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Authors: Vanitharani, Juliet, Rajendran, Albert, Bates, Paul J. J., Harrison, David L., and Pearch, Malcolm J.

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A taxonomic reassessment of *Kerivoula lenis* Thomas, 1916 (Chiroptera: Vespertilionidae) including a first record from peninsular India

JULIET VANITHARANI[1], ALBERT RAJENDRAN[2], PAUL J. J. BATES[3], DAVID L. HARRISON[3], and MALCOLM J. PEARCH[3]

[1]*Department of Zoology, Sarah Tucker College, Tirunelveli – 627 007 Tamil Nadu, India*
E-mail: juliet@sancharnet.in
[2]*Research Department of Zoology, St. John's College, Palayamkottai, Tirunelveli – 627 002, Tamil Nadu, India*
[3]*Harrison Institute, Centre for Systematics and Biodiversity Research, Bowerwood House, St. Botolph's Road, Sevenoaks, Kent, TN13 3AQ, Great Britain*

In January 2002, a specimen of *Kerivoula lenis* was collected in Tirunelveli District, southern Tamil Nadu, India. It represents a range extension of over 1950 km. This is the first record of the taxon since its original description from Calcutta in 1916. The taxonomic status of *K. lenis* is reassessed. It is compared for the first time with *K. papillosa* and *K. flora* and more briefly with the nine other species of *Kerivoula* currently recognised in Asia.

Key words: Chiroptera, India, systematics, distribution, *Kerivoula lenis*

INTRODUCTION

Kerivoula lenis Thomas, 1916 was described as a species closely allied to *Kerivoula papillosa* Temminck, 1840, but with a smaller skull and teeth, shorter muzzle and narrower palate. The type locality was given as Calcutta, India, which Thomas (1916) stated "may be provisionally accepted as correct". Although the taxon *lenis* was described in 1916, the single specimen on which it was based, had been presented by J. T. Pearson to the Indian Museum in 1879. It was included in Blanford (1888–1891), who referred it to *K. papillosa* but expressed doubts over its origin, stating that it was "not absolutely proved [...] that the specimen was Indian". Blanford (1888–1891) also mentioned a second specimen from Sri Lanka, but noted that the identification was less certain. There are no further records of this latter specimen.

In his description of *K. p. malayana*, Chasen (1940) commented that *K. lenis* was "rather smaller than *papillosa*" but made no further comments. Chasen (1940) distinguished *K. p. malayana* from the nominate subspecies by its larger skull. However, Tate (1941) suggested that *malayana* was "not especially larger" and there was little difference in size between the two subspecies. Meanwhile, Tate (1941) considered

lenis to be a "near relative" of *papillosa* [and *malayana* "and perhaps *jagorii*" (Peters, 1866)] but did not equate this to any particular taxonomic rank (*jagorii* is now included in the genus *Phoniscus* Miller, 1905). Subsequent authors, whilst accepting the type locality of *lenis*, reduced its taxonomic rank to that of a subspecies of *K. papillosa*, without comment. These included Ellerman and Morrison-Scott (1951); Hill (1965), who included four cranial and dental measurements; Corbet and Hill (1992), who noted that the holotype of *lenis* is a little smaller than the more eastern specimens of *K. papillosa*; and Bates and Harrison (1997), who also noted the smaller size of *lenis* and suggested that the status of the taxon is unclear. Meanwhile, Payne *et al.* (1985) in their brief review of *K. papillosa* from Borneo gave ranges of forearm and mass measurements of 38–49 mm and 6–13 g respectively and suggested that more than one species may have been included. This suggestion was made again by Kingston *et al.* (1999) who noted that size variation in specimens that they referred to *K. papillosa* was extensive. They divided their adult specimens into two arbitrary size classes: smaller individuals with a forearm length < 40.0 mm (37.8–40.0) and a body mass ≤ 7.0 g (6.0–7.0 g) and larger individuals with a forearm length > 40.0 mm (40.5–45.0) and a body mass > 7.0 g (7.5–11.0). They were referred to '*K. papillosa* s[mall]' and '*K. papillosa* l[arge]' respectively. They also noted that the echolocation calls of the two taxa differed in the start, end, peak and centre of frequencies.

The recent specimen from Tamil Nadu, southern India is compared to the type of *K. lenis*. In turn, the taxon *lenis* is compared in detail for the first time with *K. papillosa* and *K. flora* Thomas, 1914*b* and is reviewed in the context of the nine other species of *Kerivoula* currently recognised from Asia.

Material and Methods

The single specimen (ALB-01) was collected at 18:30 h on 13 January, 2002 in a deserted rest house situated in the private Therkumalai Estate, which is at an altitude of 800 m in the Courtallam Hills, Tirunelveli District, Tamil Nadu (approx. 08°50'N, 77°21'E). It was captured in a butterfly net whilst flying around one of the rooms of the old dilapidated building, the cracked walls of which were made of raw unburnt brick with red clay soil mortar. There were many crevices in the tiled roof, which was supported by Palmyra palm planks and bamboo reapers. The Therkumalai Estate has a warm tropical monsoon climate, with an average annual rainfall of 3100 mm. Maximum and minimum temperatures range between 23° and 34°C, and between 16° and 25°C, respectively (Rajendran, 1996). The Courtallam Hills have scrub jungles in the foothills (70 to 150 m a.s.l.). These merge with semi-evergreen and tall evergreen species in the upper reaches (above 400 m m a.s.l.), without any indication of deciduous forests in between. The common species within and adjacent to Therkumalai Estate are *Alstonia scholaris*, *Syzygium cumini*, *Schleichera oleosa*, *Dalbergia paniculata*, *Michelia chambaga* and *Canarium strictum*. On the open exposed areas, the grass *Cymbopogan flexiosus* is abundant, whilst *Ochlandra* reed brakes occur in damp sites among the evergreen and semi-evergreen forests. Commercial plants include *Gossinia mongostana*, *Miristica fragrans*, *Syzygium aromaticum*, *Areca catechu* and *Citrus* spp. (Rajendran, 1996). Fifteen external, cranial and dental measurements were taken for each specimen. HB: head and body length — from the tip of the snout to the base of the tail, dorsally; T: tail length — from the tip of the tail to its base adjacent to the body; HF: (hind) foot length — from the extremity of the heel behind the os calcis to the extremity of the longest digit, not including the claws; TIBIA: length of tibia — from the knee joint to the ankle; FA: forearm length — from the extremity of the elbow to the extremity of the carpus with the wings folded; E: ear length — from the lower border of the external auditory meatus to the tip of the pinna; GTL: greatest length of skull: the greatest anteroposterior diameter of the skull, taken from the most projecting point at each extremity; CBL: condylobasal length — from an exoccipital condyle to the alveolus of the anterior incisor; CCL: condylo-canine length — from an exoccipital condyle to the alveolus of the anterior incisor; ZB: zygomatic breadth — the greatest width of the skull across the zygomatic arches; BB: breadth of braincase — greatest width of the braincase at the posterior roots of the zygomatic arches; C–M^3: maxillary toothrow length — from the

front of the upper canine to the back of the crown of the third molar; $C–M_3$: mandibular toothrow length — from the front of the lower canine to the back of the crown of the third lower molar; $M^3–M^3$: posterior palatal width — taken across the outer borders of the third upper molars; MDL: mandible length — from the most posterior part of the condyle to the most anterior part of the mandible. These measurements are illustrated in Figs. i–v in Bates and Harrison (1997). In addition, two further measurements were taken for one specimen of *K. lenis* (ABL-01) from Therkumalai Estate only. These were included to facilitate further comparison with the description of the holotype of *K. lenis* included in Thomas (1916). Length of third metacarpal — from the extremity of the carpus to the distal extremity of the metacarpal; and lower leg with hind foot and claw — from the knee joint to the tip of the longest claw, with leg extended. Descriptive statistics are given in the following format: $\bar{x}$, range, and SD.

Results

Intraspecific Variation

Comparative material

Kerivoula lenis: India: ♂, ALB-01, Therkumalai Estate, Tamil Nadu, approx. 08°50’N, 77°21’E; sex?, BM.79.11.21.126, holotype, Calcutta, West Bengal, 22°35’N, 88°21’E; Malaysia: ♂, BM.1988.46, Pasoh Forest Reserve, Negri Sembilan, approx. 02°58’N, 102°16’E; 2 ♂♂, BM.84.2071/2075 Sepilok, Sabah.

Description

The recent specimen from Tamil Nadu compares favourably in size to that of the holotype of *lenis*. Although the forearm length at 38.6 mm is shorter than that recorded for the type at 41 mm, the length of the third metacarpal is comparable, 42.4 and 42.5 mm, respectively; so too is the measurement for the lower leg and hind foot with claw, 29.3 and 29 mm. The measurements for the holotype are based on those originally cited by Thomas (1916). Three other specimens from Malaysia here assigned to *K. lenis* are also comparable in size with a forearm length range of 37.2–40.2 mm. The skull of the holotype of *K. lenis* is badly damaged. However, the dentition, rostrum and palate are complete and compare favourably in size and shape to those of the recent specimen from Tamil Nadu and the three other specimens from Malaysia, although the palate is narrower than in the four other specimens seen (Table 1).

Interspecific Variation

Comparative material

Kerivoula papillosa malayana: Malaysia: ♀, BM.47.1438, holotype, Ginting, Bidai, approx. 01°22’N, 110°08’E; ♂ and ♀, BM.62.723–724, Ulu Gombok, 308 m a.s.l., 03°20’N, 101°45’E; ♀, BM.67.1608, Pahang, Selangor, 03°51’N, 102°11’E; ♂, BM.60.1569, 22 km from Pahang, Selangor; ♀, BM.16.4.20.6, Semangko Pass, Selangor/Pahang boundary, approx. 03°36’N, 101°44’E; ♂ and ♀, BM.93.4.1.30–31, Sarawak; ♀ and sex?, BM.84.2066–67, Gomantong, Sabah, 05°33’N, 118°06’E; ♂, BM.84.2079, Baturong, Sabah, 05°01’N, 118°20’E; ♀, BM.84.2068, Madai, Sabah, 05°01’N, 118°21’E; 3 ♂♂, BM.84.2069 (subadult)/2073/2074, Sepilok, Sabah; ♀, BM.84.2072, Sepilok, Sabah; ♂, BM.84.2080, Rinangisan, Sabah; 2 ♀♀, BM.84.2076/2077, Segarong, Sabah, approx. 04°29’N, 118°36’E; 2 ♂♂, BM.84.2064/2065 (subadult), Bodi Tai, Sabah; ♂, BM.51.161, Caves near Long Lama, Baram River, Sarawak, 03°46’N, 114°28’E; Indonesia: ♂, BM.1982.147, River Ranu, Sulawesi, 01°51’S, 121°30’E; Cambodia: 3 sex?, BM.7.1.1.535–537, no exact locality.

Kerivoula flora: Indonesia: ♂, BM.97.4.18.22 (holotype) S. Flores, Lesser Sunda Islands, centered on 08°40’N, 121°00’E; Vietnam: ♂, HZM.1.32607, Kon Ka Kinh Nature Reserve, 14°18’N, 108°25’E; ♀, HZM.5.31779, Pu Mat, 18°58’N, 104°46’E; Thailand: sex?, BM.78.2385, Chiang Mai, 18°59’N, 98°58’E.

TABLE 1. Cranial and dental measurements (in mm) of three species of *Kerivoula*; x̄, SD, minimum–maximum, sample size in parentheses where different to *n*. Used abbreviations: GTL: greatest length of skull; CBL: condylo-basal length; CCL: condylo-canine length; ZB: zygomatic breadth; BB: breadth of braincase; C–M^3: maxillary toothrow length; C–M_3: mandibular toothrow length; MDL: mandible length

Sample type, *n* and sex	GTL	CBL	CCL	ZB	BB	C–M^3	M^3–M^3	C–M_3	MDL
				Kerivoula lenis					
4♂♂	16.8, 0.16	15.4, 0.09	14.8, 0.15	10.2, 0.22	7.4, 0.13	6.8, 0.03	6.3, 0.07	7.3, 0.09	12.1, 0.15
	16.4–17.1	15.2–15.5	14.5–15.1	9.6–10.6	7.1–7.7	6.7–6.8	6.2–6.6	7.2–7.6	11.8–12.4
holotype (sex?)	–	–	–	–	–	6.6, –	6.0, –	7.2, –	11.9, –
				K. papillosa					
10♂♂	17.9, 0.12	16.7, 0.15	16.1, 0.15	11.2, 0.12	7.9, 0.05	7.3, 0.03	6.8, 0.03	8.0, 0.08	13.0, 0.12
	17.5–18.4	16.0–17.3 (9)	15.4–16.7 (9)	10.7–11.9 (9)	7.7–8.2	7.2–7.5	6.7–6.9	7.6–8.3	12.5–13.6
11♀♀	18.1, 0.13	16.9, 0.11	16.3, 0.13	11.3, 0.13	8.0, 0.05	7.4, 0.06	6.9, 0.04	8.1, 0.07	13.3, 0.09
	17.6–19.0	16.5–17.6	15.9–17.1	10.8–11.9 (8)	7.7–8.4	7.1–7.8	6.7–7.1	7.7–8.6	12.9–14.0
holotype (♀)	18.1, –	–	–	–	7.9, –	7.6, –	7.0, –	8.1, –	13.2, –
				K. flora					
1♂	16.1, –	–	–	9.0, –	7.4, –	6.2, –	5.6, –	6.7, –	–
holotype (♂)	16.2, –	14.9, –	14.4, –	9.5, –	7.5, –	6.2, –	5.7, –	6.7, –	11.4, –
2♀♀	15.6, –	14.4, –	13.9, –	9.2, –	7.6, –	6.1, –	5.5, –	6.4, –	–
	15.4–15.8	14.4–14.5	13.9 (1)	9.0–9.5	7.4–7.7	6.1–6.2	5.4–5.6	6.4 (1)	–

Description

Externally, *K. lenis* averages smaller than *K. papillosa*. However, there is some overlap in all measurements and smaller *papillosa* cannot be distinguished from larger *lenis* on external morphometric characters alone. This is especially the case for individuals with a forearm of between 40.0 –41.0 mm (Fig. 1, see also Table 2). Similarly, there is an overlap in external measurements between *K. lenis* and *K. flora* and the identity of individuals with a forearm of 37.0–40.0 mm cannot be determined with certainty.

Based on dry specimens, there would appear to be little difference in pelage colour between *lenis* and *papillosa.* However, future studies may identify some significant colour characters in live specimens in the field and Thomas (1916) in his description of *lenis* noted that the general colour is similar to *papillosa* but that the "head more whitish buffy, and the hairs of the back with their basal three-fifths dark slaty blackish; in *papillosa* only the bases are darker, and that not so strongly". It is not known whether this holds true for all individuals. In dry specimens of *papillosa*, the dorsal pelage has russet brown hair tips. On the ventral surface, the hairs are grey brown with dark roots. According to Kitchener *et al.* (1990), specimens of *flora* from Lombok have drab brown pelage with buff tips on the dorsal surface: slightly paler on the ventral surface. Like *papillosa* and *lenis*, the ears of *flora* have a well-defined emargination on the posterior borders. Thomas (1916) in his description of *lenis* suggested that the projection near the base of the outer margin of each tragus "is far longer and more pointed" in *lenis* than in *papillosa*. It is unclear whether this is a constant character.

The skulls of *K. lenis* are absolutely smaller than those of *K. papillosa* in all measurements except breadth of braincase (BB) and lower toothrow length ($C–M_3$), where there is some overlap. *K. lenis* exceeds *K. flora* in all measurements except breadth of braincase (Table 1). The rostrum of *K. lenis* is less robust than that of *K. papillosa*, being both relatively narrower and more shallow. As in *K. papillosa*, the braincase is inflated and considerably elevated above the rostrum; the sagittal crest is present but weak (Fig. 2). The palate ($M^3–M^3$)

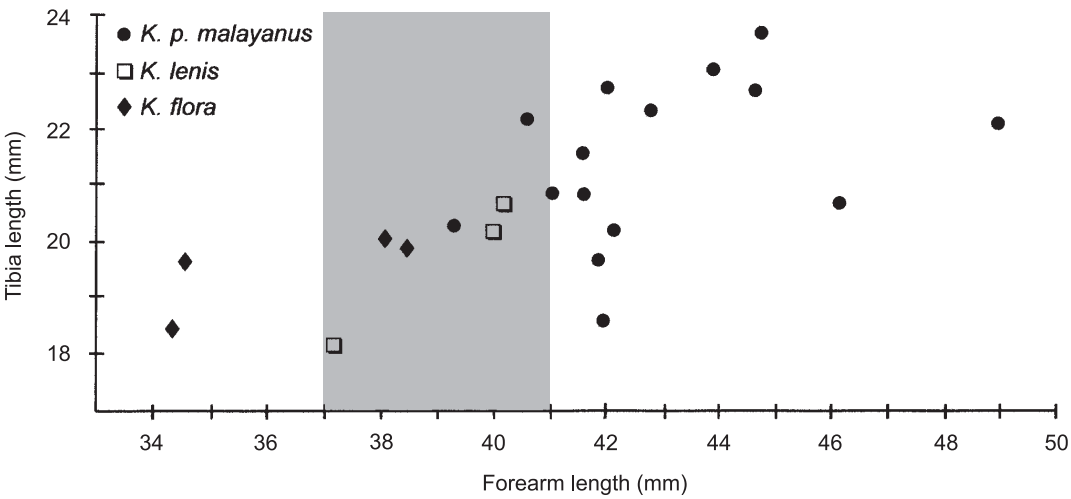

FIG. 1. The relationship between forearm length and tibia length for three species of *Kerivoula*. The zone of overlap in forearm length is shaded

TABLE 2. External measurements (in mm) and body mass (in g) of three species of *Kerivoula*; $\bar{x}$, SD, minimum–maximum, sample size in parentheses where different to *n*. Used abbreviations: HB: head and body length; TAIL: tail length; HF: foot length; TIB: tibia length; FA: forearm length; E: ear length; MASS: body mass

Sample type, *n* and sex	HB	TAIL	HF	FA	TIB	E	MASS
				Kerivoula lenis			
4♂♂	41.0, –	48.0, –	8.7, –	39.0, 0.70	19.7, 0.80	13.8, –	–
	41.0 (1)	48.0 (1)	8.7 (1)	37.2–40.2	18.2–20.7 (3)	13.8 (1)	–
holotype (sex?)	–	–	–	41[a]	–		
				K. papillosa			
10♂♂	54.5, –	50.0, –	9.0, –	42.5, 0.74	21.2, 0.40	13.0, –	7.0, –
	54–55 (2)	48–52 (2)	9 (1)	39.4–46.2 (9)	19.7–23.8 (9)	12–14 (2)	7.0 (1)
11♀♀	54.0, –	54.5, –	–	43.3, 1.17	21.4, 0.86	13.0, –	10.1, –
	53–55 (2)	54–55 (2)	–	41.1–48.9 (6)	18.6–23.1 (5)	13.0 (1)	10.1 (1)
holotype (♀)	–	–	–	–	–	–	
				K. flora			
1♂[b]	37.5, –	47.3, –	8.1	34.3, –	18.5, –	12.9, –	7.9, –
holotype (♂)	43.0, –	49.0, –	–	39.5, –	–	–	
3♀♀[b]	–	47.0, 1.40	7.7, 0.17	37.0, 1.25	19.9, 0.09	14.0, 0.55	6.0, –
	–	45.5–49.8	7.4–8.0	34.5–38.4	19.7–20.0	13.0–14.9	5.8–6.1 (2)

[a] — based on Thomas (1916)
[b] — includes data from Kitchener *et al*. (1990)

exceeds in breadth that of *K. flora*. Like *K. flora*, the internal aspects of the upper toothrows of *lenis* are virtually straight and only very slightly convergent (Fig. 3). In *K. papillosa*, the toothrows are slightly sinuous with the P^3s, in particular, situated closer together than the canines or molars. The teeth of *lenis* are less robust than those of *K. papillosa*, particularly the premolars, but exceed those of *flora* in size (Fig. 3). The three species are clearly distinguished from each other when upper toothrow length is plotted against palatal width (M^3–M^3; Fig. 4).

In *K. lenis*, the first incisor (I^2) is relatively large and unicuspidate with a well-defined cingulum on its internal posterior aspect; it exceeds the third premolar (P^4) in height. The second incisor (I^3) is tricuspidate and smaller; it is less than half the height of I^2. The canine is well-developed with a broad base and a well-defined cingulum on its internal border; it considerably exceeds that of *flora* in size. The first premolar (P^2) exceeds the second (P^3) in height and has a larger crown area. The third (P^4) is between half and two-thirds the crown area of the first molar (M^1). The upper premolars are larger than those of *flora*, but they are absolutely and relatively narrower than those of *K. papillosa*. This is especially marked in the case of P^3. The first (M^1) and second (M^2) molars have well-developed para- and mesostyles. The third molar (M^3) has the metastyle absent. In the mandibular dentition, the first (I_1) and second (I_2) incisors are tricuspidate. In the third incisor (I_3), the central cusp is well-defined, with the lateral cusps absent. The lower canine is well-developed and with a clearly defined cingular cusp on its antero-internal border. All three lower premolars are equal in height; the second (P_3) has a slightly smaller crown area. They exceed those of *flora* in size but are relatively and absolutely smaller than those of *papillosa*; this is most evident in P_3. The first molar (M_1) is very slightly larger than the second (M_2); in both, the talonid has a larger crown area than the

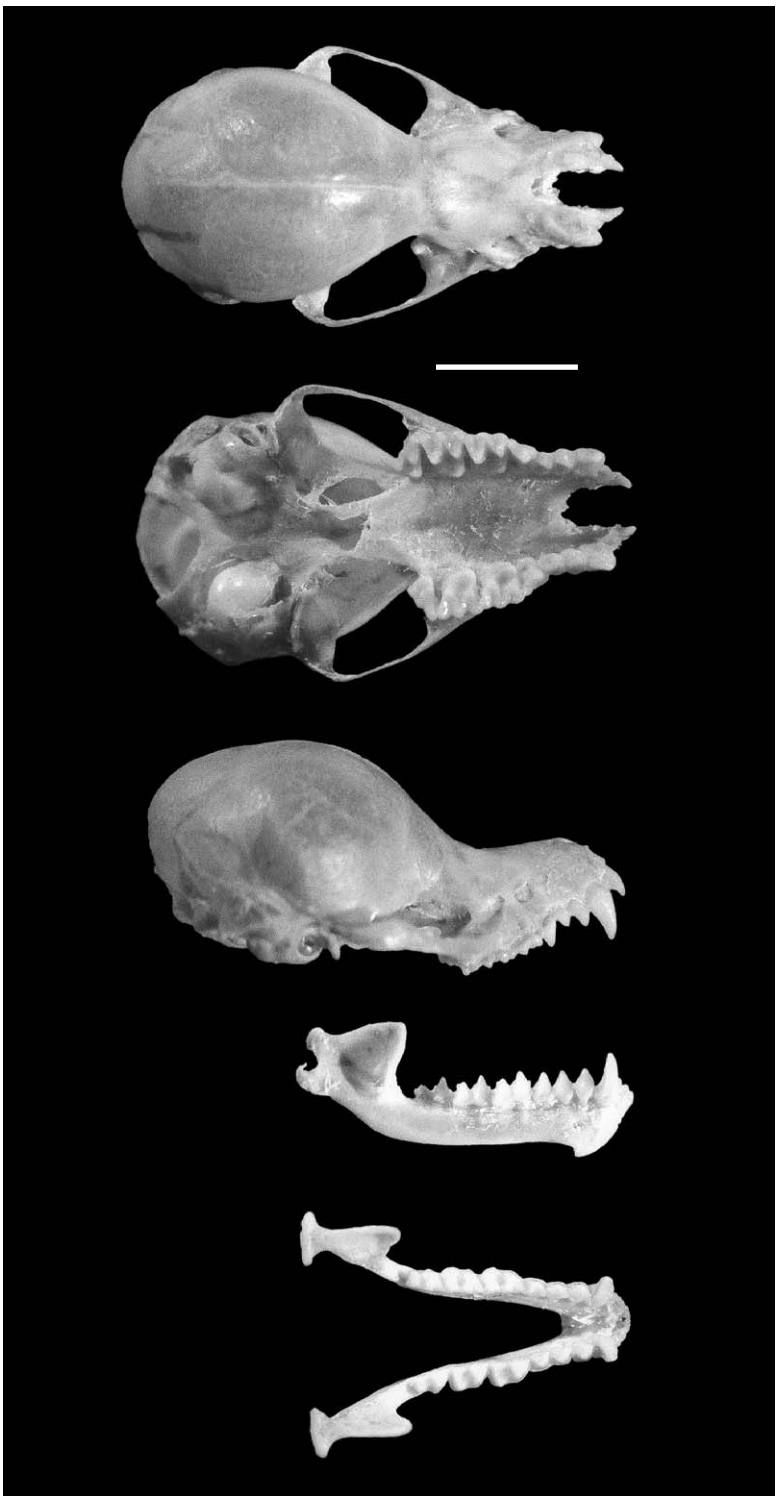

FIG. 2. Dorsal, ventral and lateral views of the cranium, and lateral and dorsal views of the mandible of *Kerivoula lenis*: ALB-01, Tamil Nadu, India. Scale = 5 mm

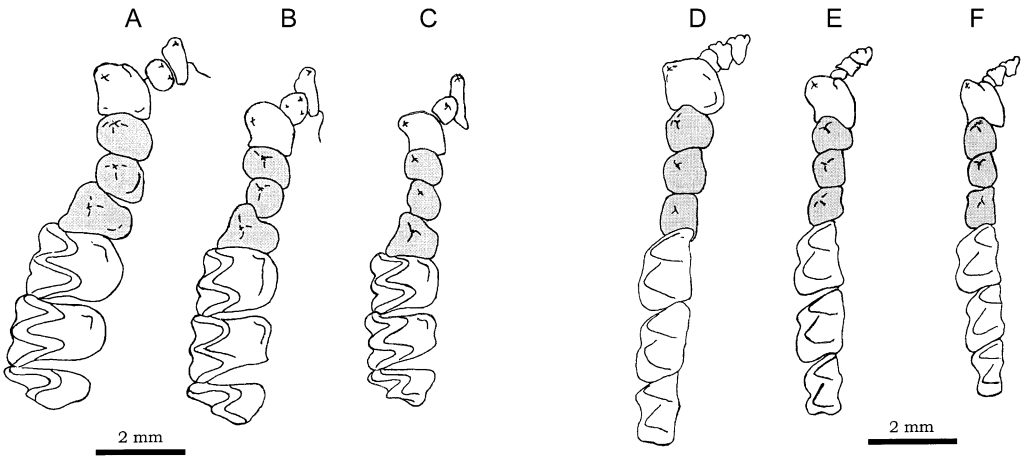

FIG. 3. Occlusal views of the maxillary (A–C) and mandibular (D–F) dentition of three species of *Kerivoula*, with the premolars shaded to emphasise the difference in relative size between the three species. A and D: *K. papillosa*, BM.67.1608, Gunong Benom, Malaysia; B and E: *K. lenis*, ALB-01, Tamil Nadu, India; C and F: *K. flora*, HZM.1.32607, Kon Ka Kinh Nature Reserve, Vietnam. Scale = 2 mm

trigonid. In the third molar (M_3), the talonid is reduced to about half to two-thirds the size of the trigonid, which is subequal in size to that of M_2. The molars, particularly M_3, are noticeably smaller in *K. flora.*

Distribution

On the basis of specimens examined for this study, *K. lenis* is now known from peninsular and eastern India, peninsular Malaysia and Sabah [for details see 'comparative material'] (Fig. 5). Specimens of *K. papillosa* were seen by the authors from peninsular Malaysia, Sarawak, Sabah, Sulawesi and Cambodia. In addition, it is recorded from Sumatra, Java, Thailand, Vietnam, and Lao PDR (McBee *et al.*, 1986; Corbet and Hill, 1992; Francis *et al.*,

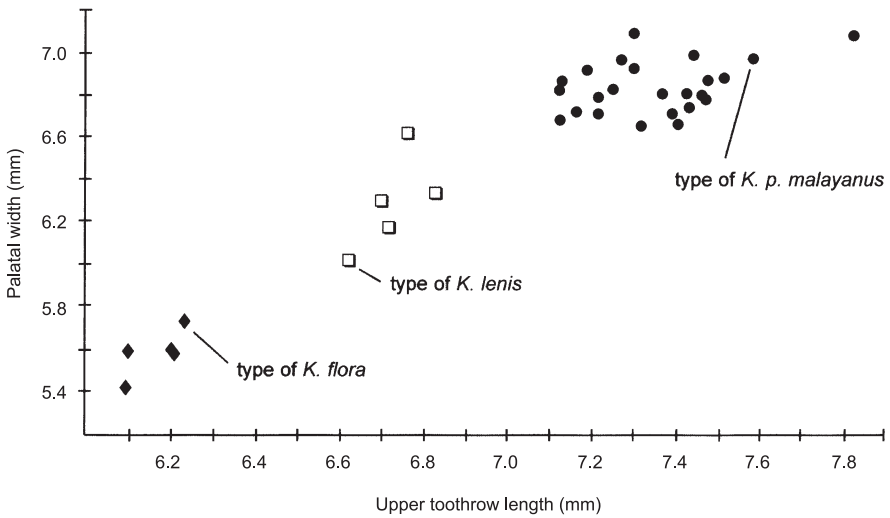

FIG. 4. The relationship between upper toothrow length (C–M^3) and palatal length (M^3–M^3) for three species of *Kerivoula*

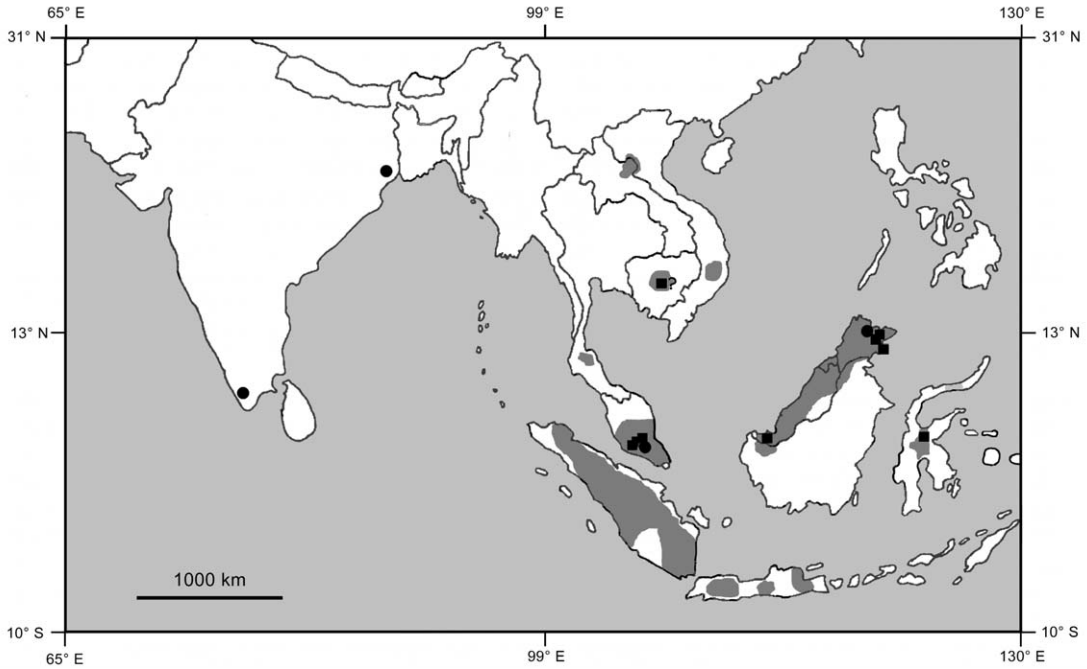

FIG. 5. Distribution of *K. lenis* and *K. papillosa* in southern and South-East Asia. Dark circles: *K. lenis* (specimens examined); dark squares: *K. papillosa* (specimens examined); ?: exact locality uncertain; shaded areas: *K. papillosa* (based on McBee *et al*., 1986 and Corbet and Hill, 1992)

1999). Specimens of *K. flora* were seen by the authors from Lesser Sunda Island, Thailand and Viet-nam. It is also known from Borneo, Bali, Lombok, Flores, ?Sumbawa, ?Sumba (Kitchener *et al.*, 1990; Corbet and Hill, 1992).

Conservation status

Both *K. papillosa* and *K. flora* are considered to be lower risk and of least concern (Hutson *et al*., 2001). *Kerivoula lenis* has not been assessed.

DISCUSSION

The recent discovery of *K. lenis* in the forests of Tamil Nadu categorically confirms the presence of this species in India and is the first record from the southern peninsula of the country. It represents a range extension of over 1950 km. The size and morphology of the single specimen, when compared with other individuals from southern and South-East Asia, confirms that *K. lenis* is a distinct species from *papillosa*. Further studies looking at the molecular systematics of the two taxa would be of interest. Previously McBee *et al.* (1986) assessed the karyology of '*K. papillosa*' from Surat Thani Province, Thailand: $2n = 38$, FN = 52 (including the sex chromosomes). However, in the light of the above findings, it is unclear whether these results refer to true *K. papillosa* or possibly *K. lenis*. *Kerivoula papillosa*, *K. lenis* and *K. flora* can be distinguished from the other nine species of the genus in Asia on the basis of skull size, most particularly condylo-basal length in which they are the three largest species (Table 3). This size distinction is not as apparent in external measurements, where not only is there overlap in forearm length between the three species but also with *K. myrella* Thomas, 1914*a* and *K. agnella*

TABLE 3. Character matrix of the twelve species of *Kerivoula* currently recognised from Asia (*sensu* Koopman, 1993). Data based on this study, Hill (1965) and Flannery (1990). Sample size in parentheses

Species	FA	CBL	C–M^3	M^3–M^3	Distribution	Comments
papillosa	39.4–48.9 (4)	16.0–17.6 (20)	7.1–7.8 (21)	6.7–7.1 (21)	Thailand to Vietnam and Indonesia	Species with largest skull and dentition
lenis	37.2–40.2 (4)	15.2–15.5 (4)	6.7–6.8 (4)	6.2–6.5 (4)	India, Malaysia	Palatal width intermediate between *papillosa* and *flora*
flora	34.3–39.5 (5)	14.4–14.9 (4)	6.1–6.2 (5)	5.4–5.7 (5)	Thailand, Vietnam to Indonesia	Upper canine basal area equal to PM^4
myrella	35.5–38.4 (5)	13.8 (1)	5.8–6.0 (2)	5.4–5.5 (3)	Lesser Sunda Islands, Bismark Island	Upper canine basal area exceeds PM^4
agnella	34.5–37.5 (3)	13.8 (1)	5.7–6.0 (3)	5.2–5.3 (3)	Papua New Guinea posterior cutting edge	Upper canine with with knife–like
muscina	32.4 (1)	12.8 (1)	5.7 (1)	5.2 (1)	Papua New Guinea	Canines reduced; orange oval patch on snout
picta	32.7–38.8 (14)	12.7–13.8 (4)	5.1–6.0 (?)	5.3–5.9 (6)	Sri Lanka to S China and Indonesia	Orange and black pelage and membranes
pellucida	28.8–33.2 (5)	12.5–13.0 (4)	5.3–5.6 (6)	4.8–5.1 (8)	Malaysia, Indonesia, Philippines	Very large pointed ears
hardwickii	30.1–35.2 (54)	11.7–13.6 (30)	4.8–5.7 (42)	4.8–5.7 (41)	Sri Lanka to Indonesia, Philippines	Relatively small ears
whiteheadi	27.6–27.8 (4)	11.8–11.9 (2)	5.0 (2)	4.7 (2)	Thailand, Malaysia, Philippines	Narrow P^2, length exceeding width
intermedia	26.7–30.7 (?)	11.1–11.8 (?)	4.6–5.0 (?)	–	Sabah (Malaysia)	Small skull, braincase elongated
minuta	24.8–29.3 (?)	10.0–11.1 (?)	4.1–4.6 (?)	–	Thailand, Malaysia	Smallest skull, braincase rounded

Thomas, 1908, although these latter taxa can be distinguished by a range of additional external, cranial and dental characters.

For the field biologist, it is unfortunate that pelage colour appears to be of limited value in the differentiation of the three study species (although see Thomas, 1916 for comments included in the Interspecific variation section above) and of Asiatic *Kerivoula* in general. Notable exceptions are *K. picta* (Pallas, 1767) with its characteristic orange and black pelage and membranes and *K. muscina* Tate, 1941 with its orange patches on the snout (Flannery, 1990). There are few other external characters, which discriminate between the different species of Asiatic Kerivoulinae. Ear shape can be used to distinguish *K. pellucida* (Waterhouse, 1845), with it large pointed ears from *K. hardwickii* (Horsfield, 1824), with its relatively small ears. However, these taxa apart, in general this feature is not diagnostic. In the same way, the relative development of a fringe of hairs on the edge of the uropatagium, although commented on by Hill (1965), cannot be used to differentiate between taxa.

The recent discovery of *K. lenis* in peninsular India shows that there is still much to learn about the systematics, distribution and ecology of the genus *Kerivoula*. Possibly, it explains the findings of previous researchers such as Payne *et al.* (1985) and Kingston *et al.* (1999) who suggested that more than one species were included within '*K. papillosa*'. Now that it is known that *K. papillosa* and *K. lenis* occur sympatrically in South-East Asia, more detailed studies may be able to determine additional characters that can be used to discriminate between the two taxa both in the field and in zoological collections.

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