MAMMALIAN SPECIES No. 731, pp. 1–4, 3 figs.

Rhinolophus paradoxolophus.

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Published 18 December 2003 by the American Society of Mammalogists

Rhinolophus paradoxolophus (Bourret, 1951)

Bourret's Horseshoe Bat

Rhinomegalophus paradoxolophus Bourret, 1951:607. Type locality "la grotte de la Roche-percée, prés de Chapa [Sapa], Province de Lao-Kay [LaoCai], Tonkin, 1.700 m," Vietnam.
Rhinolophus paradoxolophus: Hill, 1972: 431. First use of current name combination.
Rhinomegaphyllus paradoxolophus: Thonglongya, 1973:587. Name combination in synonymy and incorrect subsequent spelling of *Rhinomegalophus* Bourret, 1951.

CONTEXT AND CONTENT. Order Chiroptera, suborder Microchiroptera, family Rhinolophidae, *philippinensis* group as defined by Tate (1943); in the *trifoliatus* group as defined by Corbet and Hill (1992) in which they included *R. luctus, R. macrotis, R. marshalli, R. mitratus, R. philippinensis, R. rex, R. sedulus,* and *R. trifoliatus* of the Indomalayan Region and *R. maclaudi* of west Africa; in the *philippinensis* group proposed by Bogdanowicz (1992) and Bogdanowicz and Owen (1992) in which they included *R. macrotis, R. marshalli,* and *R. philippinensis* separate from the *trifoliatus* group (*R. luctus, R. sedulus,* and *R. trifoliatus*). Guillen et al. (2003) placed *R. paradoxolophus* along with *R. macrotis* and *R. marshalli* in a subgenus distinct from the *R. trifoliatus* group. Although described as a separate genus *Rhinomegalophus* by Bourret (1951), both Hill (1972) and Thonglongya (1973) argued that the taxon should be treated as a species of *Rhinolophus*. Recent summaries retain this arrangement (Corbet and Hill 1991; Koopman 1993; Nowak 1999). The genus *Rhinolophus* includes more than 60 species (Corbet and Hill 1992) and needs revision. *R. paradoxolophus* is monotypic.

DIAGNOSIS. *Rhinolophus paradoxolophus* (Fig. 1) is most similar in ear, antitragal, and noseleaf features to the larger *Rhinolophus rex* (Hill 1972; Thonglongya 1973). *R. paradoxolophus* is distinguished from *R. rex* by its narrower, taller antitragus and narrower sella and its smaller external measurements and skull size (Thonglongya 1973). Cranium of *R. paradoxolophus* (Fig. 2) resembles *R. rex* but is smaller with slightly more-rounded nasal swellings on skull and more-strongly developed postorbital zygomatic process (Thonglongya 1973). *R. paradoxolophus* has narrower, longer antitragus and longer sella than *R. marshalli* and is larger externally and in skull size. Selected measurements (in mm) of *R. rex, R. paradoxolophus,* and *R. marshalli,* respectively, from Thonglonya (1973) and Hill (1972) are: length of forearm, 59–63, 54.0, 45.5; length of ear, 35, 27, 27; height of antitragus from meatus, 17, 18, 13; width of antitragus at emargination of ear, 10.2, 7.5, 10; width of cup at base of sella, 9.6, 6.5, 8.1 (in ROM specimens, the measurements are 9.6 ($n = 4$) and 6.5 ($n = 1$) for *R. paradoxolophus* and *R. marshalli* respectively); height of sella from cup, 10.1, 8.5, 6.0; width of sella at base, 4.6, 5.2, 4.4; width of sella at top, 7.0, 5.5, 4.0; greatest length of skull, 22.1, 21.1, 19.3; condylo-canine length, 20.0, 18.2, 17.0; zygomatic width, 9.9, 9.7, 9.1; mastoid width, 11.2, 10.5, 9.1; length of upper toothrow, C–M3, 7.8, 7.1, 6.8.

GENERAL CHARACTERS. *Rhinolophus paradoxolophus* is an unusual rhinolophid with very large ears and very large antitragal lobes, along with great expansion of internarial region of noseleaf into a broad, cup-like structure above anterior leaf. Cup-like structure passes beyond base of sella to join base of connecting process. Sella is high and wide and obscures both the low connecting process and the low, rounded posterior noseleaf.

FIG. 1. (Top) Adult female *Rhinolophus paradoxolophus* (Royal Ontario Museum 107591) captured in Na Hang Nature Reserve, Vietnam. Photograph by J. L. Eger. (Bottom) Lateral view of head of adult male *R. paradoxolophus* (Royal Ontario Museum 112379) captured at Lan Dat, Vietnam. Photograph by J. A. Knowles.

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Rhinolophus paradoxolophus* from Vietnam (male, Royal Ontario Museum 107716). Greatest length of skull is 21.9 mm. Photograph by M. B. Fenton.

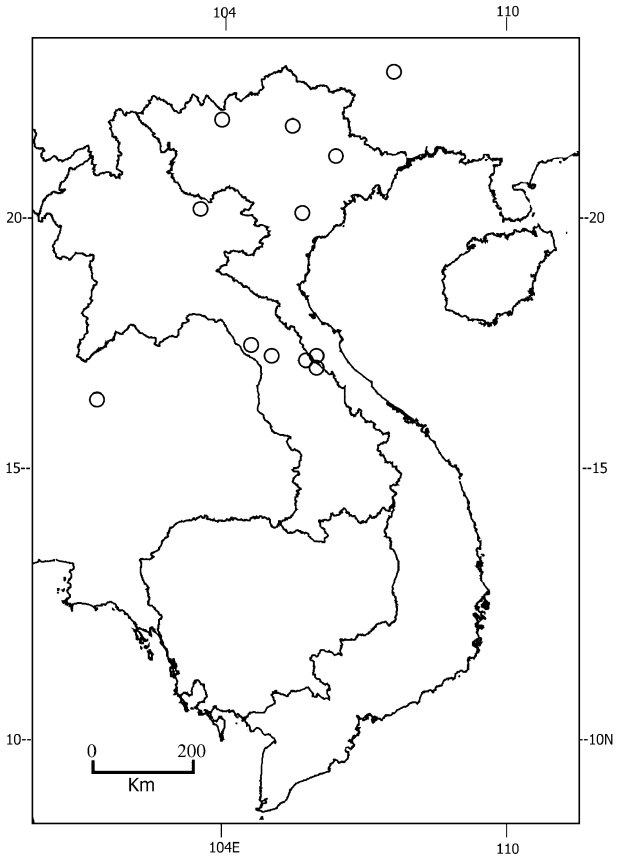

FIG. 3. Distribution of *Rhinolophus paradoxolophus* in southeast Asia (open circles) showing locality records from the Royal Ontario Museum; the Institute of Ecology and Biological Resources, Hanoi; Bourret (1951); Eger and Theberge (1999); Francis et al. (1999); Hendrichsen et al. (2001); Hill and Kemp (1996); and Thonglongya (1973).

The description of the type specimen referred only to external characters (Bourret 1951). Skull and dentition were described by Dorst (1954). The following is taken from that account and supplemented by observations of live animals and preserved specimens.

R. paradoxolophus is a medium-sized *Rhinolophus* (average length of forearm 55.2 mm) with long, narrow skull; very low sagittal crest; and deep, frontal depression. Mastoid width exceeds zygomatic width (Fig. 2). Narial swellings are large, prominent, and rounded. Palate is long; pre-palatal emargination extends posteriorly to line joining anterior faces of P4–P4; post-palatal emargination extends anteriorly to line joining mesostyles of M3–M3.

In the original description, *R. paradoxolophus* from Vietnam were blackish-brown dorsally, lighter below (Bourret 1951). Hill (1972) referred to the holotype as a young, adult female, perhaps explaining the discrepancy in color between the holotype and other specimens collected from Vietnam (on deposit in the Royal Ontario Museum). The latter specimens have dorsal fur 10–12 mm in length that is dark cinnamon brown (Bister Brown—Ridgway 1912) at tips and pale at base; fur is paler ventrally.

Ears of *R. paradoxolophus* are very large, each with large antitragal lobe which has a basal pocket; anterior margin of ear is convex, with rounded tip; posterior margin is convex distally and proximally; anterior noseleaf is very wide, with deep median emargination, extending beyond sides of muzzle and contiguous with posterior leaf. Internarial region is greatly expanded to form a broad cup-like structure, extending beyond base of sella to cover small lateral pocket behind each nostril. Sella is large, tongue shaped, rounded at apex, and widened at base to join internarial cup; a shallow, longitudinal, medial depression extends almost entire length of sella. Connecting process is low, rounded, and inserted about three-quarters along sella, joining posterior noseleaf near its base. Posterior noseleaf is low and rounded, about one-third height of sella. Number of lateral pockets between anterior and posterior faces of posterior noseleaf is 4; other values reported for number of pockets are attributable to complicated nature of noseleaf, preparation of specimens, and terminology used to describe noseleaf.

Mean external measurements (in mm) of 21 specimens in the Royal Ontario Museum; (*SD* and range in parentheses) are: length of forearm, 55.2 (1.5; 52–57); total length, 85.3 (3.1; 79–89); length of tail, 32.2 (1.7; 29–35); length of hind foot, 10.5 (0.8; 8–12); length of ear, 33.9 (1.4; 32–37); mass, 10.8 g (1.3; 9–15). Mean cranial measurements (in mm; $n = 10$) are: greatest length of skull, 22.06 (0.57; 21.1–22.7); condylo-canine length, 18.56 (0.34; 18.1–19.2); zygomatic width, 9.38 (0.19; 9.1–9.6); mastoid width, 10.28 (0.19; 10.0–10.6); interorbital constriction, 2.82 (0.17; 2.5–3.1); length of maxillary toothrow (C–M3), 7.4 (0.19; 7.1–7.7); width across upper molars (M3–M3), 6.35 (0.11; 6.2–6.5); width across maxillary canines, 4.7 (0.15; 4.4–5.0) ; length of mandible, 12.98 (0.20; 12.5–13.2); length of mandibular toothrow (c–m3), 7.54 (0.13; 7.2–7.7). Hendrichsen et al. (2001) provide additional measurements including wing ratios.

DISTRIBUTION. Distribution of Bourret's horseshoe bat (Fig. 3) is from northern Vietnam (Bourret 1951; Dang Huy Huynh et al. 1994; Eger and Theberge 1999; Hendrichsen et al. 2001; Hill and Kemp 1996; specimens in Royal Ontario Museum and

Institute of Ecology and Biological Resources, Hanoi); adjacent southwest China (MBF); central Vietnam (Hendrichsen et al. 2001; Timmins et al. 1999); central Thailand (Thonglongya 1973); and northern and central Laos (Francis et al. 1999). No fossils are known.

FORM AND FUNCTION. Dental formula is i 1/2, c 1/1, p 2/3, m 3/3, total 32. Upper incisors are minute, bifid, and widely separated. Upper canines have elongate, elliptical base, narrow shaft, and knife-like posterior edge. Anterior upper premolars (P4) are small and in toothrow; 2nd lower premolars (p3) are spicule-like and in toothrow, separating p2 and p4; lower incisors are tricuspid.

ONTOGENY AND REPRODUCTION. *Rhinolophus paradoxolophus* females netted in Na Hang Nature Reserve, Tuyen Quang Province, northern Vietnam in mid to late May were pregnant or lactating. Litter size is 1.

ECOLOGY. *Rhinolophus paradoxolophus* roosts in caves. Individuals were caught by us in mist nets at entrances to caves and in harp traps in primary lowland rain forest on limestone in northern Vietnam (vegetation of the area is in Hill and Kemp 1996). The specimen from Thailand was netted in a mist net in rather dry pine forest (*Pinus merkusii* and *Shorea*—Thonglongya 1973), and the specimen from southwestern China was found torpid in a limestone cave in late November 1999 (MBF). *R. paradoxolophus* may be closely associated with limestone formations (Francis et al. 1996).

BEHAVIOR. Echolocation calls of a bat netted in China were high duty-cycle, typical of *Rhinolophus* (Fenton 2001). Echolocation calls were 40–50 ms long and dominated by a 43 kHz constant-frequency component. Terminal portions of calls swept from 43 to 37 kHz. *R. paradoxolophus* may use echolocation calls dominated by the 1st harmonic. In Laos, C. M. Francis (personal communication) recorded echolocation frequencies of 22–25 kHz from handheld *R. paradoxolophus*. Relative to many Rhinolophid species, *R. paradoxolophus* uses low-frequency echolocation sounds.

The following ectoparasites were found on *R. paradoxolophus* collected at Na Hang Nature Reserve, Tuyen Quang Province, Vietnam: Trombiculidae (chigger) larvae; 1 species of mite, *Eyndhovenia euryalis* (Spinturnicidae); 1 species of Nycteribiidae fly, *Phthiridium*; and 3 species of Streblidae fly, *Ascodipteron, Brachytarsina falcozi,* and *Raymondia pseudopagodarum* (specimens deposited in the entomology collection, Royal Ontario Museum). *Ascodipteron*, which embeds itself in ears and wing membranes, is also known from Thailand (Thonglongya 1973). Many of the *R. paradoxolophus* netted in northern Vietnam were infected heavily with *Ascodipteron* flies, especially in the genital region.

CONSERVATION STATUS. *Rhinolophus paradoxolophus* is listed by the International Union for the Conservation of Nature/Chiroptera Specialist Group as Vulnerable with severe fragmentation; decline in area, extent, and/or quality of habitat (VU B1+2c—Hutson et al. 2001) for Laos, Thailand, and Vietnam. Once considered extremely rare, colonies of up to 50 individuals were found in caves in central Laos (Francis et al. 1999) and northern Vietnam (Hill and Kemp 1996). Single individuals or small groups were found in other areas of China, Laos, and Vietnam.

REMARKS. The specific name, *paradoxolophus,* is derived from Greek *paradoxos* meaning contrary to all expectation and *loph* meaning crest. The name refers to the fact that the noseleaf, with its wide sella and hidden posterior lancet, differs from the typical morphology of the noseleaf in other *Rhinolophus* species. The seeming absence of a posterior noseleaf combined with large ears, give *R. paradoxolophus* the appearance of a megadermatid rather than a rhinolophid species, thus accounting for Bourret (1951) ascribing this species to a new genus.

We thank the Institute of Ecology and Biological Resources, Hanoi, the late Dr. Cao Van Sung, and Pham Duc Tien for facilitating field work in Vietnam and the Foundation, Royal Ontario Museum for financial support of field work in Vietnam. We are grateful to Professor Shui Zhang and H. H. Zhao for assistance with field work in China, to H. H. Zhao and Charles Francis for sharing data on bat vocalizations, to Doug Currie for arranging identification of ectoparasites, and to Burton Lim for preparation of Fig. 3. This is Contribution number 259 of the Centre for Biodiversity and Conservation Biology at the Royal Ontario Museum.

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Associate editors for this account were ELAINE ANDERSON, SERGE LARIVIÈRE, and GAIL R. MICHENER. Editor was VIRGINIA HAYSSEN.

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