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Rhinopoma hardwickii and Rhinopoma muscatellum.

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Rhinopoma É. Geoffroy St.-Hilaire, 1818

Rhinopoma Oken, 1816:926. Not available (Opinion 417, International Commission on Zoological Nomenclature, 1956).

Rhinopoma É. Geoffroy St.-Hilaire, 1818:113. Type species *Vespertilio microphyllus* Brünnich, 1782.

CONTEXT AND CONTENT. Order Chiroptera, Suborder Microchiroptera, Family Rhinopomatidae. The family contains one genus with three living species: *Rhinopoma hardwickii* Gray, 1831; *R. microphyllum* (Brünnich, 1782); and *R. muscatellum* Thomas, 1903 (Hill, 1977; Koopman, 1984). Following is a key to the three recognized species of rhinopomatids (Corbet, 1978; DeBlase et al., 1973; Qumsiyeh, 1985).

1. Large; forearm 57 to 75 mm, greatest length of the skull 18 to 23 mm; skull robust, with well-developed sagittal and lambdoidal crests; rostrum with narial swellings poorly defined, almost flat ..... *R. microphyllum*
   Small; forearm 46 to 63 mm, greatest length of the skull 14 to 19 mm; skull slender and with rounded braincase; lambdoidal and sagittal crests poorly developed; rostrum with well-defined narial swellings 2
2. Muzzle with well-developed transverse dermal ridge; narial inflations rounded; posterior margin of palate rounded ..... *R. hardwickii*
   Muzzle with poorly developed, almost flat dermal ridge; narial inflations angular in profile; posterior margin of palate angular ..... *R. muscatellum*

Rhinopoma hardwickii Gray 1831

Lesser Mouse-tailed Bat

Rhinopoma hardwickii Gray, 1831:37. Type locality Bengal, India.

Rhinopoma sennaariense Fitzinger, 1866:547. Type locality restricted to Fazuglo (=Fazughli), Sudan. Initially a *nomen nudum*, validated by Kock (1969).

Rhinopoma longicaudatum Fitzinger, 1866:547. Type locality Sennaar, Sudan. *Nomen nudem.*

Vespertilio ferox Stresemann, 1954:172. "Sackhara [=Saqqara], Egypt." *Nomen nudum.*

Vespertilio brevicauda Stresemann, 1954:172. Saqqara, Egypt. *Nomen nudum.*

Rhinopoma muscatellum Thomas, 1903

Small Mouse-tailed Bat

Rhinopoma muscatellum Thomas, 1903:498. Type locality Wadi Bani Ruha, Muscat, Arabia.

Rhinopoma pusillum Thomas, 1920:25. Type locality Sib, southeastern Persia.

CONTEXT AND CONTENT. Same as for genus. There are four currently recognized subspecies of *Rhinopoma hardwickii* (Hill, 1977):

R. h. hardwickii Gray, 1831:37, see above.

R. h. cystops Thomas, 1903:498. Type locality Luxor, Egypt.

R. h. arabium Thomas, 1913:89. Type locality Wasil, Yemen, Arabia (*sennaariense* Fitzinger a synonym).

R. h. macinnesi Hayman, 1937:530. Type locality Bat Island, near Central Island, Lake Rudolf, Kenya.

Only two subspecies are recognized in *Rhinopoma muscatellum* (DeBlase et al., 1973):

R. m. muscatellum Thomas, 1903:498, see above.

R. m. seianum Thomas, 1913:90. Type locality "Seistan," a region on the Afghan-Iran border.

DIAGNOSIS. Both *Rhinopoma hardwickii* (Figs. 1 and 2) and *R. muscatellum* are smaller than *R. microphyllum*; the forearm measures 46 to 63 mm and the greatest length of the skull 14 to 19 mm. The tail is free and long, usually longer than the forearm. The lacrimal region of the skull is inflated (Fig. 3), not flat as in *R. microphyllum*. Males do not have strongly developed lambdoidal and sagittal crests as in *R. microphyllum*. The posterior edge of the palate has a rounded profile in *Rhinopoma hardwickii* with the lateral components almost parallel (Harrison, 1964; Hill, 1977; Qumsiyeh, 1985), whereas the posterior edge of the palate is angular in *R. muscatellum* (DeBlase et al., 1973; Hill, 1977). The superior transverse dermal ridge surrounding the narial pad is well developed in *Rhinopoma hardwickii*, but is almost flat or slightly depressed in *R. muscatellum*. Cranially, *R. muscatellum* has larger, relatively more angular narial inflations than *R. hardwickii*.

The least breadth of the postpalatal projection of *Rhinopoma muscatellum* ranges from 1.6 to 2.2 mm and that of *R. hardwickii* from 2.2 to 2.7. *R. muscatellum* is generally the smaller of the two species but there is some overlap in measurements with those of *R. hardwickii* (DeBlase et al., 1973).

GENERAL CHARACTERISTICS. The following general characters, summarized from Miller (1907) and Harrison (1964), are based on *R. hardwickii* but apply equally to *R. muscatellum* unless indicated otherwise. *Rhinopoma hardwickii* is a small bat with a slender, long, free tail. The face is glandular and the ears are connected across the forehead (Madkour, 1961). The muzzle bears a small triagonal noseleaf terminally (Fig. 2). The eyes are well developed. The pinna is large and is crossed by 10 transverse ridges. The tragus is well developed. The feet are slender and smaller than in *R. microphyllum*. The interfemoral membrane is small and encloses less than one-fourth of the tail.

The skull (Fig. 3) is short, with an oval braincase and a short rostrum. Cranial bones are delicate and the tympanic bone is loose. The widest part of the skull is at the squamosal branch of the zygomatic arch. The lacrimal region of the skull is inflated. The dental formula is i 1/2, c 1/1, p 1/2, m 3/3, total 28.

Ranges in external and cranial measurements (mm) of *Rhinopoma hardwickii*, followed by those of *R. muscatellum*, both from Iran (DeBlase et al., 1973), are: total length, 119 to 141, 112 to 125; length of tail, 57 to 70, 52 to 70; length of hindfoot, 12 to 15, 12 to 13; length of ear, 18 to 21, 18 to 20; length of forearm, 52.4 to 60.0, 45.0 to 52.4; condylobasal length, 15.6 to 16.9, 14.4 to 15.5; zygomatic breadth, 9.9 to 10.9, 8.9 to 9.9; postorbital constriction, 2.4 to 2.9, 2.1 to 2.3; length of maxillary toothrow, 5.7 to 6.3, 5.2 to 5.6; breadth of palate, 7.3 to 7.8, 6.5 to 7.2; least breadth of postpalatal process, 2.2 to 2.5, 1.8 to 2.1; length of mandible, 11.3 to 12.4, 10.7 to 11.7.

DISTRIBUTION. *Rhinopoma hardwickii hardwickii* is known from Thailand (probably an accidental record; Lekagul and McNeely, 1977), Burma, and through India and Pakistan to Iran (Fig. 4). *R. h. cystops* occurs in the Sahara Desert from the Hoggar Mountains through the Air Mountains of Niger, and in Upper Egypt south of Qena (Fig. 5). *R. h. arabium* occurs in the other parts of North Africa essentially surrounding the range of *R. h. cystops*, in West Africa (in Niger, Mali, and Mauritania), and in Arabia (Figs.

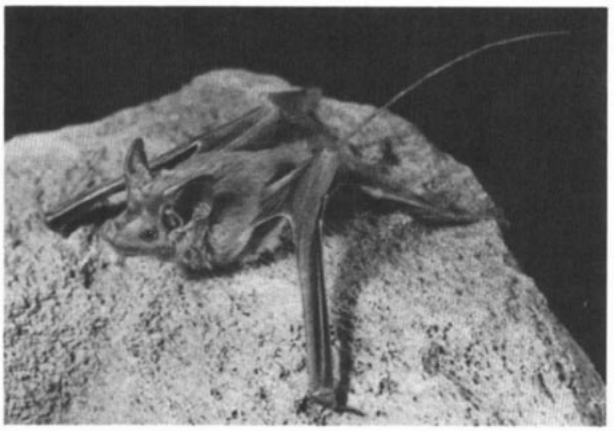

FIG. 1. A live specimen of *Rhinopoma hardwickii* obtained by M. B. Qumsiyeh from Palestine. Photograph by C. S. Hood.

FIG. 2. Facial appearance of *Rhinopoma hardwickii arabium* from Giza, Egypt. Photograph by M. B. Qumsiyeh.

4 and 5). *R. h. macinnesi* occurs in East Africa in southeastern Sudan, Kenya, and possibly in Somalia and eastern Ethiopia (Fig. 5; Hill, 1977; Kock, 1969; Qumsiyeh, 1985). *Rhinopoma muscatellum* (Fig. 4) occurs in Oman, Iran, and Afghanistan, and possibly into Pakistan (DeBlase et al., 1973). There also is a questionable record from Eritrea, Ethiopia (Hill, 1977; Largen et al., 1974). No fossil rhinopomatids have been reported.

FORM. Descriptions here are for *Rhinopoma hardwickii* but apply equally to *R. muscatellum.* The skull is broad and slender (Fig. 3). Sagittal and lambdoidal crests are poorly developed. The nasal inflations project forward in lateral profile. The cochlea has three turns. Coronoid and angular processes of the mandible are well developed. Upper incisors are minute, barely emerging from the gum, canines are conical and simple and the upper premolar (P4) small. The first and second upper molars lack distinct hypocones; the third upper molar has a metacone, mesostyle, and three commissures. The lower incisors are small; posterior lower premolar (p4) is wider than p3 (Harrison, 1964; Wassif and Madkour, 1963). The vertebral column consists of 12 thoracic, 6 lumbar, 4 sacral-pseudosacral, and 17 caudal vertebra (Wassif and Madkour, 1963). The coracoid process of the scapula is "hooked-shaped" and ossifies independently (Wassif and Madkour, 1963). The anatomy of ear ossicles and tympanic bone were described in detail by Wassif (1946, 1948) and Madkour (1977*b*).

Thomas (1903:498) characterized the skull of *Rhinopoma muscatellum* as follows: "nasal prominences large, thin, inflated, projecting forward decidedly in front of the anterior end of the middle line of the nasals. Hinder edge of palate distinctly behind the level of the last molar. Bullae conspicuously larger than in allied forms." DeBlase et al. (1973:836) found that in *Rhinopoma hardwickii* "the rostrum narrows gradually from the widest part of the nasal inflations to the intraorbital constriction," whereas "in *R. muscatellum* the outer sides of the nasal inflations are essentially parallel for most of the length of the rostrum, then taper abruptly to the intraorbital constriction."

The hyoid bone in *R. hardwickii* is smaller than that in *R. microphyllum.* The stylohyoid is club-shaped and the thyrohyals are convex posteriorly. The cricoid is bony and is partly fused with the first tracheal rings. Tracheal rings are incomplete and bony (Wassif and Madkour, 1969). The humerus in *R. hardwickii* has a large median epicondyle but a smaller capitulum than that in *R. microphyllum* (Madkour, 1978).

Two phalanges are found in all forearm fingers except the first in both *R. hardwickii* and *R. microphyllum* (Wassif and Madkour, 1970). The presternum is wide and the sternal part of the rib fuses in adults with the manubrium sterni (Wassif and Madkour, 1971). The ilium is about three times as long as the ischium and the pubis lacks a symphysis in *Rhinopoma.* Four vertebra fuse together to form the sacral-pseudosacral region (Wassif and Madkour, 1972*b*). The os penis is "racket"-shaped but varies in size and shape with age (Wassif and Madkour, 1972*b*).

In both *R. hardwickii* and *R. microphyllum,* large filiform papilla occupy a relatively small, triangular area on the tongue partly surrounding the three circumvillate papilla (Madkour, 1976*b*; Wassif and Madkour, 1972*a*). The alimentary tract is no different superficially from that found in other Egyptian Microchiroptera (Madkour, 1976*b*).

The palatal rugae include a large and oval precanine ruga and a relatively large (relative to other Egyptian bats examined) ruga in the canine area (Wassif and Madkour, 1972*c*). Smith and Starrett (1979) studied wing morphometrics of rhinopomatids and concluded that they are less specialized than other bats.

Females have two pectoral mammary glands and teats but also have a pair of pelvic teats without mammary glands (Madkour, 1976*a*). Short hair is distributed sparsely on the muzzle and on the upper lip. The pelage is fine and unicolored, pale gray brown, paler ventrally. Benedict (1957:294) presented a detailed analysis of the structure of hair in *Rhinopoma* and reported hairs "short, straight filaments that have broadly lobate, coronal scales, except in the distal portions where the lobes become pointed and form a dentate margin."

Kulzer et al. (1985) reported that the facial area of *R. hardwickii* contains a great number of glands, which they described and figured in detail. Among the more interesting of their findings was that apocrine sweat glands are stimulated simply by handling captured bats and that they do not function in thermoregulation.

FUNCTION. Flight consists of a series of "alternating flutters and glides, with a rising and falling motion giving a superficial resemblance to that of a small bird from a distance" (Harrison, 1964:62). Simmons (1979) and Simmons and Stein (1980) stated that rhinopomatids are "acoustically primitive" because they use signals with four or more harmonics and little frequency modulation among other "primitive" features. In a more detailed study of echolocation in *Rhinopoma hardwickii* under natural conditions, Habersetzer (1981) reported that individuals emit constant frequency (CF) sounds of 48 ms duration during flight in open spaces. Those CF sounds were in three bands when bats were flying in groups but in one band when they are flying singly. Frequency modulated sounds were produced only shortly before landing and as bats left their roosts. These results were further confirmed by Simmons et al. (1984).

ONTOGENY AND REPRODUCTION. Little is known of the reproductive biology of these species. Prakash (1960) reported that young of *Rhinopoma hardwickii* are born in June and July in India. Deciduous teeth form minute spicules replaced by the permanent set early in life (Wassif and Madkour, 1963). In Egypt and the Sudan, females of *R. hardwickii* have been taken with single embryos in late March and lactating females were found in August (Hoogstraal, 1962; Kock, 1969). Gaisler et al. (1972) collected females in early stages of pregnancy in Egypt in late April.

ECOLOGY AND BEHAVIOR. *Rhinopoma hardwickii* occurs in desert or semidesert habitats. These bats usually are found in dry caves, ruins, underground tunnels, mosques, and old buildings, where they roost mostly solitary, not in clusters (Gaisler et al.,

FIG. 3. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Rhinopoma hardwickii* (TTU 40640, ♂) from Mt. Quarantania, Jericho, Palestine. Greatest length of skull is 17.9 mm. Photographs by N. L. Olson.

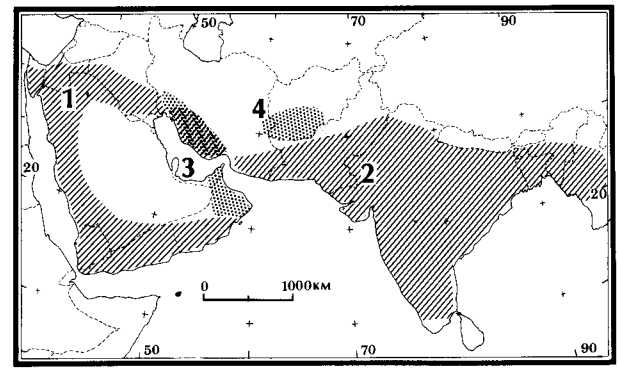

FIG. 4. Asian distribution of subspecies of *Rhinopoma hardwickii* and *R. muscatellum*: 1, *R. h. arabium*; 2, *R. h. hardwickii*; 3, *R. m. muscatellum*; 4, *R. m. seianum*. The two species are sympatric in southwestern Iran.

1972; Hoogstraal, 1962; Qumsiyeh, 1985). Individuals of this species are active year round, drawing on stored abdominal fats in winter (Hoogstraal, 1962; Kock, 1969; Vogel, 1977). The specimen shown in Fig. 1 was kept for 2 months in February and March; it refused food until it was sacrificed. In Egypt, fat deposits first appear late in July and attain maximum development in October (Madkour, 1977*a*).

Madkour (1977*a*) mentioned that colonies remained near Cairo, Egypt, throughout the year. Kingdon (1974) reported that *Rhinopoma hardwickii* feeds on small insects, especially small beetles, in Kenya; Brosset (1962) reported remains of Diptera in guano of this species from India. Dor (1947) found three skulls of "*R. microphyllum*" (most probably *R. hardwickii*) in pellets of the owl, *Tyto alba*, in Palestine. Hoogstraal and Traub (1963) found light (47 of 500 individuals) infestation of fleas, *Chiropteropsylla aegyptia* (Ischnopsillidae), on *R. hardwickii* in Egypt. Dipteran parasites include *Brachytarsina diversa* (Streblidae) and *Nycteribia pedicularia* (Nycteribiidae; Kock, 1983).

Khasuria (1972) made some observations on behavior during courtship and mating. Gaisler et al. (1972) and Kock (1969) made additional ecological observations regarding *R. hardwickii* roosts in Egypt and Sudan, respectively. The former authors reported roost temperatures ranging from 22.8° to 27.5°C and relative humidities of about 35%. Kock (1969), however, recorded temperatures in roosts from 31.7 to 34.5°C. Occasionally, all-male colonies are found (Brosset, 1962; Panouse; 1951; Prakash, 1960).

Rhinopoma muscatellum was found in "small, dimly lit, hot caves" or at entrances of larger caves in Iran (DeBlase, 1980:63). This species is in need of additional ecological studies.

Rhinopoma hardwickii has been taken in the same roosts with, or netted or shot in the same sites as, *Eptesicus nasutus*, *Pipistrellus kuhlii*, *R. microphyllum*, *R. muscatellum* (DeBlase, 1980), *Rhinolophus clivosus* (Gaisler et al., 1972), *Asellia tridens*, *Taphozous perforatus*, *Nycteris thebaica*, and *Rhinolophus landeri* (Kock, 1969).

Rhinopoma muscatellum has been taken in Iran with the other two species of the genus, and with *Rousettus aegyptiacus*, *Rhinolophus hipposideros*, *R. euryale*, *R. blasii*, and *Myotis capaccinii* (DeBlase, 1980).

GENETICS. The standard karyotype of *Rhinopoma hardwickii* has a diploid number of 36 and a fundamental number of 68 as reported for specimens from India (Ray-Chaudhuri et al., 1968) and Palestine (Qumsiyeh and Baker, 1985). The X-chromosome is a medium-sized metacentric and the Y-chromosome is a small acrocentric. Based on G-band studies, the karyotype of *R. microphyllum* (2n = 42, FN = 66) differs from that of *R. hardwickii* by three Robertsonian rearrangements and two inversions

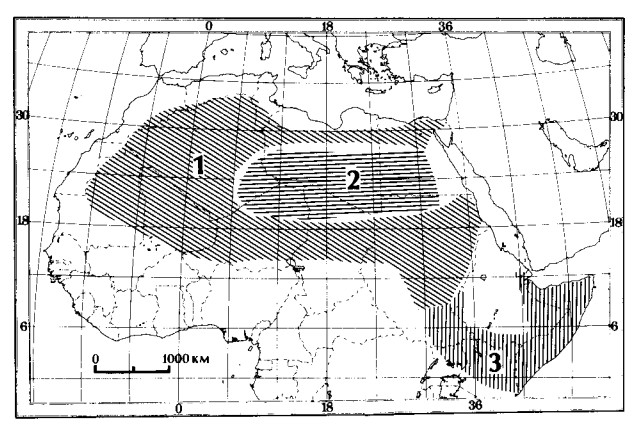

FIG. 5. African distribution of subspecies of *Rhinopoma hardwickii*:1, *R. h. arabium*; 2, *R. h. cystops*; 3, *R. h. macinnesi*. Distribution of *R. h. arabium* extends to Arabia and Iran and is shown in Fig. 4.

(Qumsiyeh and Baker, 1985). Heterochromatin is restricted to the centromeric region on all chromosomes (Qumsiyeh and Baker, 1985).

REMARKS. The family Rhinopomatidae retains some primitive morphological features for microchiropterans (Koopman, 1984). Qumsiyeh and Baker (1985) found G-band chromosomal homologies between *Rhinopoma hardwickii* and *Macrotus waterhousii*, a species regarded as chromosomally primitive for the superfamily Phylostomoidea (Patton and Baker, 1978).

Rhinopoma cordofanicum Heuglin, 1877 was included as a synonym of *R. hardwickii* by Kock (1969), but was recognized as a valid subspecies of that species by Koopman (1975). However, this name is a synonym of the larger species, *Rhinopoma microphyllum* (Hill, 1977; Qumsiyeh, 1985). Some authors have listed *Rhinopoma microphyllus* É. Geoffroy St.-Hilaire, 1818, as the earliest description of what now is regarded as *R. hardwickii*. *R. microphullus* is a homonym of *Vespertilio* (=*Rhinopoma*) *microphyllus* Brünnich, 1782. Moreover, Geoffroy's text seems to indicate that he was applying the name to the bat described by Brünnich; thus Geoffroy's name probably does not belong in the synonymy of *R. hardwickii*.

In Africa, *Rhinopoma hardwickii* seems to be a more common species than *R. microphyllum* (Gaisler et al., 1972; Kock, 1969; Qumsiyeh, 1985). This situation is reversed in Afghanistan and Iran (DeBlase, 1980; Gaisler, 1970).

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