matruh*: Siwa Oasis

TABLE 19.—*Selected measurements of* Eptesicus bottae innesi *from Cairo, Egypt (BMNH 19.7.7.3528♂, lectotype, and 3.12.8.9♂) and Yotvata, Israel (HZM 1.3668♀), and Ein Geddi, Israel (HUJ 6312, USNM 552397).*

	Egypt		Israel	
Variate	Lectotype	3.12.8.9	Yotvata	Ein Geddi
HBL	54		59.5	—, 52.0
T	43	39.3	40.0	—
HF	8.6	8.3	8.9	—, 7.6
E	14.5	14.2	16.5	—, 15.3
FA	41.7	40.3	42.3	—, 42.1
GLS	16.7	16.4	16.6	16.4, 16.3
CCL	15.2	14.7		15.1, 14.8
BBC	8.0	7.7	7.2	7.9, 7.9
IOC	3.1	4.2	3.3	3.8, 3.7
ZYGB	10.6	10.3	10.4	10.7, 10.7
C-M3	5.7	5.7	5.7	5.7, 5.7
BCD	6.0	5.6		5.4, 5.7
M	11.2	10.8	12.0	11.2, 10.9
c-m3	6.7	6.3	6.3	6.4, 6.6

3(BMNH); *No exact locality*: "Libyan desert W. of Alexandria" 1(USNM). PALESTINE (*O. h. jin*): *Jerusalem*: Jerusalem 1(MCZ); *Southern*: Ein Geddi 3(TAU); Mamshit 1(TAU); Shen Ramon 1(TAU). JORDAN (*O. h. jin*): *Amman*: Azraq ed Druz 2(SAM); Karyatein 3(HUJ); this locality may not refer to El Qaryatein in Jordan). LIBYA: *Derna*: Bahr El Tubat 2(USNM).

Records of Egyptian specimens not examined.—Sinai: El Arish (Wasif, 1953); *Red Sea*: Quseir (Klunzinger, 1878, *fide* Kock, 1969); *El Wadi El Gadeed*: Kharga Oasis (Gaisler *et al.*, 1972).

TABLE 20.—*Selected measurements of* Otonycteris hemprichii *from Egypt, Bahr el Tubat (Libya), and the Eastern Mediterranean region. Measurements as in Table 1.*

Variate	Giza Pyramids ♂, ♀	Siwa Oasis 2 ♀♀	Bahr el Tubat Libya ♂, ♀	Jordan and Israel 5 ♂♂, 1 ♀
TL	122, 112		113, 122	130.2(115-143)6
T	56, 51		49, 53	56.0(53-60)6
HF	11, 8.5		12, 14	12.5(10-14)6
E	40, 35.5		39, 40	39.2(35-42)6
FA	59, 57.7		55.1, 61.2	66.0(63-69)5
GLS	23.0, 21.9	24.0, 23.5	22.2, 23.3	24.1(23.7-24.4)3
CCL	20.7, 20.7	21.6, 21.4	19.8, 21.2	21.3(21.0-21.6)3
BBC	10.9, —	10.0, 9.8	10.2, 10.9	10.9
IOC	4.3, —	4.1, 4.0	4.1, 4.1	4.4(4.4-4.5)3
ZYGB	14.1, 13.6	13.2, 14.1	13.0, 14.2	14.6(14.2-15.1)3
C-M3	7.7, —	8.1, 8.1	7.9, 8.2	8.1(7.9-8.5)3
BCD	6.9, —	7.0, 7.1	6.7, 7.0	7.4(7.0-7.9)3
M	15.0, —	16.1, 15.9	14.6, 15.6	15.8(15.7-15.9)3
c-m3	9.0, —	9.3, 8.7	9.3, 9.3	9.3(9.1-9.5)3
CORH	7.7, —	9.0, 8.1	7.6, 8.3	8.2(7.7-8.7)3

Genus *Nycticeius* Rafinesque, 1819

Nycticeius schlieffenii schlieffenii Peters, 1859

Nycticejus schlieffenii Peters, 1859:224.
Scotoeinus schlieffeni albiventer Thomas and Wroughton, 1905:540. From Naikhala, Northern Province, Sudan.
Scoteinus schlieffenii schlieffenii, Allen, 1939:97.
Scotoeinus schlieffeni schlieffeni, Ellerman and Morrison-Scott, 1951:177.

Type specimen.—From Cairo, Egypt. Dobson (1878) indicated that the holotype is in the Berlin Museum.

Common name.—Schlieffen's bat.

General distribution.—Egypt, Sudan, southwestern Arabia south and east through most of the Savannah areas of Africa, south to Botswana and Namibia.

Distribution in Egypt.—The nominate subspecies is known from Cairo (type locality) and Suez (Fig. 28).

Diagnosis.—A very small bat, it approximates the size of *Pipistrellus bodenheimeri* and *P. ariel* but differs in having only one pair of upper incisors, and the small upper premolar is absent. In this regard it is interesting to note Anderson's (1902:126) comment on a female of *Pipistrellus kuhlii* from Suez, the same locality as Harrison's (1961) specimen. Anderson (1902) wrote that in this specimen "the outer upper incisors are so small that they are scarcely visible even with the aid of the lens, and on the right side of the upper jaw the first premolar is absent." Allen (1914) mentioned that the species has a "large penial bone" (12 mm long), but Koopman (1965:16) pointed out that Allen's specimen is a *Scotophilus* and that *Nycticeius* does not have this feature. For external and cranial measurements of this species in Egypt and Arabia, see Harrison (1961, 1964).

Biology.—Nothing is known of the biology of this species in Egypt.

Specimens examined (6).—SUDAN: *Kassala*: Port Sudan 1(BMNH); Suakin 2(BMNH); Telaweit 1(FMNH); *Northern*: Nukhaylah 1(BMNH, type of *albiventer*); Shendi 1(BMNH).

Records of Egyptian specimens not examined.—Other than the type locality from Cairo, Harrison (1961) referred to this species a specimen, which was previously reported by Rüppel (1842:156) as *V. savii*, from Suez (SMF 11956, orig. No. II.N.12.a). This was the second specimen taken from Egypt, and the species has not been found in Egypt since.

Genus *Barbastella* Gray, 1821

Barbastella barbastellus leucomelas (Cretzschmar, 1826)

Vespertilio barbestellus Schreber, 1774:168, pl. 55.
Vespertilio leucomelas Cretzschmar, 1826:73, pl. 28b.
Barbastella leucomelas leucomelas, Neuheuser and DeBlase, 1974:92.
Barbastella barbastellus leucomelas, Kock, 1969:176.

Type specimen.—Senckenberg Museum, number 4373 (original number II.M.I.a); mounted skin and skull; "Arabia Petraea" [=Sinai] (Mertens, 1925). Lectotype.

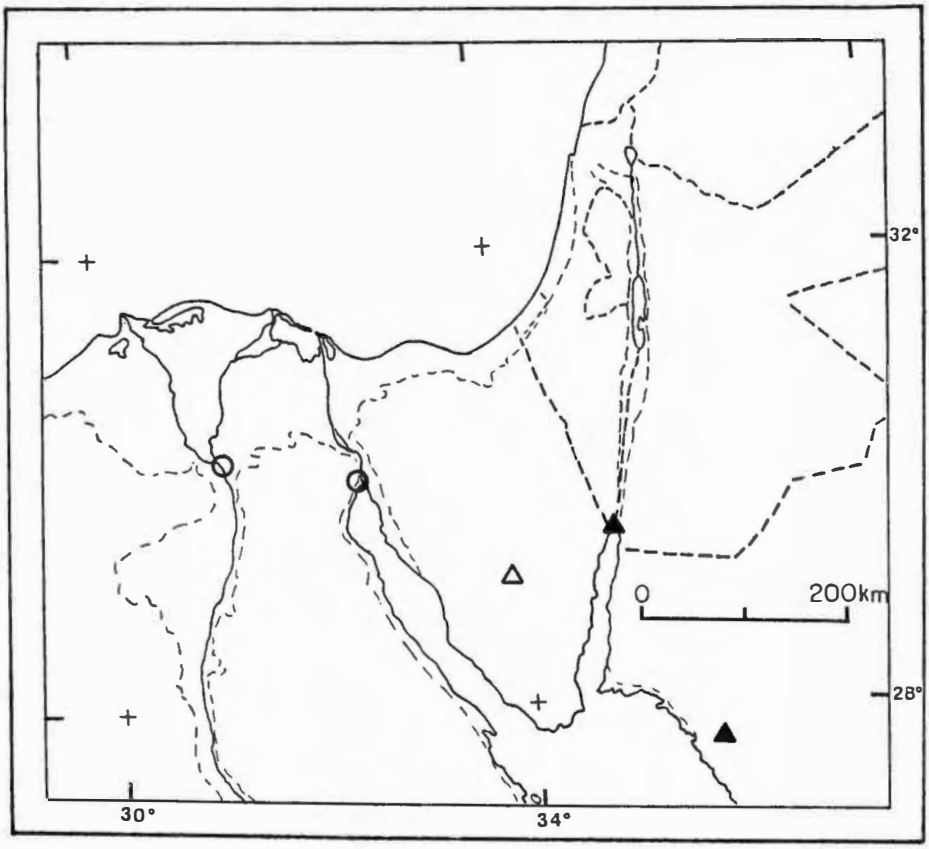

FIG. 28.—Distribution of *Nycticeius schleiffeni* (circles) and *Barbastella barbastellus leucomelas* (triangles). Solid symbols indicate specimens examined, open ones, literature records.

Common names.—Sinai barbestelle, Eastern barbestelle.

General distribution.—Morocco and western Europe across most of southern Europe to the Caucasus. Also known from Eritrea (northern Ethiopia), Sinai, Israel, Iran, Afghanistan to the Himilayas, Honshu, Hokkaido (Japan) and perhaps Indo-China. *Barbastella b. leucomelas* occurs in Sinai, southern Israel, Eritrea, Caucasus (Corbet, 1978:60), and Iran (Neuhauser and DeBlase, 1974).

Distribution in Egypt.—Only in the Sinai peninsula, possibly as a relict (Harrison, 1964; Fig. 28).

Diagnosis.—This is a small bat with medium-sized ears that are joined on the forehead. A long triangular and pointed tragus reaches to more than half the length of the pinnae. The first upper incisors is strongly bicuspid. The canine and the large premolars are in contact, with the first premolar displaced medially.

Remarks.—Because I did not examine the type material, I shall rely here on Harrison's (1964:176-178) description of the holotype and the specimens available to me (see below). Previous authors have distinguished the Sinai barbastelle from the European one by the lack of the projecting lobe in the ear and the generally paler color of the latter. The Sinai barbastelle is also slightly larger. The taxonomic status of the two forms was rendered difficult by the lack of material from or near the type locality in the Sinai. The two specimens from Eilat are slightly larger and darker than the type specimen. The specimens examined from Eilat, "Coast of Arabia", "Erythrea", Gilgit (India) and Szechwan (China) correspond to the description of the Sinai barbastelle by having a simple margin of the ear with no extra lobe. Although the number of specimens is small, the tibia appear to be larger in *B. b. leucomelas* than in *B. b. barbastellus*. *B. b. leucomelas* is also, overall, smaller than *B. b. darjeliensis*, but larger than *B. b. barbastellus* (Tables 21 and 22).

Neuhauser and DeBlase (1974) and DeBlase (1980) reported on a pale specimen from Iran as *B. l. leucomelas* and dark specimens from Iran and Afghanistan as *B. l. darjeliensis*. The holotype of *B. b. leucomelas* was described as having "corporis colore supra nigro; infra ex nigro et albo variegato". Further in the description Cretzschmar (1826:73) emphasizes the dark color of the head, chest, back, and membranes. The pale color of the holotype can be explained by its bleaching, since the specimen stood in exhibition for a long time (Kock, 1969:178). Specimens from Siciliy were reported as intermediate in color between the European and the Sinai specimens (Kock, 1969:178). I concur with Kock (1969) that the present evidence does not justify the separation of two species unless the alleged sympatry in Transcaucas area of the Soviet Union (Kuzyakin in Bobrinski *et al.* 1965, Map 27) is clearly established.

Biology.—Very little is known about the biology of this species. Cretzschmar (1826:73) indicated that this species occurred in old deserted houses. The two specimens collected in Eilat, Israel, were mistnetted in a cultivated area.

Specimens examined.—The specimens I examined are listed in Table 21.

Records of Egyptian specimens not examined.—The only locality record of this species in Egypt is the type locality, Sinai (Cretzschmar, 1826; Rüppel, 1842; Kock, 1969).

Genus ***Plecotus*** É. Geoffroy St.-Hilaire, 1813

Plecotus austriacus christiei Gray, 1838

Vespertilio auritus var B *austriacus* Fischer, 1829:117.

Vespertilio auritus var A *aegyptius* Fischer, 1829:117; junior homonym of *Vespertilio pipistrellus* var *aegyptius ibid.*:105.

Plecotus christii, Gray, 1838:495.

Plecotus auritus aegyptius, Allen, 1939:96.

Plecotus auritus christiei, Ellerman and Morrison-Scott, 1951:181.

Plecotus wardi christiei, Lanza, 1960:15.

Plecotus austriacus christiei, Bauer, 1960:220; Hanak, 1966:64.

TABLE 21.—*Selected external measurements of* Barbastella. *Measurement of the holotype of* leucomelas *from Harrison (1964); Iranian specimens, DeBlase(1980).*

Specimens	HBL	T	TB	HF	E	TR	FA
			B. b. leucomelas				
Holotype		33.2		6.8			37.9
"Coast of Arabia,"							
BMNH 7.1.1.346		42		6.5			37.3
Eilat, Israel							
HUJ 5201♂	50.2	50.2	19.5	6.8	18	14	39.2
HUJ 6304♂	45.0		18.9	7.8	15.8	9.1	38.9
			B. b. darjeliensis				
Gilgit, India							
MCZ 32975♀			20.4	8.5	14.9	7.9	43.2
Szechwan, China							
MCZ 29885♂			18.2	10.0			43.8
			B. b. leucomelas or ***B. b. darjeliensis***				
Sang-e-Sar, Iran	59	58		6.5			37.3
M.R.S. Nat. Park, Iran	66	44		6.8	18		41.6
			Barbastella b. barbastellus				
Rudesdorf, Germany							
MCZ, 4(3♂♂)			17.1(16.7-17.5)	7.9(7.5-8.6)	14.2	7.3	38.3(37.3-38.8

TABLE 22.—*Selected cranial measurements of* Barbastella. *Measurements of the Iranian specimens from DeBlase (1980).*

	GLS	CCL	BBC	POC	ZYGB	C-M3	BCD	M	c-m3
				B. b. leucomelas					
"Coast of Arabia,"									
BMNH 7.1.1.346						4.1		8.8	4.6
Eilat, Israel									
HUJ 5201♂	14.6	12.9	6.4	3.5	7.4	4.4	5.2	8.6	4.9
HUJ 6304♂	14.6	13.0	6.8	3.6	7.8	4.5	5.3	8.7	5.1
				B. b. darjeliensis					
Szechwan, China									
MCZ 29885♂						5.9		11.0	6.8
				B. b. leucomelas or ***B. b. darjeliensis***					
Sang-e-Sar, Iran	16.0		?8.1	3.8	7.8	4.9		10.0	5.4
M.R.S. Nat. Park, Iran	14.2		?8.2	3.5	7.2	4.5		9.8	4.8
				Barbastella b. barbastellus					
Rudesdorf, Germany	15.9	13.9	7.4	4.0	7.7	5.0	5.4	8.8	5.2
MCZ, 2♂♂	14.4	12.9	7.4	3.6	7.5	4.6	5.2	9.0	5.0

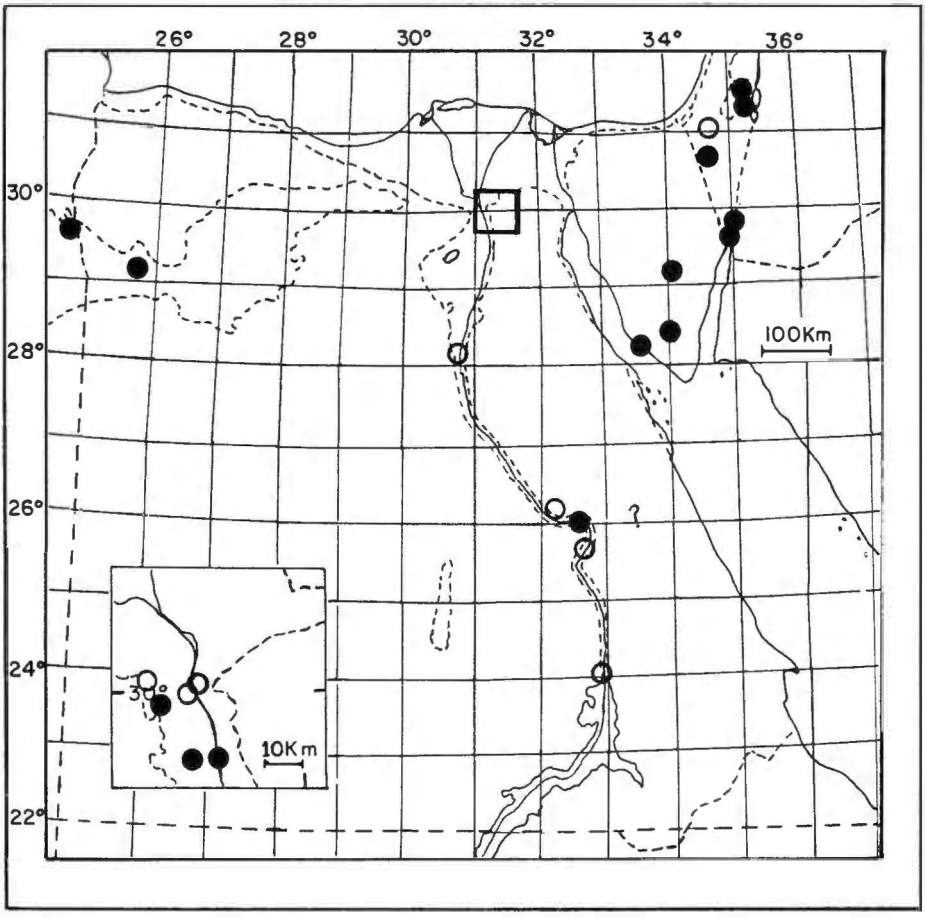

FIG. 29.—Distribution of *Plecotus austriacus christiei*. Solid symbols indicate specimens examined; open ones, literature records; question mark indicates no exact locality.

Type specimen.—BMNH 66a, skin in poor condition, North Africa; Major Turnbell Christie. Holotype. Type locality restricted here to Southern Egypt between Qena and Aswan (see remarks).

Common names.—Grey long-eared bat, Khafash Adhani.

General distribution.—*Plecotus austriacus* occurs from southern Europe and North Africa south to Senegal and Cape Verde Islands in the West (Dorst and de Nourois, 1966) and Ethiopia in the east (Largen *et al.*, 1974), and from Arabia and the Caucasus to the Himalayas, Mongolia and western China.

Distribution in Egypt.—*P. a. christiei* occurs in Sinai, the Nile Valley, and the western desert (Fig. 29).

Diagnosis.—A small long-eared bat; forearm of Egyptian specimens measures 37-41, ears 32-39 (Table 23).

The baculum in this species has a cylindrical style and bifurcated basal plate (Wassif and Madkour, 1972*b*). The description given be Wassif and Madkour (1972*b*) for bacula of Egyptian *Plecotus* appears different from that of the bacula of European specimens of *austriacus* as shown in the diagrams by Lanza (1959, 1960). For this reason, I examined specimens from various areas of North Africa and found a difference in bacular morphology of specimens of the desert areas of Egypt and Libya, and those from Marquis-type areas of Libya, Algeria and Morocco (Fig. 31 and compare with fig. 1 in Lanza, 1960). The bacula of specimens from Jabal Akhdar and Gharian in Libya are clearly similar to those from Europe. The Egyptian specimens are different in having slightly shorter basal plates, which also are more angular than are those of the Jabal Akhdar specimens (Fig. 31). These differences correlate with size differences, the Egyptian specimens having smaller bacula.

Remarks.—The taxonomy on this species in North Africa and the Middle East was rendered difficult by its previous confusion with *P. auritus* (Lanza, 1960; Bauer, 1960; Hanak, 1966). The problem persists because many characters used to distinguish the two species appear to break down in specimens outside Europe (Harrison, 1964; Baker *et al.*, 1974). Recent authors (Kock, 1969; Hayman and Hill, 1971; Anciaux de Faveaux, 1976; Corbet, 1978) followed the tradition of Aellen and Strinati (1969) and Harrison (1964) in using the name *P. austriacus christiei* Gray (1839) for the North African material.

Kock (1969:180) was aware that in North Africa two forms exist, and he stated that "Es ist noch ungeklart, ob in Nordafrika *auritus* neben *austriacus* oder zwei Unterarten von *austriacus*, die typische und *a. christiei*, vorkommen." Examination of bacula and skulls from North Africa corroborate the latter view; specimens of this species from northeastern Libya, Gharian, and Atlas areas of Morocco are more similar to the nominate subspecies than to *christiei* both in size, shape of bacula, and enlargement of the bullae (Fig. 30). The color also corresponds to this arrangement, *P. a. christiei* has a much paler color than the nominate subspecies. The type locality of this form is unfortunately not specific, being merely "North Africa." The type is an old skin with no skull, but by virtue of its color and forearm length it is assumed to have come from a desert locality, and furthermore it is identical to specimens that I have examined from southern Egypt. Gray (1838:495), in describing this latter form, wrote "fur pale, hairs whitish with dusky tips; beneath white." Because all specimens from northwestern Africa and northern Libya are dark in color and larger in size than both the Egyptian specimens and the type, it is further unlikely that the type came from those areas. The type was collected by Major Christie, who made most of his collections in southern Egypt and northern Sudan ("Nubia"). Because of the above mentioned reasons and the need to fix the type locality, I hereby affix southern Egypt (the Nile Valley between Qena and Aswan) as the type

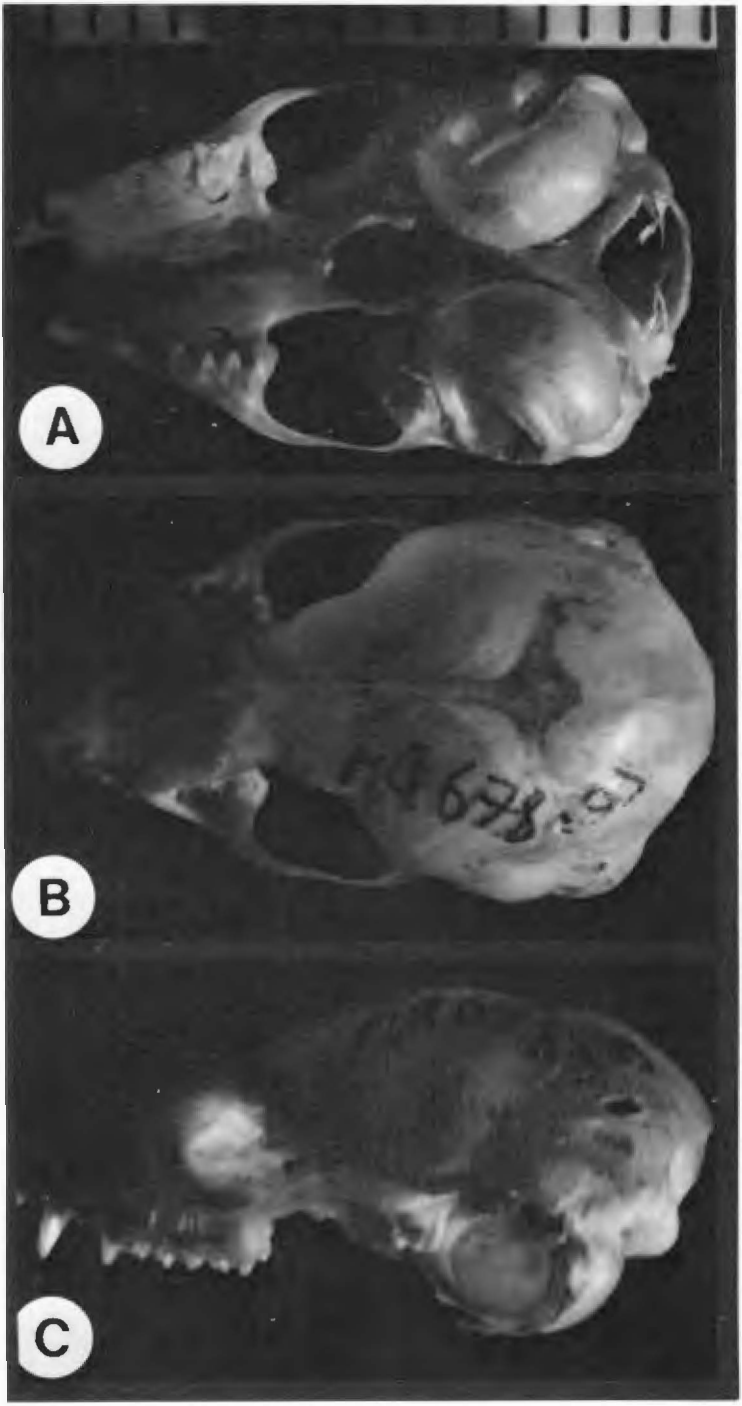

FIG. 30.—Ventral (A), dorsal (B), and lateral (C) views of skull of *Plecotus austriacus christiei* (MQ 678, Dandara Temple, Qena Gov.). Note the large size of the tympanic bullae.

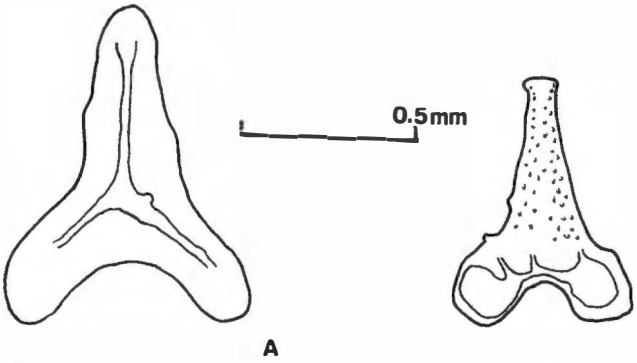

FIG. 31.—Bacula of *Plecotus austriacus austriacus* from Wadi Al Kuf, Jabal Akhdar, Libya (A) and *P. a. christiei* from Dandara Temple, Qena Gov., Egypt (B).

locality. This subspecies occurs throughout the desert areas of North Africa from Algeria to Egypt and extends further into Palestine and Arabia. The difference in cranial dimensions, color, and shape of bacula between *P. a. austriacus* and *P. a. christiei* are so striking that they may justify specific distinctions as suggested by Hayman (1948). The two forms come close together in northeastern Libya: specimens from Jabal Akhdar represent *P. a. austriacus* and those from Giarabub oasis, *P. a. christiei*. Because these two forms are closer to each other phenetically than either is to *Plecotus auritus*, and since they have a parapatric distribution (*P. austriacus austriacus* occurs in the Mediterranean maquis and grassland areas, and *P. austriacus christiei* occurs in desert and subdesert habitats), they are tentatively considered conspecific in this work.

TABLE 23.—Plecotus austricaus: *measurements as in Table 1.*

	Egypt		Israel	
	Males	Females	Males	Females
TL	95(92-96)3	95, 93	95	99
T	44(42-45)3	48, 46	43	50
HF	8.4(8.0-9.0)4	8.0, 8.5	7.6(5-9)7	8.7
E	35(32-37)3	38, 35	37.9(35-39.6)7	38
FA	38.2 ± 1.1(37.0-40.5)8	39.1(38.3-40.5)3	40.2(38.5-41.7)8	41.0
GLS	16.8(16.3-17.1)5	16.8(16.7-17.1)4	17.4(16.8-18.2)4	17.7
CCL	14.7(14.3-15.0)5	14.8(14.6-15.2)4	15.1(14.8-15.5)4	15.7
BBC	8.3(8.1-8.5)5	8.1(8.0-8.3)4	8.2(8.1-8.5)4	8.2
IOC	3.3(3.2-3.4)5	3.3(3.1-3.4)4	3.5(3.4-3.6)4	3.5
ZYGB	8.8(8.6-8.9)4	8.6(8.5-8.6)4	8.7(8.5-8.8)4	8.8
C-M3	5.5(5.3-5.6)5	5.4(5.3-5.7)4	5.7(5.5-6.1)4	6.0
BCD	5.4(5.3-5.5)5	5.3(5.1-5.5)3	5.4(5.1-5.5)4	5.5
M	10.0(9.7-10.3)5	10.0(9.9-10.2)4	10.3(10.0-10.6)4	10.9
c-m3	6.0(5.8-6.1)5	5.8(5.5-6.2)4	6.1(5.7-6.3)4	6.6
CORH	3.3(3.0-3.5)5	3.3(3.2-3.4)4	3.5(3.4-3.6)4	3.6

Biology.—This bat was found in Egypt in dark areas of the pyramids, old monuments, caverns, and old houses (Anderson, 1902:115). In Tunisia, a lactating female was captured on 5 June by Baker *et al.* (1974). I obtained four specimens from the large rooms of Dandara Temple, where the bats were hanging on the sides of the walls.

Specimens examined (52).—The specimens from Jabal Akhdar and Gharian in Libya represent *P. a. austriacus*; all others, *P. a. christiei*. EGYPT: *Sinai*: Jabal El 'Ajmah 5(HUJ); St. Catherine Monastery 1(HUJ); Tor 1(BMNH); Um Hashiba 1(TAU); *Giza*: El Badrshein 3(USNM); Giza Pyramids 2(BMNH); Saqqara 1(CM), 2(FMNH); *Matruh*: Siwa 1(BMNH), 4(FMNH), 6(USNM); *Qena*: Dandara 4(MQ); *Aswan*: Aswan 1(BMNH); *No exact locality*: "Desert variety, Nile" 5(BMNH); "Egypt" 1(MCZ); "5th cataract of the Nile" 1(BMNH). PALESTINE: *Jerusalem*: Mogharet Khureitun 1(BMNH), 1(HUJ), 1(SAM); *Southern*: Avdat 1(HUJ), 1(TAU); Eilat 2(TAU); Timna 1(HUJ); Wadi Khabra 1(HUJ). LIBYA: *Derna*: Giarabub 1(MSNG); *Jabal Akhdar*: 6 km SE Qasr Maqdam 1(MQ); Wadi El Kuf 1(MQ); *Gharian*: Tagherna 1(MQ).

Records of Egyptian specimens not examined.—Red Sea: El Gidda (Frauenfeld, 1856, *fide* Kock, 1969); *Cairo*: Cairo (Hoogstraal, 1962); Giza: Abu Rawash (Heyneman and Macy, 1962); Mena (Anderson, 1902:114). *Minya*: Minya (Anderson, 1902); *Qenya*: Dishna (Flower, 1932); Luxor (Anderson, 1902: 114; Gaisler *et al.*, 1972).

Family MOLOSSIDAE

The contents of this family have been recently reviewed by Freeman (1981), who recognized 12 genera based on morphometric analysis. Only two species of the genus *Tadarida* occur in Egypt.

Key to Species in Egypt

1. Larger, FA greater than 54, GLS greater than 23; mandible with three pairs of lower incisors; skull elongate ..... *Tadarida teniotis*
   Smaller, FA less than 54, GLS less than 22; mandible with two pairs of lower incisors; skull more rounded ..... *Tadarida aegyptiaca*

Genus *Tadarida* Rafinesque, 1814

Tadarida teniotis rueppellii (Temminck, 1827)

Cephalotes teniotis Rafinesque, 1814:12.
Dysopes rüpelii Temminck, 1827:224, pl. 18.
Mops rüpelii, Allen, 1939:108.
Nyctinomus rüpelii, Fitzinger, 1866:545.
Tadarida teniotis rueppelli, Ellerman and Morrison-Scott, 1951:134.

Type locality.—Temminck (1827:225), in describing this form, gave "Egypt" as the locality and wrote that "on le trouve en Egypte dans les souterrains des grands edifice." The species is known only from the Cairo and Giza areas, and the oldest specimens were known only from Cairo's old buildings. I therefore restrict the type locality to Cairo.

Common name.—European free-tailed bat.

General distribution.—This species ranges from Madeira and Canary Islands (Hutterer, 1979), through southern Europe and North Africa to Japan (see Aellen, 1966, for more detail).

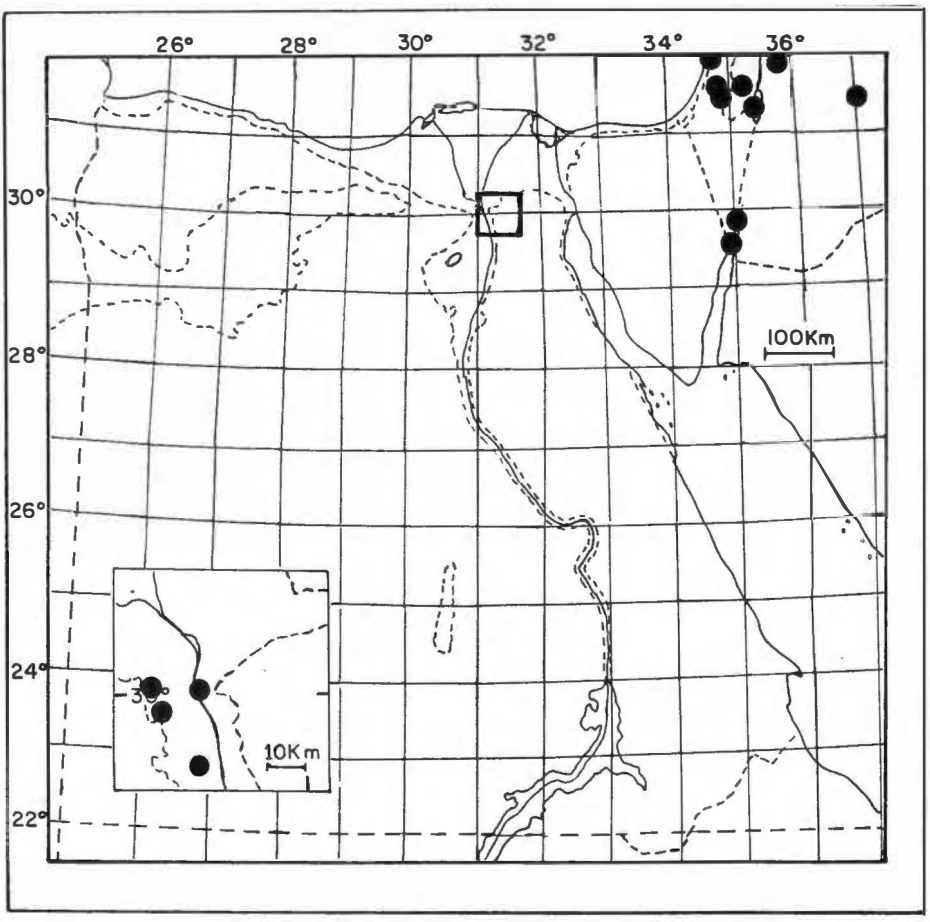

FIG. 32.—Distribution of *Tadarida teniotis*. Solid symbols indicate specimens examined; open ones, literature records.

Distribution in Egypt.—This subspecies is known from Egypt only from the Giza and Cairo areas (Fig. 32). Temminck (1827:225) mentions that his new form was obtained by Rüppel from Arabia, Egypt and "Nubie." I could find no specimens of this species from farther south than Saqqara in Egypt, and it is unlikely that this Palearctic species occurs in southern Egypt or northern Sudan.

Diagnosis.—A large mollosid bat with a forearm of 54.5-63.9, and a greatest length of the skull of 23.2-25.2. In cranial characters, it differs from *T. aegyptiaca* in having larger, more elongate skulls (Fig. 34 and compare with Fig. 35), and three pairs of lower incisors.

Remarks.—Tadarida t. rueppellii was considered to average grayer in color than the nominate subspecies (Harrison, 1964:106). The specimens that I examined showed some individual variation in color; specimens from

Libya are closer to the nominate subspecies than those from Egypt. In size there is little geographic variation (Aellen, 1966), and it is possible that *rueppellii* is consubspecific with the nominate subspecies. One of the specimens examined from Abu Rawash is an immature specimen (FMNH 91483) in alcohol and was previously referred to *T. aegyptiaca*.

Biology.—This bat inhabits narrow crevices in caves and other rocky habitats (Harrison, 1964:108). The species roosts in small caves in the area of Abu Rawash and Giza. In Lebanon, Lewis and Harrison (1962) obtained pregnant females, each with a single well-developed embryo, on 31 May. They estimated the time of birth at Mid-June.

Specimens examined (76).—EGYPT: *Cairo*: Cairo 1(USNM), 1(ZMUC); *Giza*: Abu Rawash 6(BMNH), 25(FMNH), 11(USNM); Giza Pyramids 3(BMNH), 1(FMNH), 1(USNM); Saqqara 1(USNM); *No exact locality*: Egypt 4(FMNH), 10(USNM). PALESTINE: *Coastal*: Jaffa 3(TAU); *Jerusalem*: Jerusalem 2(HUJ); *Southern*: Beit Guvrin 1(HZM); Eilat 1(TAU); Ein Geddi 1(TAU); Yotvata 1(TAU). JORDAN: *Amman*: Faidhat ad Dahikiya 2(SAM); Jbeiha 1(SAM).

Tadarida aegyptiaca aegyptiaca (É. Geoffroy St.-Hilaire, 1818)

Nyctinomus aegyptiacus É. Geoffroy St.-Hilaire, 1818:128.
Dysopes geoffroyi Temminck, 1827:226, pl. 19, substitute for *aegyptiacus* É. Geoffroy St.-Hilaire.
Nyctinomus geoffroyi, Fitzinger, 1866:545.
Nyctinomus aegyptiacus, Allen, 1939:110.
Tadarida aegyptiaca aegyptiaca, Ellerman and Morrison-Scott, 1951:134.

Type specimen.—MNHN A.467; adult male; in alcohol, with skull extracted; Egypt (Dobson, 1878:424; Rode, 1941:251). Holotype. Koopman (1975:422) restricted the type locality to Giza, where "other bats described by É. Geoffroy originated."

Common name.—European free-tailed bat.

General distribution.—Most of the Ethiopian region, north to the Algerian Sahara and Egypt, east through Arabia, Iran, Pakistan, and India to Sri Lanka.

Distribution in Egypt.—The nominate subspecies occurs in Giza and the Red Sea Governorates (Fig. 33).

Diagnosis.—This is a medium-sized *Tadarida*, FA 47-55.4, GLS 20.3-21.9. The skull is distinguished from that of *T. teniotis* by being smaller and relatively shorter (Figs. 34 and 35). Only two pairs of lower incisors occur in this species.

Biology.—This bat seems to prefer semiarid regions (Brosset, 1962) and it roosts in caves and large buildings (Rosevear, 1965). It was also found under stone slabs on a hillside in Zimbabwe (Irwin and Donnelly, 1962). In Egypt, the available specimens were mostly obtained from crevices in caves in the Abu Rawash and Giza areas.

The distribution of this species is spotty, most probably due to difficulty of finding roosts by collectors and the rare employment of mistnetting in capturing this species. As an example, a specimen taken by mistnetting has recently been recorded from 110 km. N Tamanrasset in Algeria, a distance

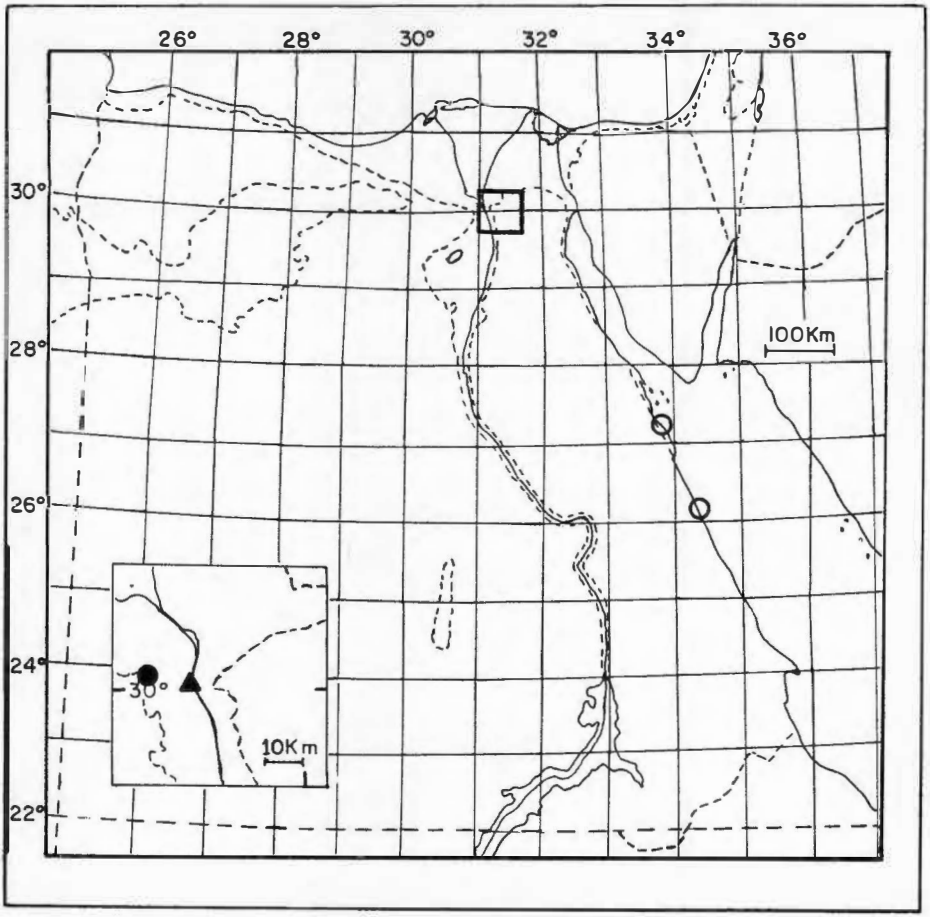

FIG. 33.—Distribution of *Tadarida aegyptiaca*. Solid symbols indicate specimens examined; open ones, literature records; solid triangle, type locality.

of several hundred kilometers from the nearest known locality (Schlitter and Robbins, 1973). I also collected several specimens in Tamanrasset and one in Beni Abbes in Algeria. In those two areas, reproductively active females were obtained between dusk and midnight, on 16 May and 3 June 1981.

Specimens examined (26).—EGYPT: *Giza*: Abu Rawash 3(BMNH), 10(FMNH), 12(USNM); Giza 1(BMNH).

Records of Egyptian specimens not examined.—Red Sea: 20 km. S Ghardaga (Kock, 1969); Quseir (Klunzinger, 1878, *fide* Kock, 1969); *No exact locality*: "Cataract of the Nile" (Dobson, 1878).

DELETIONS FROM THE FAUNAL LIST OF EGYPTIAN BATS

The following species have been reported erroneously from Egypt in the literature and are discussed here.

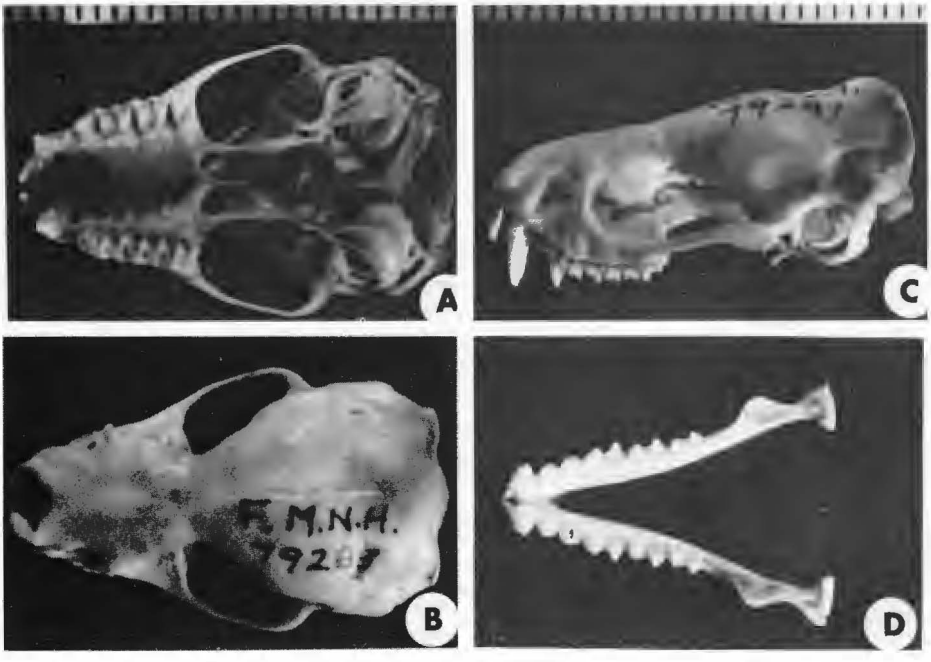

FIG. 34.—Ventral (A), dorsal (B), and lateral (C) views of skull and mandible (D) of *Tadarida teniotis* (FMNH 79283 from Abu Rawash, Giza Gov.).

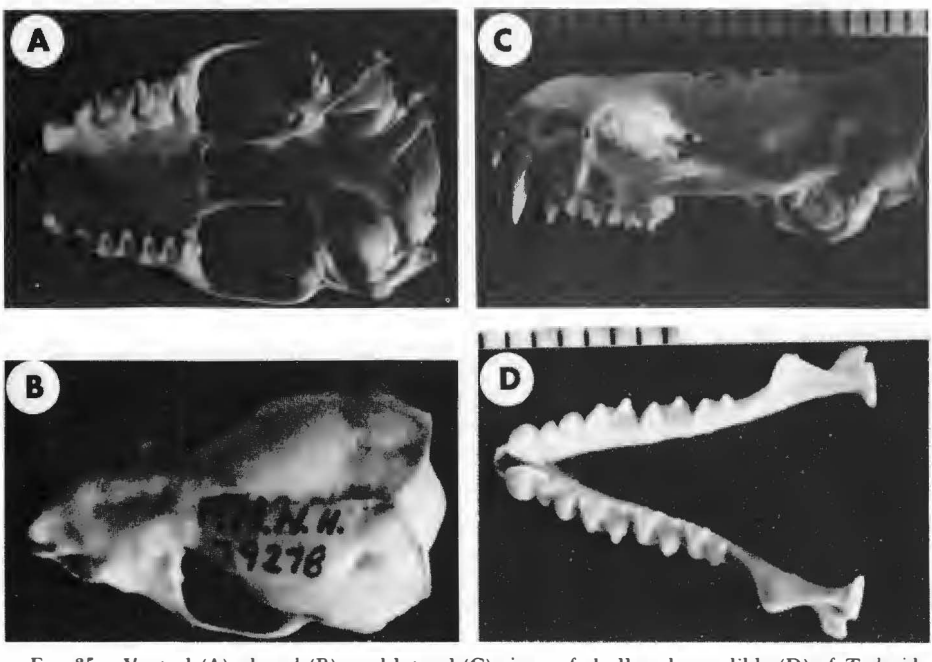

FIG. 35.—Ventral (A), dorsal (B), and lateral (C) views of skull and mandible (D) of *Tadarida aegyptiaca* (FMNH 79278 from Abu Rawash, Giza Gov.).

TABLE 24.—Tadarida aegyptiaca *and* T. teniotis: *measurements as in Table 1.*

Variate	*Tadarida aegyptiaca*	*Tadarida teniotis*	
	Egypt	*Egypt*	Kuf Nat. Park, Libya
TL	112.1 ± 5.5(104-120)10	127.7 ± 5.4(122-139)11	127.8 ± 5.7(119-136)12
T	44.0 ± 2.2(41-46)10	46.2 ± 3.1(40-52)12	43.2 ± 3.8(37-48)12
HF	8.5 ± 0.6(8-9.5)10	11.0 ± 1.4(9.5-13)11	11.5 ± 0.7(10-12.5)12
E	20.2 ± 2.0(18-23)10	28.3 ± 3.8(18-33)11	28.6 ± 2.0(25-31)12
FA	53.3 ± 1.7(50-55.4)10	61.1 ± 1.7(58-63)7	59.6 ± 2.0(57-63)12
GLS	21.0 ± 0.4(20.6-21.9)9	23.9 ± 0.4(23.2-24.3)7	23.8 ± 0.5(23.2-24.8)12
CCL	19.1 ± 0.5(18.6-20.2)10	21.5 ± 0.8(20.0-22.4)7	21.8 ± 0.5(21.1-22.6)12
BBC	10.5 ± 0.3(10.0-11.0)10	12.1 ± 0.3(11.7-12.7)7	11.9 ± 0.3(11.6-12.8)12
IOC	4.5 ± 0.1(4.4-4.7)9	5.0 ± 0.4(4.6-5.8)7	4.7 ± 0.2(4.5-5.1)12
ZYGB	12.6 ± 0.2(12.3-13.0)8	13.9 ± 0.4(13.5-14.5)7	13.8 ± 0.5(13.1-15.1)12
C-M3	7.6 ± 0.3(7.3-8.2)10	8.8 ± 0.2(8.5-9.0)7	8.7 ± 0.2(8.5-9.0)12
BCD	6.5 ± 0.2(6.2-7.0)9	7.2 ± 0.4(6.5-7.6)7	7.3 ± 0.3(7.2-7.8)11
M	14.1 ± 0.3(13.8-14.8)10	16.4 ± 0.4(15.7-16.7)7	16.3 ± 0.4(15.8-17.0)12
c-m3	8.8 ± 0.3(8.3-9.5)10	10.0 ± 0.2(9.6-10.2)7	9.8 ± 0.2(9.5-10.2)12
CORH	5.0 ± 0.2(4.6-5.5)10	4.8 ± 0.3(4.3-5.0)7	4.8 ± 0.3(4.5-5.3)12

Rhinolphus euryale Blasius, 1853.—DeBlase (1972) discussed the numerous misidentifications of this bat in Southwest Asia and Egypt. All specimens that I examined from Egypt previously referred to this species I found to be clearly identifiable as *R. mehelyi* (see systematic remarks under *R. mehelyi* in species accounts.

Trianops persicus Dobson, 1871.—Allen (1939) and Ellerman and Morrison-Scott (1951) included Egypt in the range of this species in their checklists. I found no other reference to this species from Egypt in the literature and agree with Harrison (1964) that it probably does not occur in Egypt.

Pipistrellus savii Bonaparte, 1837.—Rüppel (1842:156) reported on a specimen from Suez, which he doubtfully identified as this species. Harrison (1961) referred this specimen to *Nycticeius schlieffenii* Peters, 1859.

Chaerephon major (Trouessart, 1897; generic status from Freeman, 1981).—The species was described by Trouessart (1897:146) from "Nilus Super." De Winton (in Anderson, 1902:155) stated that the type specimen in the British Museum (Natural History) was "collected by Mr. Francis Galton above Assuan (First Cataract)." Kock (1969:148) indicated that the type came from an area on the fifth cataract of the Nile, north of Berber, Sudan. The type specimen I examined in the British Museum has a label that only indicates "Cataract of the Nile." I agree with Kock (1969:148) that the locality can be safely fixed to north of Berber.

ZOOGEOGRAPHICAL ANALYSIS

The flora of North Africa encompasses elements from the Holarctic Floral Empire and the Paleotropical Floral Empire (Ozende, 1977). Most of Egypt is part of the largest stretch of desert which extends from Mauritania to Arabia and southwestern Asia to northwestern India. Because of its unique

flora, this area was named the Saharo-Sindian phytogeographic region (see Atallah, 1977). This area was considered a subregion of the Palearctic (Zohary, 1973) or a transition zone between the Palearctic and the Paleotropical regions (Muller, 1973:7). The mammals of the Sahara and Arabia, including most of Egypt, were also termed Saharo-Sindian (Harrison, 1964; Ranck, 1968; Atallah, 1977). The flora and fauna of North Africa, however, changed drastically in the Pleistocene. Arambourg (1966) argued that during the Tertiary, there was an essentially endemic African fauna, which was preserved until the Quaternary, towards the end of which "certain Eurasian elements penetrated to North Africa, probably by way of the Near East and Suez" (p. 63). It is of interest to investigate the importance of Egypt and the Nile Valley for mammal distributions as an area connecting Africa, Asia, and Europe.

Osborn and Helmy (1980) only marginally touched on the zoogeography of the land mammals of egypt. Because of this and because an analysis based on bats only may not be as productive as that taking into account all mammals, I shall discuss here the general mammal distributions and compare distributions of bats with those of other mammals. I will discuss the distribution of the mammals within Egypt, then summarize the status of the bat species occuring in Egypt, and last try to draw generalizations regarding the biogeographical implications of the general mammal distributions.

The distributions of mammals in the southwestern Palearctic is not as well known as that of other areas, such as Europe or North America. That area has been little collected, and the research was mostly done by Europeans on short tours through the mostly hostile area. The results were published in many languages and in obscure journals (see Bibliography). There are, however, certain areas within the southwestern Palearctic that have been well collected because of historic, political, or other reasons. Thus, choosing random areas for analysis of distributions would be meaningless because the areas vary in the mammalian knowledge from being well known to almost not investigated.

Various authors have employed the index of "faunistic congruence" (Wallin, 1969:374) in studying the faunal relationships of bats. The use of this index was extended traditionally and applied in Old World bat studies (Gaisler *et al.*, 1972; Nader, 1978; DeBlase, 1980). This index was used to compute "similarity" between large political entities, which may include more than one phytogeographic region. As an example, the index for relationship of Arabia to adjacent areas may be significantly changed if one includes the mostly Ethiopian southwestern region. Gaisler *et al.* (1972) gave the values for this index for bats between Egypt and each of Europe, the "Maghreb," Arabia and the Sudan, respectively. They found that the highest correlation was between Egypt and Arabia.

I have chosen for analysis of the distributions 20 areas extending from southern Spain and northwestern Africa to Afghanistan (Fig. 36). Those

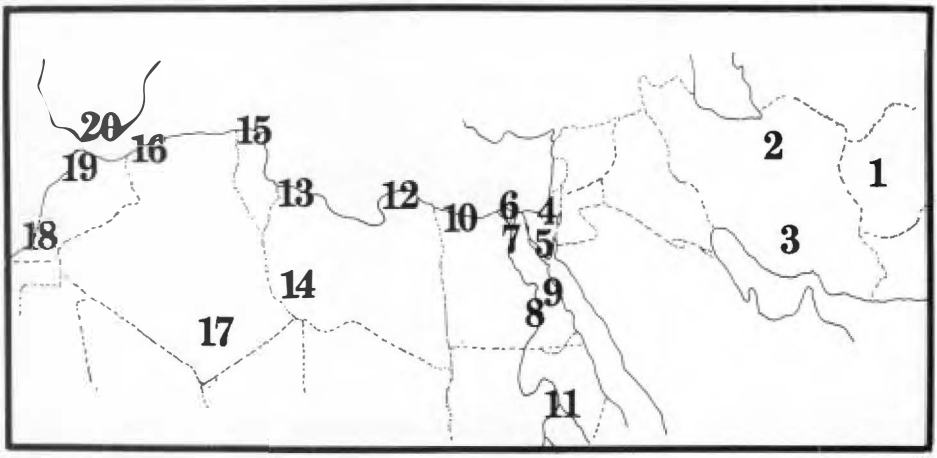

FIG. 36.—A map of areas in North Africa and adjacent areas chosen for cluster analysis of mammal distributions. For area definitions see text.

areas were chosen because they span the area of most interest, because their mammals are well known both in taxonomy and distribution, and because they include areas in the Ethiopian and Palearctic regions. The areas chosen are defined below, and references to the source of data on the mammal distribution other than those from Corbet (1978), are given:

1. Afghanistan: The political boundaries but excluding eastern Afghanistan where Oriental mountain forms such as *Macaca mulatta* occur (Hassinger, 1973; Gaisler, 1970*a*, *b*).
2. Northern Iran: For a definition of this and the next area, see DeBlase (1980:265-266). References are those of Lay (1967) and DeBlase (1980).
3. Southern Iran: Lay (1967); DeBlase (1980).
4. Palestine: The area between the Mediterranean and the River Jordan and the Dead Sea, excluding the Negev desert. Atallah (1977).
5. Sinai: The deserts of Sinai (including the Suez area) and the Negev desert. Data for this and the next five areas are taken from Haim and Tchernov (1974), Osborn and Helmy (1980), and this work.
6. Nile Delta: The delta of the Nile between Rosetta and Damietta and north of Cairo.
7. Lower Egypt excluding the Delta: Cairo and Giza areas, which are the areas best known faunistically in Egypt.
8. Southern Nile of Egypt: Qena and Luxor areas are not as well known as the other areas of Egypt but include some interesting mammals, such as *Pipistrellus aegyptius*.
9. Eastern Desert: Includes the Sudan Administrative area and Northern Kassala province of Sudan.
10. Western coastal desert: The coastal area west of the Delta of the Nile to the Libyan borders.

11. Khartoum area of the Sudan: The boundaries of the province of Khartoum. Setzer (1956), Happold (1967), Kock (1969), and Koopman (1975).
12. Jabal Akhdar and Cyrenaican Plateau: For a definition of this area see Qumsiyeh and Schlitter (1982). Distribution of mammals in Libya (this and the next two areas) were taken from Zavattari (1934), Toschi (1954), Setzer (1957), Ranck (1968), and Hufnagel (1972).
13. Tripoli area/Libya: Coastal region from Tunisian borders to Tripoli represented by the Gefara plains (Qumsiyeh, 1983).
14. Fezzan region.
15. Northern Tunisia: Tunisia excluding the desert areas of the south. Lataste (1887*a*).
16. Oran/Algeria: Mountains and coastal regions of northwestern Algeria. Seurat (1930), Kowalski (1979).
17. Ahaggar/Algeria: The mountain regions of southern Algeria from Tamanrasset to Djanet. Foley (1922), Seurat (1930), and Dekeyser (1950).
18. Southwestern Morocco: The Anti Atlas mountains and the coastal region in the west. Agacino (1935), Cabrera (1932), Panouse (1957).
19. Northern Morocco: Morocco north of the latitude line passing at Casablanca. Cabrera (1932), Panouse (1957).
20. Southern Spain: South of Cordoba. Cabrera (1914), Agacino (1937).

It was apparent upon performing the phenetic analysis that various methods produce somewhat different clusters. The reasons for that are two-fold. First, some clustering techniques are intended for continuous measurements, and distribution data are not continuous. Second, the programs give equal weight to the presence as to the absence of species, and, as such, some species or areas group together because they share absences, or "zeroes" in the data. NTSYS package (Rohlf *et al.*, 1974) proved to be by far the most useful package for the analysis of the distributions because the data could be coded as presence/absence of species and the resulting matrix could be checked with the original one and a cophenetic correlation coefficient could be obtained. The package has a routine (SIMQUAL), which can process qualitative data. I first used Jaccard's and Dice's coefficients to establish a matrix of area similarity. I used an unweighted pair-group method using arithmetic averages (UPGMA) to perform a cluster analysis on those. To test whether bats conform to the overall results of the analysis, I ran the same program summarized above on all mammal species (217), on land mammals alone (148) and on bats (69). The phenograms of the areas resulting from this are presented in Figs. 37A, 37B, and 37C, respectively. The original data used are presented in Table 25 for reference. The UPGMA method, using taxonomic distance, was found to be the clustering algorithm that produces the highest cophenetic correlation (Presch, 1979).

When comparing the distributions of bats to the land mammals, it was apparent that there is little similarity in the clustering results (Fig. 37).

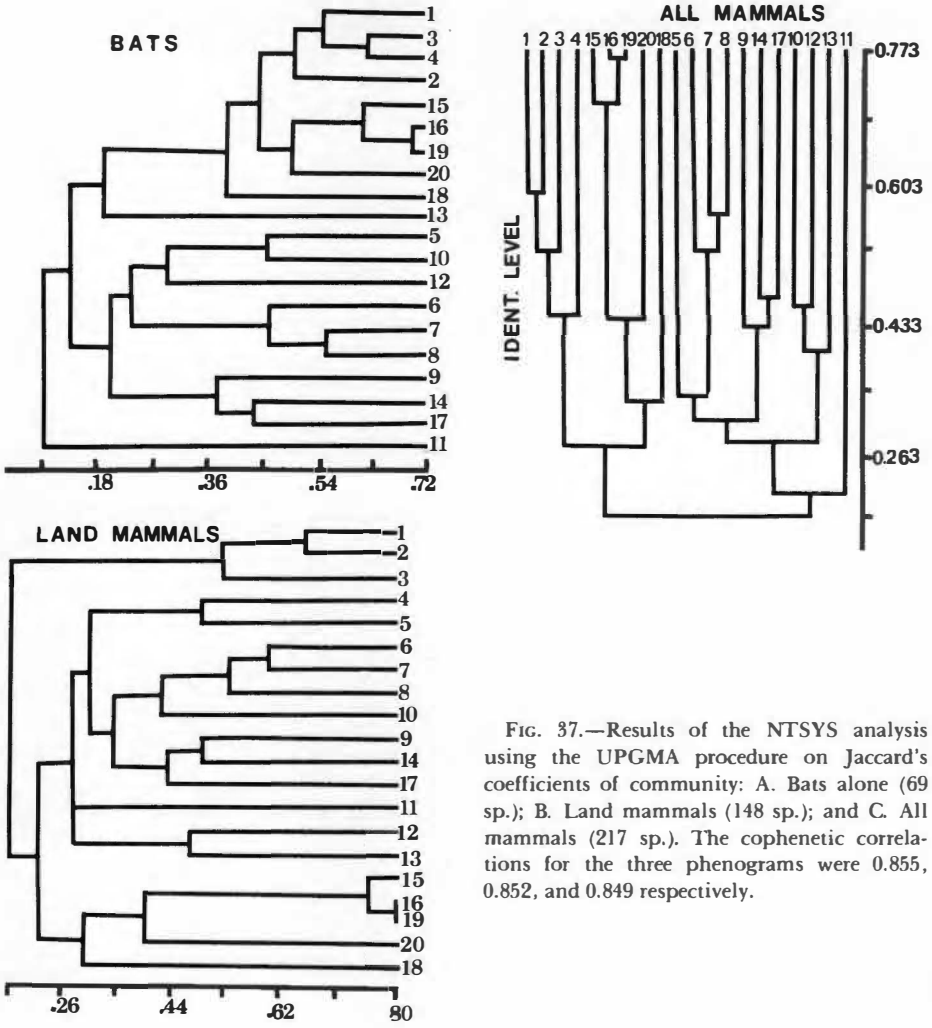

FIG. 37.—Results of the NTSYS analysis using the UPGMA procedure on Jaccard's coefficients of community: A. Bats alone (69 sp.); B. Land mammals (148 sp.); and C. All mammals (217 sp.). The cophenetic correlations for the three phenograms were 0.855, 0.852, and 0.849 respectively.

Southern Iran groups with the other Saharo-Sindian areas when using land mammals but groups with the nearby areas of northern Iran, Afghanistan, and Palestine when using the bats. With the major clusters, areas 15, 16, 19, and 20 (northwestern Africa and southern Spain) are closer to the above areas when using the bats than when using the land mammals alone. The apparent anomalies could be explained by the fact that many Palearctic bats are widespread and, as such, occur in all of the northern areas 1, 2, 3, 4, 15, 16, 19, and 20, whereas the land mammals are not as widespread. This explanation seems to hold true for the southern bats and land mammals as exemplified by area 11, which lies at the edge of the Savanna belt of Africa. If the subspecies of bats were included in the analysis, one would expect them to conform to the results of the analysis of the species of land

mammals. Thus, the ability to disperse does not by itself exclude the bats from the zoogeographic analysis. Bats, like other mammals, are specific in their distributions to the areas of suitable habitat, and the only difference is that they are able to extend their range into areas of suitable habitats more readily than can other mammals. The land mammals seem to substantiate the division of the southwestern Palearctic to three components (at the identification level of 0.261 in Fig. 37B): 1) Palestine, northern Iran, and Afghanistan; 2) Northwestern Africa and southern Spain; and 3) The rest of the areas, which can be grouped as the Saharo-Sindian elements. Area 11 was grouped with many others when using the land mammals, but was grouped separately when using the bats alone or both the bats and land mammals. This could be due to the fact that the bats of this area are known much better than are the land mammals; only a few species of land mammals are recorded from that area, and even in those, the taxonomy is poorly known.

Climatically and phytogeographically, Egypt can be divided into the following five regions (modified from Osborn and Helmy, 1980):

1. Western Desert: The Mediterranean coastal desert zone and the desert west of the Nile Valley.
2. Northern Egypt: The area of the Nile Valley north of Qena Governorate.
3. Southern Egypt: A limited area of the Nile Valley south of Qena.
4. Eastern Desert: The desert area between the Red Sea and the Nile Valley of 100 m or more in elevation.
5. Sinai: This area is not as easily defined as might be thought at first glance. The coastal area represents an extension of the Eastern Mediterranean coastal region. On the other hand, the "Negev" Desert is clearly an extension of the Sinai Desert. For consistency, I will use the term Sinai to refer to the political boundaries of Sinai (not including the Gaza Strip).

Though the Nile River itself does not seem to be an effective barrier to dispersal, the lower Nile Valley, and especially the delta region, has acted as a climatic-vegetation barrier for mammals adapted to desert and subdesert conditions. A number of land mammals, especially those limited to the Mediterranean coastal desert zone, occur only to the west of the Nile Valley: *Dipodillus campestris*, *D. Simoni*, *Meriones shawi*, *Spalax leucodon aegyptiacus*, *Allactaga tetradactyla*, *Jaculus jaculus*, *Poecilictis libyca*, *Gazella leptocerus*, *G. dorcas dorcas*, and previously *Oryx dammah*, *Addax nasomaculatus*, and *Alcelaphus buselaphus*. Others such as *Dipodillus dasyurus*, *Sekeetamys calurus*, *Acomys russatus*, *Caracal caracal schmitzi*, and *Capra ibex* occur only in the desert and subdesert areas east of the Nile Valley (that is, do not enter the lowlands).

In the few cases in which desert-adapted species do occur both east and west of the Nile Valley, they often have distinct subspecies. Examples include *Dipodillus henleyi*, *Meriones crassus*, and *Psammomys obesus*. On

TABLE. 25.—*Distributions of mammals in 20 areas in the southwestern Palearctic Region and surrounding areas. See text for definitions of areas. Presence is indicated by a plus sign; absence, a minus sign.*

	Area																			
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Erinaceus europaeus	−	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Erinaceus algirus	−	−	−	−	−	−	−	−	−	−	−	+	+	−	+	+	−	−	+	+
Hemiechinus auritus	+	+	+	+	+	+	+	−	−	−	−	+	−	−	−	−	−	−	−	−
Paraechinus aethiopicus	−	−	−	+	+	+	+	+	+	+	+	+	−	−	+	−	+	−	−	−
Paraechinus hypomelas	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Neomys fodiens	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Crocidura floweri	−	−	−	−	−	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−
Crocidura religiosa	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−
Crocidura suaveolens	+	−	−	+	+	−	−	−	−	−	−	−	−	−	−	+	−	+	+	+
Crocidura russula	+	+	−	+	+	−	−	−	−	−	−	−	−	−	+	+	−	−	+	+
Crocidura leucodon	−	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Crocidura lasia	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Crocidura flavescens	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
Crocidura sericea	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−
Crocidura lusitania	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−
Suncus murinus	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Suncus etruscus	+	+	−	+	−	+	−	−	−	−	−	−	−	−	+	+	−	−	+	+
Talpa caeca	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Talpa streeti	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Elephantulus rozeti	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	+	−	+	+	−
Eidolon helvum	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Rousettus aegyptiacus	−	−	+	+	−	+	+	+	−	−	+	−	−	−	−	−	−	−	−	−
Epomophorus gambianus	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Epomophorus labiatus	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Rhinopoma hardwickei	+	−	+	+	−	+	+	+	−	−	+	−	−	−	+	−	−	+	−	−
Rhinopoma microphyllum	+	−	+	+	−	+	+	+	−	−	+	−	−	−	−	−	−	+	−	−
Rhinopoma muscatellum	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Coleura afra	−	−	−	−	−	−	−	−	+	−	+	−	−	−	−	−	−	−	−	−
Taphozous perforatus	−	−	+	−	−	+	+	+	+	−	+	−	−	−	−	−	−	−	−	−
Taphozous nudiventris	+	+	+	+	−	−	+	+	+	−	+	−	−	−	−	−	+	−	−	−
Nycteris thebaica	−	−	−	+	+	+	+	+	−	−	+	−	−	−	−	−	−	+	−	−
Nycteris hispida	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Nycteris macrotis	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Lavia frons	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Rhinolophus ferrumequinum	+	+	+	+	−	−	−	−	−	−	−	−	−	−	+	+	−	−	+	+
Rhinolophus clivosus	+	+	−	+	+	+	+	+	+	+	+	+	−	+	−	+	+	−	−	−
Rhinolophus simulator	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Rhinolophus hipposideros	+	+	+	+	+	−	−	−	−	−	−	−	−	−	+	−	−	+	+	+
Rhinolophus landeri	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Rhinolophus fumigatus	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Rhinolophus euryale	−	+	+	+	−	−	−	−	−	−	−	−	−	−	+	+	−	−	+	−
Rhinolophus mehelyi	−	+	+	+	−	+	+	−	−	+	−	+	−	−	+	+	−	+	+	+
Rhinolophus blasii	+	+	+	+	−	−	−	−	−	−	−	−	−	−	+	+	−	−	+	−
Hipposideros caffer	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	+	+	+	−
Asellia tridens	+	−	+	+	+	−	+	+	+	+	+	−	−	+	−	−	+	+	−	−
Trianops persicus	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Myotis mystacinus	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+

TABLE 25.—*Continued.*

Myotis emarginatus	+	+	+	+	−	−	−	−	−	−	−	−	−	−	+	−	+	+	−
Myotis nattereri	−	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+
Myotis bechsteini	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Myotis myotis	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Myotis blythi	+	+	+	+	−	−	−	−	−	−	−	+	−	+	+	−	+	+	+
Myotis formosus	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Myotis daubentoni	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Myotis capaccinii	−	−	+	+	−	−	−	−	−	−	−	−	−	−	+	−	−	+	+
Pipistrellus pipistrellus	+	+	+	+	−	−	−	−	−	−	+	−	−	+	+	−	−	+	+
Pipistrellus kuhlii	+	+	+	+	+	+	+	−	−	+	+	−	+	+	−	+	+	+	
Pipistrellus aegyptius	−	−	−	−	−	−	−	+	−	−	−	−	−	+	−	−	+	−	−	−
Pipistrellus savii	+	+	+	+	−	−	−	−	−	−	−	−	−	+	+	+	+	+	+
Pipistrellus bodenheimeri	−	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Pipistrellus rusticus	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Pipistrellus ariel	−	−	−	−	−	−	−	−	+	−	+	−	−	−	−	−	−	−	−
Pipistrellus rueppellii	−	−	−	−	−	−	+	+	−	−	+	−	−	−	−	−	+	+	−	−
Nyctalus leisleri	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Nyctalus noctula	−	+	−	+	−	−	−	−	−	−	−	−	−	−	+	−	−	+	+
Nyctalus lasiopterus	−	+	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−
Eptesicus nasutus	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Eptesicus bobrinski	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Eptesicus nillsoni	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Eptesicus walli	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Eptesicus rendalli	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Eptesicus floweri	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Eptesicus bottae	−	+	+	+	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−
Eptesicus serotinus	+	+	+	+	−	−	−	−	−	−	−	+	−	+	+	−	+	+	+
Vespertilio murinus	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Otonycteris hemprichi	+	+	−	+	+	−	+	−	+	+	−	−	−	+	−	−	+	−	−	−
Nycticeius schlieffeni	−	−	−	−	+	−	+	−	−	−	+	−	−	−	−	−	−	−	−	−
Scotoecus hirundo	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Scotophilus nigrita	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Barbastella barbastellus	+	+	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+
Plecotus austriacus	+	+	+	+	+	−	+	+	−	+	−	+	+	−	+	+	−	+	+	−
Miniopterus schreibersii	+	+	+	+	−	−	−	−	−	−	−	+	−	−	+	+	−	+	+	+
Tadarida teniotis	+	+	+	+	−	−	+	−	−	−	−	+	−	−	−	−	−	−	−	+
Tadarida aegyptiaca	−	−	+	−	−	−	+	−	+	−	−	−	−	−	−	+	−	−	−	−
Tadarida major	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Tadarida pumila	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Tadarida condylura	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Tadarida demonstrator	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Tadarida midas	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Macaca sylvanus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	+	+	+
Ochotona rufescens	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Lepus capensis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oryctolagus cunnicculus	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	+	+	+
Sciurus vulgaris	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Sciurus anomalus	−	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Atlantoxeros getulus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	+	−
Xerus erythropus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−
Spermophilopsis leptodac	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Spermophilus citellus	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−

TABLE 25.—*Continued.*

Spermophilus fulvus	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Callomyscus bailwardi	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Cricetulus migratorius	+	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Mesocricetus auratus	−	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Arvicola terrestris	−	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Arvicola spidus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Pitymys aphghanus	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Pitymys duodecimcostatus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Microtus nivalis	−	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Microtus socialis	+	+	+	+	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−
Microtus transcaspicus	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Microtus cabrerae	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Ellobius fuscicap	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Gerbillus campestris	−	−	−	−	+	+	−	+	+	+	−	+	+	+	+	+	+	+	−
Gerbillus nanus	+	−	+	+	+	−	−	−	−	−	−	−	+	+	−	−	−	−	−
Gerbillus dasyurus	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Gerbillus henleyi	−	−	−	+	+	+	+	−	+	−	−	+	−	−	−	+	−	−	−
Gerbillus gerbillus	−	−	−	+	+	+	+	+	+	+	−	−	+	+	+	−	+	−	−
Gerbillus andersoni	−	−	−	+	+	+	+	−	−	+	−	+	−	−	−	−	−	−	−
Gerbillus pyramidium	−	−	−	+	+	+	+	+	+	+	−	−	+	+	−	−	+	−	−
Gerbillus perpallidus	−	−	−	−	−	+	−	−	−	+	−	−	−	−	−	−	−	−	−
Gerbillus aureus	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−
Gerbillus cheesmani	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Gerbillus hoogstraali	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−
Gerbillus occiduus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−
Dipodillus simoni	−	−	−	−	−	−	−	−	−	+	−	+	+	−	+	−	−	−	−
Dipodillus amoenus	−	−	−	−	−	+	+	−	+	+	−	−	−	+	−	−	−	−	−
Dipodillus maghrebi	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−
Tatera indica	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Pachyuromys duprasi	−	−	−	−	−	−	−	−	−	+	−	−	+	−	−	−	+	+	−
Sekeetamys calurus	−	−	−	+	+	−	+	−	+	−	−	−	−	−	−	−	−	−	−
Meriones persicus	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Meriones vinogradovi	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Meriones tristrami	−	+	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Meriones meridianus	+	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Meriones shawi	−	−	−	−	−	−	−	−	−	+	−	−	−	−	+	+	−	+	+
Meriones libycus	+	+	+	+	−	−	−	−	−	+	−	+	+	−	−	−	+	+	−
Meriones caudatus	−	−	−	−	−	−	−	−	−	−	−	+	+	+	−	−	−	−	−
Meriones crassus	+	+	+	+	+	−	+	−	+	+	+	−	−	+	−	−	+	+	−
Meriones sacramenti	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Meriones zarudnyi	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Psammomys obeses	−	−	−	+	+	+	−	−	−	+	−	+	−	−	−	−	−	+	−
Spalax leucodon	−	−	−	+	−	−	−	−	−	+	−	+	−	−	−	−	−	−	−
Apodemus mystacinus	+	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Apodemus flavicollis	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Apodemus sylvaticus	+	+	+	+	−	−	−	−	−	−	−	−	−	+	+	−	−	+	+
Arvicanthis niloticus	−	−	−	−	−	+	+	+	−	+	+	−	−	−	−	−	−	−	−
Lemniscomys barbarus	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	−	−	+	−
Rattus rattus	+	+	+	+	+	+	+	+	−	+	+	+	+	−	+	+	−	+	+
Rattus norvegicus	+	+	+	+	−	+	+	+	+	−	−	−	−	+	−	−	−	−	+
Rattus rattoides	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Mus musculus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

TABLE 25.—*Continued.*

Acomys russatus	−	−	−	+	+	−	+	−	+	−	−	−	−	−	−	−	−	−	−
Acomys cahirinus	−	−	+	+	+	+	+	+	+	+	+	−	−	+	−	−	+	+	−	−
Nesokia indica	+	+	+	+	−	+	+	−	−	+	−	−	−	−	−	−	−	−	−	−
Eliomys quercinus	−	−	−	+	+	−	−	−	−	+	−	+	+	+	+	+	−	+	+	+
Dryomys nitedula	+	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Jaculus jaculus	−	−	+	+	+	+	+	+	+	+	−	+	+	+	−	−	+	+	−	−
Jaculus orientalis	−	−	−	+	+	+	−	−	−	+	−	+	+	−	−	−	−	+	−	−
Jaculus blanfordi	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Jaculus elater	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Allactaga euphratica	+	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Allactaga hotsoni	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Allactaga tetradactyla	−	−	−	−	−	−	−	−	−	+	−	+	−	−	−	−	−	−	−	−
Hystrix indica	+	+	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Hystrix cristata	−	−	−	−	−	−	−	−	−	+	+	+	+	−	+	+	−	−	+	−
Ctenodactylus gundi	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	+	−	−
Massoutiera mzabi	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−
Canis lupus	+	+	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Canis aureus	+	+	+	+	+	+	+	+	−	+	+	+	+	−	+	+	−	+	+	−
Vulpes vulpes	+	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	+
Vulpes ruepelli	+	+	−	−	+	−	+	+	+	+	+	+	−	+	−	−	+	−	−	−
Vulpes zerda	−	−	−	−	+	−	−	−	+	+	−	−	−	+	−	−	+	+	−	−
Ursus arctos	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Mustella nivalis	+	+	+	+	−	+	+	−	−	−	−	−	−	−	+	+	−	−	+	+
Mustella putorius	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Vormela peregusna	+	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Martes martes	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Martes foina	+	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Poecilictis libyca	−	−	−	−	−	−	+	−	−	+	−	−	−	+	−	−	+	+	+	−
Ictonyx striatus	−	−	−	−	−	−	−	−	+	−	+	−	−	−	−	−	−	−	−	−
Mellivora capensis	+	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−
Meles meles	+	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Lutra lutra	+	+	+	+	−	−	−	−	−	−	−	−	−	−	+	+	−	−	+	+
Genetta genetta	−	−	−	+	−	−	−	−	+	+	+	+	−	−	+	+	−	−	+	+
Herpestes ichneumon	−	−	−	+	−	+	+	−	−	−	+	−	−	−	+	+	−	+	+	+
Herpestes auropunctatus	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Herpestes edwardsi	+	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Ichneumin albicauda	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	−	−
Hyaena hyaena	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−
Proteles cristatus	−	−	−	−	−	−	−	−	+	−	+	−	−	−	−	−	−	−	−	−
Felis sylvestris	+	+	+	+	+	−	+	+	−	+	+	+	+	−	+	+	+	+	+	+
Felis chaus	+	+	+	+	−	+	+	+	−	+	−	−	−	−	−	−	−	−	−	−
Felis margarita	−	+	−	+	−	−	−	−	−	+	−	−	−	−	−	−	+	+	−	−
Felis manul	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Felis caracal	−	+	−	+	+	−	+	−	+	−	−	−	−	−	+	+	−	−	+	−
Felis serval	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−
Panthera pardus	+	+	+	+	+	−	−	−	−	+	−	−	−	−	+	+	−	−	+	−
Panthera tigris	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Acinonyx jubatus	+	+	−	−	−	−	−	−	−	+	−	−	−	−	−	−	−	+	−	−
Procavia syriaca	−	−	−	+	+	−	−	−	+	−	+	−	−	+	−	−	+	−	−	−
Equus hemionus	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Equus africanus	−	−	−	−	−	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−
Sus scrofa	+	+	+	+	−	−	−	−	−	−	−	−	−	−	+	+	−	+	+	+

TABLE 25.—*Continued.*

Cervus dama	−	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Cervus elaphus	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−	−
Capreolus capreolus	−	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+
Addax nasomaculatus	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−
Gazella subgutturosa	+	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Gazella dorcas	−	−	−	+	+	−	+	+	+	+	−	−	−	+	−	−	+	+	+	−
Gazella gazella	−	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Gazella cuvieri	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	+	−	−
Gazella leptoceros	−	−	−	−	−	−	+	−	−	+	−	−	+	−	−	−	−	−	−	−
Gazella dama	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	−	−	−
Capra aegagrus	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Capra ibex	+	−	−	+	+	−	−	−	+	−	−	−	−	−	−	−	−	−	−	−
Capra lervia	−	−	−	−	−	−	+	+	+	+	−	−	−	−	−	−	+	+	−	−
Ovis orientalis	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−

the other hand, the Gulf of Suez and the Suez Canal lowlands do not seem to form an effective barrier between the Sinai and the Eastern Desert. Only two species, *Acomys cahirinus* and *Procavia capensis*, have different subspecies in these two areas, and the subspecific status of both of these is still questionable. It is thus apparent from the mammal distributions in Egypt that the major single factor affecting those distributions is the Nile Valley. This can be explained by the effect of the Nile on the climate and vegetation, which creates an area of almost subtropical conditions in the lowlands (Zohary, 1973). This not only results in the disjunct distribution of desert mammals, but also results in the association of the Nile Valley mammals with Ethiopian mammals, and their distinction from nearby areas of Egypt.

Of the 22 species of bats reported from Egypt, six are Ethiopian species, with wide distributions in Africa south of the Sahara: *Rousettus aegyptiacus*, *Nycteris thebaica*, *Taphozous perforatus*, *Rhinolophus clivosus*, *Pipistrellus rueppellii*, and *Nycticeius schlieffenii*. *Rousettus aegyptiacus* occurs north through the Eastern Mediterranean to Turkey and Cyprus. The same can be said for *Nycteris thebaica* and *Taphozous perforatus*, distributions of which reach to the eastern Mediterranean and to southwestern Asia. *Rhinolophus clivosus* has differentiated considerably in the southern Palearctic, with at least two subspecies occurring in Egypt. Two old records of *Nycticeius* are known from Egypt (Cairo and Suez). These localities are the only ones known from North Africa, and a large hiatus exists between this area and the northernmost record in Ethiopian Africa (central Sudan). Another species, *Taphozous nudiventris*, has a similar distribution to that of *T. perforatus* but extends as far east as Malaysia, and it might be originally an Ethiopian species.

Eight bat species occurring in Egypt are distributed in the "intermediate" zone between the Palearctic and the Ethiopian regions (that is, North Africa, Arabia, and Southwest Asia), with some reaching the Oriental

region. These are *Rhinopoma hardwickei, R. microphyllum, Taphozous nudiventris, Asellia tridens, Pipistrellus ariel, P. bodenheimeri, P. aegyptius,* and *Otonycteris hemprichi.* These species are adapted for semidesert habitats (especially oases and Wadi beds) and may be termed Sharao-Sindian (*sensu* Atallah, 1977) or Saharo-Arabian (*sensu* Zohary, 1973). The term "Afro-eremic" (Lattin, 1967) also has been used for this group (Gaisler *et al.*, 1972; Nader, 1978), but most of these species are not "eremic" in the strict sense of being desert dwellers. To these, *Eptesicus bottae innesi* and *Barbastella barbastellus leucomelas,* can be added; both subspecies occur from Egypt to Afghanistan.

Rhinolophus hipposideros is a Mediterranean species which occurs only marginally in the Sinai peninsula and might extend to the mountain regions of Egypt, because there is an old record from the mountains of Ethiopia. Another Mediterranean species, *R. mehelyi,* is known from some localities in Lower Egypt but only around cultivated areas near the Nile River.

Of the remaining species of bats occurring in Egypt, *Plecotus austriacus* and *Tadarida teniotis* are widespread Palearctic species. The former occurs as far south as the Cape Verde Islands, Senegal, and Ethiopia, and the latter as far south as the Sahara Desert. Two species, *Pipistrellus kuhlii,* and *Tadarida aegyptiaca,* could not be clearly assigned to a given zoogeographic region because of their widespread distributions. The former was considered by Gaisler *et al.* (1972) to be Mediterranean, and the latter as "S. Palearctic arboreal." I believe, however, that much remains to be learned about the systematics and biogeography of the *kuhlii*-group, especially in Africa, before any comments on the affinities of this species can be given.

I attempted to group all the mammals of Egypt in relation to the phytogeographic regions as understood by Zohary (1973:81). In this regard, five regions are represented by mammals in Egypt: Oriental, Sudanian, Irano-Turanian, Mediterranean, and Saharo-Arabian. The last three are subdivisions of the Palearctic region. As a result of the clustering methods, it was apparent that three major groups occur in Egypt: 1) Ethiopian (Sudanian) elements that enter the areas of the Nile; 2) Mediterranean elements, mostly in the coastal regions; and 3) Saharo-Sindian elements. Table 26 lists Egyptian mammals characteristic of each of these groupings based on the analysis of distributions carried by the UPGMA method. The mammals occurring in the Saharo-Arabian phytogeographic region usually also occur in the Irano-Turanian region, and as such I use the more inclusive term, the Saharo-Sindian region, to include both these phytogeographic regions. I have attempted not to include those mammals having widespread distribution and not clearly assignable to such groupings. Those are listed at the end as "Pluriregional species."

Setzer (1957) maintained that there are specific differences between *Paraechinus aethiopicus, dorsalis,* and *deserti.* In view of the allopatric ranges and the small differences involved, I follow Corbet (1978) in

TABLE. 26.—*The mammals of Egypt characteristic of major zoogeographical subdivisions. See text for detail.*

SUDANIAN	
Crocidura flavescens	*?Acomys cahirinus*
Crocidura religiosa	*Ictonyx striatus*
Rousettus aegytpiacus	*Genetta genetta*
Tapozous perforatus	*Herpestes ichneumen*
Nycteris thebaica	*Proteles cristatus*
Rhinolophus clivosus	*Procavia capensis*
Pipistrellus rueppelli	*Hippopotamus amphibius*
Nycticeius schleiffeni	*Addax nasomaculatus*
Arvicanthis niloticus	*Alcelaphus buselaphus*
MEDITERRANEAN	
Crocidura suaveolens	*Spalax ehrenbergi*
Suncus etruscus	*Eliomys quercinus*
Rhinolophus mehelyi	
SAHARO-SINDIAN	
Paraechinus aethiopicus	*Meriones libycus*
Hemiechinus auritus	*Meriones shawi*
Rhinopoma hardwickei	*Meriones sacramenti*
Rhinopoma microphyllum	*Meriones tristrami*
Asellia tridens	*Pachyuromys duprasi*
Eptesicus bottae	*Psammomys obesus*
Otonycteris hemprichi	*Acomys russatus*
Gerbillus pyramidium	*Jaculus orientalis*
Gerbillus andersoni	*Jaculus jaculus*
Gerbillus gerbillus	*Allactaga tetradactyla*
Gerbillus dasyurus	*Vulpes rueppelli*
Gerbillus perpallidus	*Vulpes zerda*
Gerbillus henlyi	*Poecilictis libyca*
Dipodillus simoni (incl. kaiseri)	*Felis margarita*
Dipodillus amoenus	*Gazella leptoceros*
Sekeetamys calurus	*Gazella dorcas*
Meriones crassus	
PLURIREGIONAL SPECIES (Species common to Mediterranean and Saharo-Sindian regions)	
Plecotus austricaus	*Hyaena hyaena*
Dipodillus campestris	*Ammotragus lervia*
Felis chaus	*Gazella gazella*
Felis sylvestris	*Sus scrofa*

considering those forms conspecific. The consideration of subspecies in the above arrangement instead of species may sharpen the distinctions between the various phytogeographical subregions and decrease the number of those listed under "Pluriregional" species.

The Oriental element is least represented in Egypt, with but two commensal species (*Nesokia indica* and *Suncus murinus*), which reach their

TABLE. 26.—*Continued.*

WIDESPREAD (Species that are widespread or could not be placed in any of the above groups)	
Rhinolophus hipposideros	*Canis aureus*
Pipistrellus kuhlii	*Vulpes vulpes*
Barbastella barbastellus	*Mustella nivalis*
Tadarida teniotis	*Caracal caracal*
Tadarida aegyptiaca	*Panthera pardus*
Lepus capensis	*Acinonyx jubatus*
Rattus rattus	*Equus asinus*
Rattus norvegicus	*Capra ibex*
Mus musculus	
Hystrix cristata	
ENDEMIC SPECIES	
Crocidura floweri	*Pipistrellus ariel*
Pipistrellus bodenheimeri	*Dipodillus mackilligini*

westernmost distribution in Egypt and at least one of them (the latter) was probably transported by man (Osborn and Helmy, 1980:53), and, as such, no additional zoogeographical comments seem useful. The Ethiopian (Sudanian) element is fairly well represented but those species generally occur only in the Nile Valley and climatically similar Wadi and oasis areas.

By virtue of the location of Egypt, it is surprising that the Mediterranean element is not pronounced even if one includes such species as *Pipistrellus kuhlii, Plecotus austriacus, Gazella gazella, Sus scrofa* and other species of possible Mediterranean origin. The above list indicates that the mammal fauna in Egypt is mostly of Palearctic affinities. Within this group, the Saharo-Sindian element is well represented. Four endemic species occur in Egypt and southern Palestine. The bats seem to conform to the other land mammals in their respective affinities with the various regions.

According to Zohary (1973) the Mediterranean element in the flora of Cyrenaica in Libya suggests more affinities with Crete and the Western Mediterranean rather than with the closer Eastern Mediterranean territory. In Egypt, the flora of the coast is distinctive and is not similar to any of the Mediterranean floras in North Africa (Boulos, 1975). The bat species occurring in Jabal Al Akhdar in Libya are mostly of Mediterranean origin (Qumsiyeh and Schlitter, 1982), a condition which correlates with the general flora and fauna of the region (Boulos, 1975; Higgs, 1961). A few Mediterranean bats occurring in Jabal Al Akhdar may enter Egypt, at least in the northwestern coastal plain. However, most of the Egyptian coast is likely to be free of Mediterranean bats other than those mentioned, because of the clear difference in its flora (Boulos, 1975), fauna, and climate (precipitation less than 100 millimeters).

From the above discussion of the mammal distributions, it is apparent that there are three groups, each of which includes a large number of species with similar distributions. These are:

1. Northern group: Some Palearctic and especially Mediterranean species have their southernmost records in Egypt (usually in the Sinai or in the Mediterranean coastal desert zone), but may extend along the Red Sea hills to the highlands of East Africa (For example, *Barbastella barbastellus leucomelas*). Many of the species in this group have a limited southern Palearctic distribution.
2. Southern group: A surprisingly large number of species of both land mammals and bats have a distribution that extends from the Near East (including Egypt) south to the parklands of South Africa and east through Arabia to southwest Asia. Some members of this group extend farther east with, as an example, *Taphozous nudiventris* reaching Burma. This group of species, which occurs in parkland-grassland-thorn scrub habitats, includes most of the species listed as "Sudanian" above and such species as *Caracal caracal*, *Panthera pardus*, and *Acinonyx jubatus* listed as Pluriregional above.
3. Saharo-Sindian group: This group occurs in the phytogeographic regions designated by Zohary (1973) as Saharo-Arabian and Irano-Turanian. Many of the species in this group have Egypt as the center of their range and occur in the desert and subdesert regions extending from Mauritania to northwestern India.

The first of the above groups has the smallest number of species occurring in Egypt. The fossil faunal evidence of the Pleistocene in Palestine, together with pollen studies, indicate a possible occurrence of temperate woodlands in the lowlands of Palestine and possibly the northern coasts of Egypt during the early Würm (Butzer, 1964:296). Thus, it seems that this group represents relicts from more favorable climatic periods. Among the bats, this can be seen clearly in the boreal *Rhinolophus hipposideros*, with isolated records in the mountains of Ethiopia and Sinai.

The Saharo-Sindian group is one that probably evolved in the "intermediate" desert zone between the Ethiopian and Palearctic regions. The Southern group seems to be a group of species that avoids deserts, subdeserts and mountain regions and occurs in lowlands characterized by a subtropical climate and a vegetation of parkland-grassland-thorn scrub. It is possible that the history of this group goes back much earlier than the Pleistocene, because most members of this group have a wide distribution from South Africa to Asia. This group may also be termed Afro-Asian and includes three types of distributions for the bats: Afro-Arabian: *Nycteris thebaica*, *Nycticeius schlieffeni*; Afro-Asian: *Rousettus aegyptiacus*, *Taphozous perforatus*, *Rhinolophus clivosus*, *Pipistrellus rueppellii*, and *Tadarida aegyptiaca*; Afro-Oriental (also Malaya and Sumatra): *Rhinopoma microphyllum*, *R. hardwickei*, and *Taphozous nudiventris*.

It is interesting to note that most species considered in this work as having a "Southern" distribution and the Saharo-Sindian species all have the centers of their distributions around the Red Sea (especially Egypt and Palestine). This could explain why in those areas there are a number of

endemic forms; examples include: one bat, *Pipistrelus ariel*, and one rodent, *Dipodillus mackilligini*, both described from Wadi Alagi, Sudan Administrative area, and endemic to southeastern Egypt and northeastern Sudan; *Pipistrellus bodenheimeri* in Wadi Araba, Sinai, and possibly Oman; *Eptesicus bottae innesi* in Egypt and Wadi Araba; and *Crocidura floweri* in the lower Nile Valley.

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APPENDIX A.—List of localities. I have accepted the list provided by Osborn and Helmy (1980). Here I list localities not listed by those authors and localities for which collecting locality coordinates for the bats are different.

Locality	Governorate	Coordinates
'Ajmah, Jabal	Sinai	29° 12'N 34° 02'E
Al Minya	Minya	28° 06'N 30° 45'E
Bakkari	Giza	Not found
Beni Hassan	Sharqiya	30° 54'N 31° 41'E
Delta Barrage	Qalyubiya	30° 12'N 31° 08'E
Edfu	see Idfu	
El 'Igma	see 'Ajmah, Jabal	
El Lahun	Faiyum	29° 13'N 30° 59'E
El Maabdah	Asyut	27° 20'N 31° 01'E
El Manashi	Giza	30° 11'N 31° 06'E
Gebelein	see Jabaleyn	
Gebel El Tayr	Minya	ca. 28° 13'N 30° 47'E
Gebel et Teir	see Gebel El Tayr	
Gezira	Cairo	30° 28'N 30° 51'E
Hanna	Beni Suef	28° 51'N 30° 54'E
Henneh	see Hanna	
Idfu	Aswan	24° 58'N 32° 52'E
Jabaleyn	Qena	25° 29'N 32° 29'E
Minia	see Al Minya	
Negroom	Sharqiya	not found
Philae, Is.	Aswan	24° 04'N 32° 53'E
Qurneh, Tel el	see Qurna	
Qurna	Red Sea	26° 12'N 32° 32'E
Sabkhet El Bardaweil	Sinai	ca. 31° 08'N 33° 30'E
Serapeum	Giza	29° 53'N 31° 13'E
Um Hashiba	Sinai	not found
Wadi Talaah	see St. Katherine Monastery	
Zarnikh	see Sabkhet El Bardaweil	
Zawyet Um El Rakham	MATRUH	31° 24'N 27° 03'E

APPENDIX B.—Following is a list of the abbreviations as used in the text.

Measurements

TL	*Total length.*—Distance from the tip of the snout to the tip of the tail vertebra.
HBL	*Head and body length.*—Distance from tip of the snout to the base of the tail verterbra.
T	*Tail length.*—Length of tail from base to the end of the last vertebra taken on the dorsal side.
TB	*Length of tibia*—Taken externally.
HF	*Hindfoot length.*—Distance from Metatarsal to the longest claw.
E	*Ear Length.*—Distance from notch to highest margin.
TR	*Tragus length.*—Distance from notch of ear to tip of tragus taken on the posterior side.
FA	*Length of forearm.*—Taken externally with folded wings and includes wrist bones and radius
GLS	*Greatest length of the skull.*—Distance from posterior-most portion of occipital bone to anterior-most portion of the canine in Rhinolophidae and to the anterior most portion of the skull, regardless of structure, in all other families.
CCL	*Condylo-canine length.*—Distance from occipital condyles to anterior alveolar margin of canines.
BBC	*Breadth of braincase.*—Breadth taken at the base of the zygomatic arches.
IOC	*Interorbital constriction.*—Least interorbital breadth.
ZYGB	*Zygomatic breadth.*—Maximum width of skull at zygomatic arches.
RBCA	*Rostral breadth at canine alveolars.*—Greatest breadth between labial margins.
C-M^3	*Upper tooth-row length.*—Distance from anterior margin of canine to posterior margin of M^3; maximum length at crowns.
BCD	*Braincase depth.*—Distance from basisphenoid to highest portion of parietal.
M	*Mandible length.*—Distance from anterior-most portion of incisors to mandibular condyles.
c-m^3	*Lower tooth-row length.*—Distance from anterior margin of canine to posterior margin of m^3; maximum length at crowns.
CORH	*Coronoid height.*—Maximum height of coronoid process of mandible.

Other abbreviations

C/c	*Upper/lower canine.*
I/i	*Upper/lower incisor.*
M/m	*Upper/lower molar.*
PM/pm	*Upper/lower premolar.*