



A new species of *Glischropus* from the Indochinese Subregion (Mammalia: Chiroptera: Vespertilionidae)

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Abstract

Within the tribe Pipistrellini, the genus *Glischropus* is very close to the genus *Pipistrellus* both in its external morphology and chromosomal features but can be unequivocally distinguished from the latter by the presence of thumb pads and the position of the second incisor. One of the two known species, *G. tylopus* was thought to have a wide distribution range from Myanmar to the Philippines, while the other, *G. javanus* is only known from Java. Recently collected Cambodian specimens of *Glischropus* are distinguished from their congeners by longer forearm and cranial features (the shape of the skull and the upper incisors and certain craniodental measurements) and are consequentially, described here as a new species. Based on thorough examination of the available museum material, it can be concluded that all specimens of *G. tylopus* previously collected in the Indochinese zoogeographic subregion are in fact representatives of this new species, while *G. tylopus* in a strict sense is restricted in the mainland to south of the Isthmus of Kra.

Key words: Southeast Asia, taxonomy, thick-thumbed Bat

Introduction

Among the Oriental bats which have developed pads at the base of the thumb and on the plantar surface of the foot, the genus *Glischropus* is distinguished by the following combination of characters: thumb pad unpigmented, elongated and developed but not forming a specialized, semicircular adhesive organ, tragus relatively narrow but broadly rounded, skull not especially flattened, the cavity of second upper incisor turned outwards, two premolars present in both upper and lower toothrows (Koopman 1994, Corbet and Hill 1992) and lower molars nyctalodont (Menu 1985).

Based on dental characters (Tate 1942, Menu 1985) and chromosome structure (Volleth *et al.* 2001) *Glischropus* is closely related to *Pipistrellus* and placed in the tribe Pipistrellini (Simmons 2005). This systematic position is supported by external features i.e. its general appearance, size and position of facial glands, shape of ear and tragus, proportions of wing bones and presence of a well-developed keel on the calcar, and agrees with recent DNA barcoding results based on mitochondrial COI sequences (Francis *et al.* 2010). The genus currently contains two species: *G. tylopus* (Dobson, 1875) and *G. javanus* Chasen, 1939 (Corbet and Hill 1992, Simmons 2005). This taxonomic arrangement was first suggested by Tate (1942) who regarded *G. batjanus* Matschie, 1901 (originally distinguished by its slightly smaller ears) as a junior synonym of *tylopus* (based on forearm length) and considered *javanus* distinct due to its larger size and differences in skull shape. Menu (1987) similarly regarded *javanus* as distinct on account of its skull morphology and certain differences in upper dentition and Koopman (1994) also noted these cranial differences viewing *javanus* as having a more flattened braincase. Corbet and Hill (1992) however, inversely characterized the two species noting the braincase of *javanus* as being more inflated than that of *tylopus*. Despite these conflicting views, all of the above authors noted that no overlap occurs in forearm length between the two species, *tylopus* being the smaller with a forearm length of no more than 31 mm.

According to the presently accepted view, *G. tylopus* occurs in Cambodia, Indonesia (Kalimantan, Maluku, Sumatera), Lao P.D.R., Malaysia (Sabah, Sarawak), Myanmar, Philippines, Thailand and Vietnam (Rosell-Ambal *et al.* 2008), whereas *G. javanus* is known only from two neighboring localities on Mt. Pangrango in western Java, Indonesia and has been collected on only two occasions seventy years apart (Hutson *et al.* 2008). Comparison of a

series of specimens recently collected from Cambodia with the types of *tylopus* and *javanus* however, reveals conspicuous craniodental differences. The Cambodian specimens are therefore considered distinct and described here as a new species.

Material and methods

Comparative material. *Glischropus tylopus*: BORNEO: BM(NH) 70.2.10.2 (holotype), 0.7.29.10, 10.4.5.67, 10.4.5.68, 10.4.5.69, 10.4.5.70, 7.1.1.406, 85.96, 95.11.5.4, 95.11.5.4x; MZB 26465; RMNH 32603, 32605, 32606, 32607, 32608, 32677; ZMA 19904; MALAYSIA: MHNG 1701.077, 1701.078, 1970.063; SUMATRA: RMNH 30266, 30267, 30268; MHNG 1481.072; THAILAND: PSU 2005.176; HNHM 2009.52.1. *Glischropus javanus*: JAVA: RMNH 15323 (holotype).

Museum acronyms. BM(NH): The Natural History Museum, London, UK, formerly British Museum (Natural History); CBC: Center for Biodiversity Conservation, Phnom Penh, Cambodia; HNHM: Hungarian Natural History Museum, Budapest, Hungary; IEBR: Institute of Ecological and Biological Resources, Hanoi, Vietnam; MHNG: Museum d'histoire naturelle, Geneva; MZB: Muzeum Zoologicum Bogoriense, Bogor, Indonesia; PSU: Prince of Songkla University, Hat Yai, Thailand; RMNH—National Museum of Natural History, Leiden, The Netherlands, formerly Rijksmuseum van Natuurlijke Historie; ZMA—Zoologisch Museum, Amsterdam, The Netherlands.

Measurements. Only fully grown adults were measured and used in comparisons. All measurements were taken by the author with digital calipers. Forearm length (FA) was taken from dry or alcohol preserved museum specimens with 0.1 mm accuracy. The following craniodental measurements were taken to the nearest 0.01 mm under a stereo microscope: STL: total length of skull—from the anterior rim of alveolus of the first upper incisor to the most projecting point of the occipital region; CCL: condylocanine length—from the exoccipital condyle to the front of upper canine; CCW: upper canine width—taken across the outer borders of upper canines; M³M³W: upper molar width—taken across the outer crowns of the last upper molars; ZYW: zygomatic width—the greatest width of the skull across the zygomatic arches; IOW: interorbital width—the least width of the interorbital constriction; CM³L: maxillary toothrow length—from the front of upper canine to the back of the crown of the third molar; ROW: rostral width—measured between the widest points of lachrymal tubercles; MAL: length of mandible—from the anterior rim of the alveolus of the first lower incisor to the most posterior part of the condyle; CM₃L: mandibular toothrow length—from the front of the lower canine to the back of the crown of the third lower molar.

All statistical analyses were carried out with R 2.10.1. (R Development Core Team 2009). Measurements of *Glischropus n. sp.* and *G. tylopus* were compared using Welch two sample t-tests. As *G. javanus* was represented by only one specimen it was compared with *Glischropus n. sp.* by using a one sample t-test. Measurements of *G. javanus* were treated as hypothetical means in these tests. According to quantile-comparison plots the assumptions of t-tests were satisfied. All tests were two-tailed.

Results

Glischropus bucephalus n. sp.

Figs. 1–4, Table 1.

Type material. Holotype: HNHM 2006.34.49. (field number CSOCA 113), adult male, in alcohol, skull extracted. Collected by G. Csorba, G. Ronkay and L. Duval on 29 January, 2006.

Type locality. Seima Biodiversity Conservation Area, Mondolkiri Province, Cambodia, 12°15'44N 107°03'49E, 360 m a.s.l.

Paratypes. BM(NH) 2006.545 (# SBCA 14), adult female, in alcohol, skull extracted; CBC 01202 (# SBCA 5), adult male, skin and skull, skinned body in alcohol registered as HNHM 2005.82.5; HNHM 2006.34.37. (# CSOCA 101), adult female, dry skin, skinned body in alcohol, skull extracted; HNHM 2006.34.45. (# CSOCA 109), adult male, in alcohol, skull extracted; HNHM 2006.34.46. (# CSOCA 110), adult male, in alcohol, skull extracted; HNHM 2006.34.48. (# CSOCA 112), adult female, in alcohol; HZM 1.39552 (# SBCA 13), adult male,

in alcohol, skull extracted. All paratypes were collected on the same locality as the holotype specimen by J. Walston and B. Hayes on December 2003 and April 2005 and by G. Csorba, L. Duval and G. Ronkay on January, 2006.

Referred material. THAILAND: PSUZC-MM 2005.206 adult male, in alcohol, skull extracted, Chantaburi Province. VIETNAM: HNHM 23061 adult male, in alcohol, skull extracted, Pu Huong NR., Nghe An Province; HNHM 22859 adult female, in alcohol, skull extracted, Cat Tien NP., Dong Nai Province; IEBR PL47 adult male, in alcohol, skull extracted, Vinh Cuu NR., Dong Nai Province; IEBR CT25 subadult male and IEBR CT26 subadult female, both in alcohol, skulls extracted, Cat Tien NP., Dong Nai Province.

Etymology. The specific epithet (meaning “ox-headed” in English) refers to the massive and elevated frontal region of the new species relative to its congeners. The proposed English name is ‘Indochinese Thick-thumbed Bat’.

Description. Forearm length above 32 mm (Table 1); ears moderate in size, rounded and dark colored; tragus relatively narrow, broadly rounded and angled slightly forward, typically *Pipistrellus*-like (Fig. 1). The fur is rather long and dark brown without banding above and ventrally, individual hairs are dark brown basally, with the upper third a lighter, yellowish brown. The plagiopatagium is attached to the base of the toe and the calcar has a well-developed lobe supported by a central cartilage. The thumb has a large pinkish pad, which is oval in outline and ca. 3 mm in length. The sole of the foot is thickened and unpigmented.



FIGURE 1. Portrait of a living specimen of *Glischropus bucephalus* n. sp. (paratype, HNHM 2006.34.37., from Cambodia).

The skull has an elevated frontal region and a relatively globose braincase (Fig. 2). The narial emargination is narrow, the sagittal crest weak but present and the lambdoid crests are moderately developed. The zygoma is delicate without any dorsal projection or thickening. The basioccipital pits are ill-defined. The tips of the four upper incisors are situated in an almost straight line and the cavity of the second upper incisor (I^3) is turned outwards (Fig. 3). The first incisor (I^2) is clearly bifid and I^3 reaches half the height of I^2 . The main cusp of I^3 is much longer than

the faint secondary cusplet of the same tooth and its tip is directed downwards (Fig. 4). The first upper premolar is basally as large as I^2 and is fully intruded from the toothrow and almost completely obscured in the lateral view; its cusp reaches far beyond the cingulum of the posterior premolar. The upper and lower molars show no specific modifications and the lower molars are nyctalodont.

TABLE 1. Forearm length and selected craniodental measurements of *Glischropus* species (acronyms are defined in the Materials and Methods section). Values are given as minimum, maximum, sample size (in parentheses), mean and SD. All units are in millimeters.

Character	<i>G. bucephalus</i> n. sp.		<i>G. tylopus</i>		<i>G. javanus</i>
	min–max (n)	mean ± SD	min–max (n)	mean ± SD	(holotype)
FA	32.1–35.7 (14)	34.1 ± 0.99	27.9–30.9 (24)	29.3 ± 0.82	32.0
STL	12.19–13.05 (10)	12.53 ± 0.25	11.16–12.72 (22)	11.85 ± 0.35	12.03
CCL	11.61–12.39 (10)	11.95 ± 0.24	10.68–12.06 (22)	11.26 ± 0.33	11.4
CM ³ L	4.63–4.85 (9)	4.75 ± 0.07	4.20–4.74 (25)	4.45 ± 0.12	4.67
CCW	3.97–4.24 (9)	4.08 ± 0.07	3.46–4.03 (22)	3.80 ± 0.14	3.95
M ³ M ³ W	5.61–5.98 (9)	5.77 ± 0.12	4.97–5.42 (22)	5.24 ± 0.10	5.32
IOW	3.53–3.93 (10)	3.66 ± 0.11	3.33–3.66 (22)	3.51 ± 0.10	3.72
ROW	4.87–5.17 (9)	5.00 ± 0.09	4.16–4.69 (22)	4.46 ± 0.13	4.63
MAL	8.77–9.54 (10)	9.04 ± 0.23	7.89–8.98 (24)	8.35 ± 0.27	8.54
CM ₃ L	4.88–5.17 (10)	5.05 ± 0.09	4.45–4.94 (25)	4.64 ± 0.11	4.91

Comparisons. *G. tylopus* is significantly ($p < 0.001$) smaller than *G. bucephalus* n. sp. in all measured characters (Table 1) with no overlap in forearm length, upper molar width and rostral width. In addition, the skull of *G. tylopus* is flatter, with an almost straight rostral profile, no sagittal crest (Fig. 2) and a wider narial emargination. Dentally, the second upper incisor (I^3) of *G. tylopus* is also much shorter than the secondary cusp of I^2 and the main cusp of I^3 barely exceeds the additional cusplet of the same tooth, with its tip directed slightly forwards (Fig. 4).

The original description of *G. batjanus* by Matschie (1901: 277) was based on one juvenile and four adult (three females and one male) individuals. Although the specimens were not seen the forearm measurements (27.5–29.0 mm) of the adult specimens and the upper toothrow length (4.2 mm) of the type specimen provided by Matschie fall into the size range of *G. tylopus* and consequently distinguish *batjanus* from *G. bucephalus* n. sp.

G. javanus, of which only the holotype specimen is available, is also significantly smaller than *G. bucephalus* n. sp. ($p < 0.001$) with the exception of the interorbital width. Skull shape, sagittal crest development and upper incisor proportions in *javanus* are essentially the same as those of *G. tylopus*, and *G. bucephalus* n. sp. can therefore be separated from *javanus* on the same grounds.

Habitat. Roosts of *Glischropus* species within stalks of dead bamboo were reported for *G. javanus* by Chasen (1939) from Java and for *G. tylopus* by Kofron (1994) from Brunei. The type locality of *G. bucephalus*, Seima Biodiversity Conservation Area, comprises 3,034 km² of grasslands, secondary deciduous dipterocarp forest and some evergreen hill forest (SCW 2006), and includes large stands of giant bamboo. Another bamboo specialist, *Tylonycteris pachypus*, also occurs in significant numbers at the site (Csorba, unpublished data). In Thailand, a male individual of *Glischropus* was caught at the edge of lowland wet evergreen forest, 100 m a.s.l (Bumrungsri, pers. comm.).

Distribution. This is the first published record of *Glischropus* from Cambodia. In Myanmar, Bates *et al.* (2005) cited a single record from Blandford (1888–91) who mentioned *G. tylopus* from the Karen Hills. No further data was given in these papers.

In Thailand, Lekagul & McNeely (1977) referred to *G. tylopus* as “...found throughout the country whenever there are forests. It is rare.” but provided skull photographs of a specimen from Borneo (stored in the American Museum of Natural History Museum, New York) which clearly shows the cranial features of *G. tylopus sensu stricto*. However, Yenbutra & Felten (1986), in listing bat specimens in the Thai national reference collection (TISTR) in Bangkok and the Senckenberg Museum in Frankfurt, mentioned only a single locality for *G. tylopus* in the country: Bang Lan Dan in Yala Province, peninsular Thailand. As two other Thai specimens collected south of

the Isthmus of Kra (studied in the collections of PSU and HNHM) represent *G. tylopus*, while one individual caught in Chantaburi Province north of this zoogeographic border proved to be *G. bucephalus* **n. sp.**, the specimen mentioned by Yenbutra and Felten (1986) likely also represents *G. tylopus sensu stricto*.

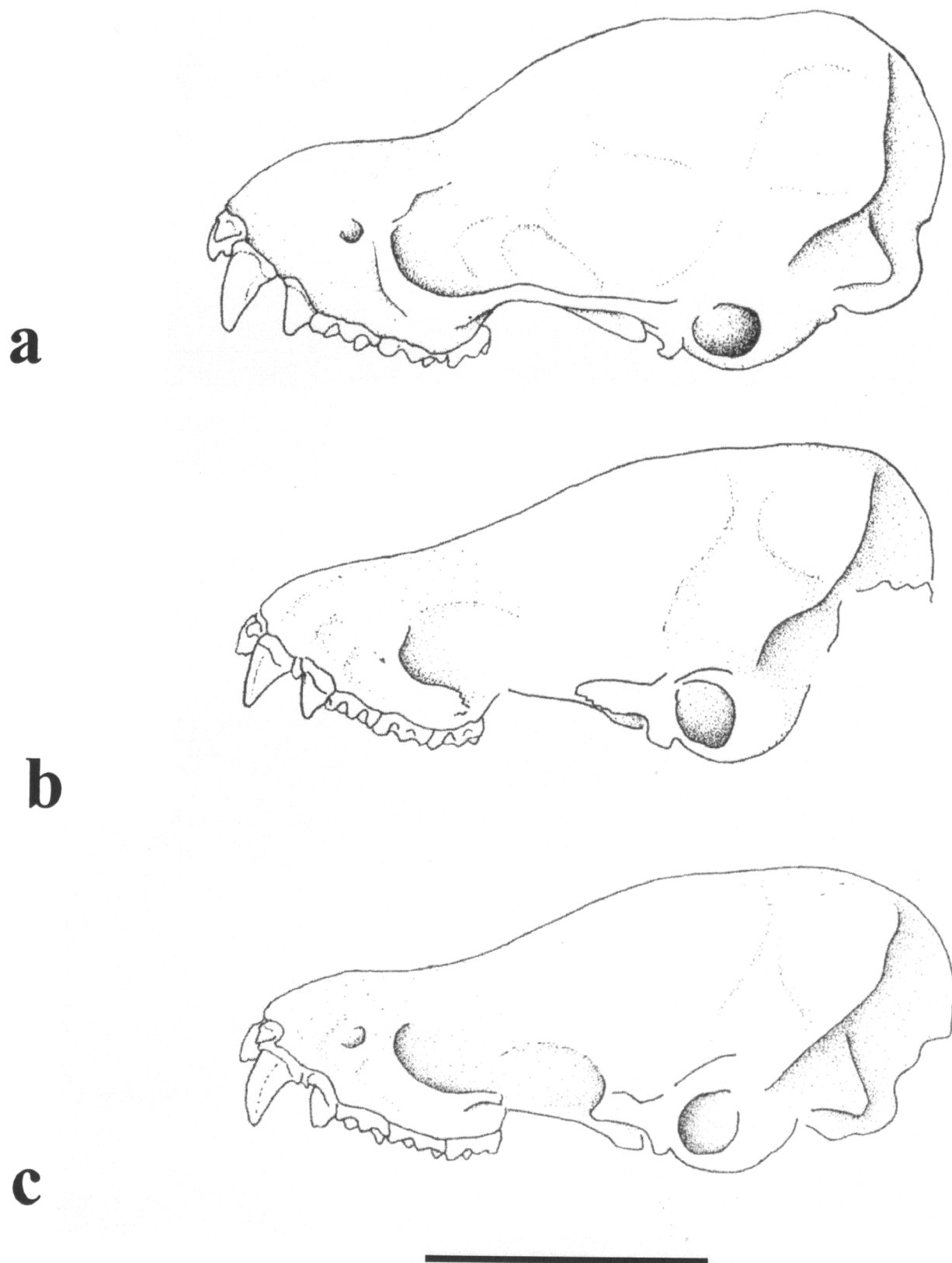


FIGURE 2. Lateral view of skulls of (A) *Glischropus bucephalus* **n. sp.** (holotype, HNHM 2006.34.49., from Cambodia) (B) *G. tylopus* (holotype, BM(NH) 70.2.10.2, from Borneo) (C) *G. javanus* (holotype, RMNH 15323, from Java). Scale = 5 mm.

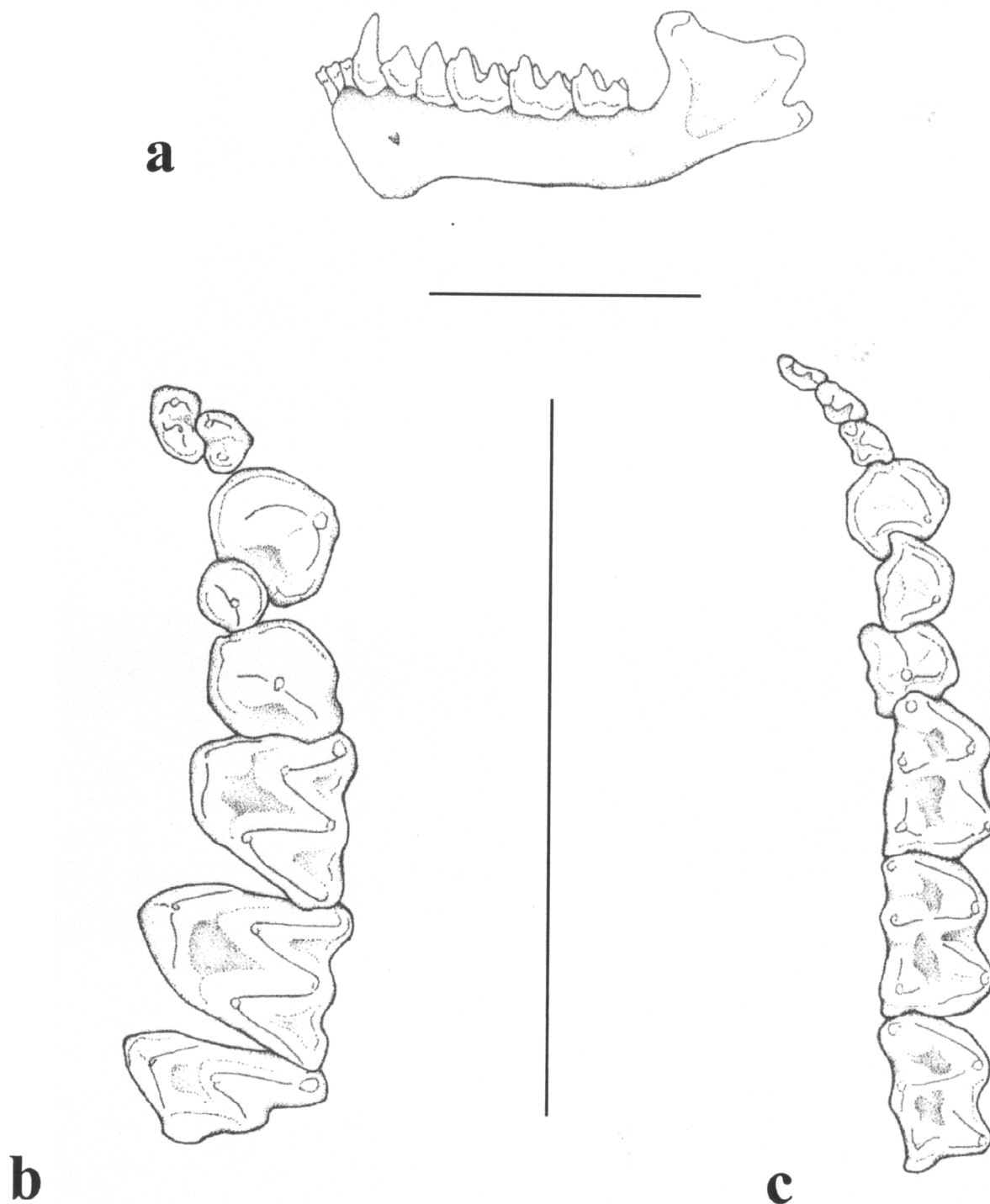


FIGURE 3. Holotype of *Glischropus bucephalus* **n. sp.** (HNHM 2006.34.49.); (A) lateral view of left mandible (B) occlusal view of left upper and (C) right lower tooththrows. Scale = 5 mm.

In Lao P.D.R., Guillen *et al.* (1997) and Francis *et al.* (1999) mentioned the occurrence of *Glischropus* from two areas (Phou Khao Khoay NBCA and Theun-Hinboun) without further details. However, forearm length measurements in 8 specimens from Laos—ranging from 32.7 to 34.6 mm—suggest these individuals represent *G. bucephalus* **n. sp.** (Francis, pers. comm.).

Judging from a skull drawing and forearm measurements of five individuals (32.8–35.7 mm) attributed to *G. tylopus* by Borissenko and Kruskop (2003: pp. 174, 184), *G. bucephalus* **n. sp.** also occurs in the Cat Loc area of Lam Dong Province, Vietnam. This is the only published record of the genus from the country to date (Dang Ngoc Can *et al.* 2008).



FIGURE 4. Frontal view of left upper incisors of (A) *Glischropus bucephalus* **n. sp.** (holotype, HNHM 2006.34.49., from Cambodia) (B) *G. tylopus* (BM(NH) 10.4.5.68, from Borneo). Scale = 1 mm.

The DNA-barcoded PSU specimen of *G. tylopus* from peninsular Thailand differed by an average of c. 11% from the three *Glischropus* specimens published in Francis *et al.* (2010) (Francis, pers. comm.). The latter (assigned in the above paper as *G. tylopus*) originated from Vietnam and Laos and most likely represent the new species. These genetic data strongly support the view that *G. bucephalus* **n. sp.** is widely distributed in the Indochinese Subregion north of the Isthmus of Kra while specimens from peninsular Thailand represent *G. tylopus*.

Remarks. According to Menu (1987), *G. javanus* is somewhat intermediate in form between *Glischropus* and *Pipistrellus* having a less developed thumb pad and the second upper incisor rotated outwards to a lesser degree compared with *G. tylopus*. Examination of the holotype for *G. javanus* indicates, however, that this taxon clearly possesses the characters that define *Glischropus* and differentiate it from true *Pipistrellus*. *G. javanus* is larger externally than *G. tylopus*, though with the exception of the interorbital width, all of its craniodental measurements are within the range of the latter species. The skulls of *G. tylopus* and *G. javanus* type specimens show slight differences in profile (Fig. 2); however, their range of variability falls within the individual variation observed in *tylopus* specimens. Accordingly, in spite of the views of Corbet and Hill (1992) and Koopman (1994), the two taxa cannot be distinguished on the basis of braincase inflation.

Unfortunately, other specimens recorded as *G. javanus* in the literature and museum collections proved on further investigation to represent other taxa. The RMNH 32617 specimen (skull in bad condition and determined by K.F. Koopman as *G. javanus*) from Tjidjoedjoeng, Buitenzorg (= Mt. Pangrango, Bogor), Java is a *Hypsugo* presumably belonging to the “*imbricatus*-subgroup”. Although no further data were provided by the authors, this specimen may represent the second (and therefore erroneous) record for *G. javanus* from Mt. Pangrango in Hutson *et al.* (2008). Further specimens identified as *G. javanus* from Krakatau, Indonesia and housed in the collection of MZB (16920, 16922) proved to be *Pipistrellus*.

Although some specimens of *Glischropus* from continental Southeast Asia mentioned in the literature were not available for study, the material investigated indicates a clear geographic division between *G. tylopus* and *G. bucephalus* **n. sp.**, with the former occurring south of the Isthmus of Kra and the latter northwards of this region. Woodruff and Turner (2009) found no evidence for a narrow mammalian faunal transition near the Isthmus of Kra (contrary to the case in birds), but also acknowledged limitations in their data due to possible misidentifications of museum material, and further anticipated that systematic revisions, discovery of cryptic species and changes in species designations could challenge their findings in some instances. The discovery of a new species of thick-thumbed bat in the Indochinese subregion and the likely restricted occurrence of its congeners to the Sundaic subregion may represent such a case.

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