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A Review of *Hipposideros lankadiva* Kelaart, 1850 (Chiroptera: Hipposideridae) with a Description of a New Subspecies from Myanmar

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ABSTRACT.– In January, 2011, a colony of *Hipposideros lankadiva* was discovered in Kachin State, upper Myanmar. The large size of the specimens when compared to those from peninsular India led to a review of the taxonomy of the species and the description of a new subspecies from Myanmar, with material from north-east India referred to this new taxon. The distribution of the species from throughout its range is summarised and mapped. Based on the material from Myanmar, new information is provided on the acoustic characters and the bacular morphology. Short notes are provided on its ecology in Myanmar and north-east India.

KEY WORDS: India, taxonomy, distribution, echolocation, ecology

INTRODUCTION

There is considerable uncertainty about the status of the subspecies and synonyms of *Hipposideros lankadiva* Kelaart, 1850 and the extent of its geographical distribution. It was described from Kandy in the central hills of Sri Lanka. Andersen (1907) considered the species to be essentially restricted to Sri Lanka. However, on the basis of two immature specimens (which had been referred originally to *H. diadema* by Thomas, 1892) Andersen (1907) also recorded it from Bhamo (Banmaw) in upper Myanmar. Subsequently, Andersen (1918) described four new hipposiderid taxa from peninsular India. They were *H. indus indus* from Gersoppa (Karnataka), which he distinguished from *H. lankadiva* on the basis of size; two new subspecies, *H. indus mixtus* from Kolar (Karnataka) and *H. i. unitus* from Mundra (Madhya Pradesh); and one additional species, *H. schistaceus* from Vijayanagar (Karnataka). All these taxa were distinguished from each other by minor differences in size and/or colour. Confusingly, Andersen (1918) restricted *H. lankadiva* to Sri Lanka and omitted any geographical reference to the specimens from Myanmar.

Kemp (1924) reported *H. lankadiva* from Siju Cave in the Garo Hills of North-east India and wrote 'I can find nothing in the skull nor the skin to distinguish these bats from *H. lankadiva* Kel., a species otherwise known to occur only in Ceylon [Sri Lanka]. On the Indian mainland the place of *H. lankadiva* is supposed to be taken by *H. indus* and its subspecies, which are all considerably smaller forms.' He considered that the discovery of *H. lankadiva* in north-

east India was an interesting case of 'discontinuous distribution' but opined that 'of course, *H. lankadiva* may in future be discovered in the Peninsula [peninsular India]'.

Tate (1941) included *lankadiva, unitus, indus, mixtus,* and *schistaceus* in a 'mainland offshoot of the [*Hipposideros*] *diadema* group' but without specifying their taxonomic status - species, subspecies or synonym. Ellerman and Morrison-Scott (1951) referred the taxa *indus, mixtus,* and *unitus* to *H. lankadiva* and suggested that *schistaceus* might be a synonym of *H. lankadiva.* Brosset (1962) also included *indus, mixtus,* and *unitus* in *H. lankadiva* and dismissed subspecific differences in India as being 'without real existence'. Hill (1963) treated *indus* as a distinguishable subspecies of *H. lankadiva* and *mixtus* as a synonym. He included *unitus* as a subspecies of *H. lankadiva* without comment. *H. schistaceus* was maintained as a separate species. This arrangement was followed by Corbet and Hill (1992) who considered the distribution of *H. lankadiva* as being confined to central and southern peninsular India and Sri Lanka.

Mandal and Nandi (1989) recorded *H. lankadiva* from the Sundarbans of West Bengal but without comment or details. Agrawal et al. (1992), following the collection of new material in West Bengal, suggested that a review of the status of the subspecies of *H. lankadiva* was required based on 'fresh material from the entire range of distribution of the species'. Das et al. (1993) and Mandal et al. (1993) repeated this view. Das et al. (1995) noted a similarity in size between specimens referred to *H. lankadiva* from north-east India, including Meghalaya and Tripura, and those from Sri Lanka. Specimens from peninsular India were rather smaller. Mandal et al. (1997) reported new material from Mizoram in north-east India and quoting Brosset (1962) suggested that the species was monotypic.

Bates and Harrison (1997) included all specimens from Sri Lanka in the nominate race *H. l. lankadiva.* This material averaged significantly larger than those seen from throughout peninsular India. All Indian material was referred to *H. lankadiva indus*, with *schistaceus, mixtus* and *unitus* included as synonyms. They noted that minor differences in size and colour in *indus*, *mixtus* and *unitus* were not significant when material from throughout the peninsula were examined. In the case of *schistaceus,* the average smaller size of the material was related to the fact that a number of the topotypes were juveniles. Sinha (1999b) compared the external and cranial specimens of *indus, lankadiva, unitus, and mixtus* and concluded that there were no major differences to be found. Sinha (1999a) examined specimens from Meghalaya but made no comment concerning their subspecific status. Srinivasalu and Srinivasalu (2001, 2012) considered all specimens from India to be preferable to *H. l. indus* with the nominate subspecies restricted to Sri Lanka. Khan (2001) reported the first record from Bangladesh but without details. This latter record was included in Molur et al. (2008), who described the species as endemic to South Asia, but was omitted by Simmons (2005) who noted it only from southern and central peninsular India and Sri Lanka. No reference to its occurrence in Myanmar was included in Francis (2008).

The discovery, therefore, of a large colony of *H. lankadiva* in eastern Kachin Province is of particular interest since it is the first documented record of the species from Myanmar since Andersen (1907) and

represents the first confirmed record from and South-east Asia. Until now, Andersen's record has been almost universally ignored in literature with the exception of passing references in Tate (1941) and Das et al. (1995). The large size of the five specimens supports the findings of previous authors such as Kemp (1924) and Das et al. (1995) who noted a similarity in size between specimens from northeast India and Sri Lanka, especially in comparison to the smaller *H. l. indus* from peninsular India. It provides a good opportunity to confirm the presence of the species in Myanmar; reassess the taxonomic status of the named forms of *H. lankadiva*; describe a new subspecies from Myanmar and determine the distribution of this new taxon.

MATERIALS AND METHODS

Five specimens, comprising four males (OMT 110105.1-2; OMT 110105.4-5) and one female (OMT 110105.3) were collected by OMT and MMA in hand nets at Pawtawmu Cave, Karmine Township, Kachin State, 25°26′ 11.4″N, 96°41′ 29.8″E. Four specimens are deposited in the University of Mandalay, Myanmar, the fifth (OMT 110105.1) is deposited at the Harrison Institute, UK. The skulls were extracted, cleaned, and stored separately to the bodies, which are preserved in 70% alcohol. Wing and tail tissue was taken for future molecular studies. The baculum of two males were extracted, prepared, and stored in glycerol. Comparative material of *H. lankadiva* from Sri Lanka and India is held in the collections of the Natural History Museum, London and the Harrison Institute (formerly the Harrison Zoological Museum), UK and summarised in Bates and Harrison (1997).

Measurements were taken with dial and digital calipers to the nearest 0.1 mm. The measurements are defined below: FA: forearm length, from the extremity of the elbow to the extremity of the carpus with the wings folded; EAR: ear length, from the lower border of the external auditory meatus to the tip of the pinna; TL: tail length, from the tip of the tail to its base adjacent to the anus; TIB: length of tibia, from the knee joint to the ankle; HF: from the extremity of the heel behind the os calcis to the extremity of the longest digit, not including the claws; 3MT: third metacarpal, from the extremity of the carpus to the distal extremity of the metacarpal; 4MT, 5MT: as above but for the fourth and fifth metacarpals respectively; 3D1P: first phalanx of the third digit, taken from the proximal to the distal extremity of the phalanx; 3D2P: second phalanx of the third digit, taken from the proximal to the distal extremity of the phalanx; 4D1P, 4D2P: as for the third digit but for the fourth; BL: greatest length of the baculum; GTL: greatest length of skull, taken from the tip of the premaxillae to the lambda; SL: skull length, taken from the occiput to the anterior part of the canine; CBL: condylo-basal length, from the exoccipital condyle to the alveolus of the incisor; CCL: condylo-canine length, from an exoccipital condyle to the anterior alveolus of a canine; ZB: zygomatic breadth, the greatest width of the skull across the zygomatic arches; BB: breadth of braincase, taken at the posterior roots of the zygomatic arches; MW: mastoid width, the greatest distance across the mastoid region; PC: post orbital constriction, taken at the narrowest point; RW: greatest rostral width, taken across the anterior lateral swellings (chambers), in dorsal view; C–M^3: maxillary toothrow length, from the most anterior part of the upper canine to the back of the crown of the

TABLE 1. External measurements (mm), bacular length (mm) and call frequency (kHz) of *Hipposideros lankadiva* – acronyms explained in methods – includes means, ranges, and standard deviations. Numbers in parentheses refer to sample size where they differ from those stated in column 1.

n	sex	CF	FA	TL	TIB	HF	EAR	3MT
				Hipposideros lankadiva gyi subsp. nov. Myanmar				
4	♂	69.8 (3)	91.9, 2.0	50.3, 4.5	35.8, 1.3	14.2, 0.8	26.1, 1.2	67.7, 2.3
		68.8-69.8	89.2-94.0	45.8-54.2	34.0-36.8	13.2-15.2	24.7-27.6	64.4-69.7
1	♀	70.7	91.6	43.8	33.9	12.8	24.2	67.3
				Hipposideros lankadiva gyi subsp. nov. North-east India				
41	♂	*	88.5	49.1 (37)	34.6	16.4 (26)	26.2 (38)	*
			83.6-93.4	40.0-56.5	32-38.8	15-19	23.0-30.0	*
45	♀	*	88.1	49.4 (43)	34.1	16.6 (39)	26.8 (44)	*
			79.5-93.2	42.5-55.9	30-36	15.0-18.0	24.0-30.0	*
				Hipposideros lankadiva indus Peninsular India				
10	♂	*	83.3, 2.2 (9)	42.6, 3.8 (8)	32.4, 1.6	14.5, 1.5 (8)	24.5, 1.3 (8)	60.8, 2.4
			80.1-87.0	35.0-47.0	30.1-34.4	12.0-16.0	22.0-26.0	57.2-63.7
8	♀	*	83.1, 5.1	41.4, 1.9	30.3, 1.7	14.9, 1.1	24.3, 2.7	61.5, 2.6
			75.0-89.0	40.0-45.0	28.3-33.1	13.0-16.0	19.5-27.0	57.0-65.0
				Hipposideros lankadiva lankadiva Sri Lanka				
3	♂	*	90.8, 2.1	48.5 (2)	37.5 (2)	13.4 (2)	26.0 (2)	66.7 (2)
			88.4-92.0	47.0-50.0	36.2-38.8	11.7-15.0	24.5-27.5	66.5-66.8
11	♀	*	89.9, 3.2	51.5, 3.5 (10)	36.1, 1.5 (7)	15.4, 2.0 (10)	24.8, 1.7 (9)	64.9, 0.5 (8)
			86.9-99.0	45.4-58.0	34.0-38.0	11.7-20.0	22.1-27.9	64.3-65.9

third upper molar; C^1–C^1: anterior palatal width, taken across the outer border of the upper canines; M^3–M^3: posterior palatal width, taken across the outer border of the posterior upper molars; ML: mandible length, from the most posterior part of the condyle to the most anterior part of the first lower incisors; C-M_3: mandibular toothrow length, from the most anterior part of the lower canine to the back of the crown of the third lower molar.

Drawings were prepared with a camera lucida and a stereo microscope.

Echolocation: Calls were recorded from individual hand held bats (not suspended within a bat bag). This was to avoid the effect of the Doppler shift compensation (Trappe and Schnitzler, 1982; Hiryu et al., 2005). A Pettersson D-240X ultrasound detector (in 10x time-expansion mode) was connected to a digital iRiver iHP-120 Multi-Codec Jukebox recorder. Calls were transferred to a laptop computer to determine the frequency of the constant frequency component (CF in kHz) using the Power spectrum in BatSound Pro 3.31 (Pettersson Elektronik, AB). A sampling frequency of 44.10 kHz was used and produced a spectrogram using 1024 samples Fast Fourier Transform (FFT) with Hanning window. The constant frequency (CF) component of 10 calls from each individual were analysed and measured in kHz.

RESULTS

The external, cranial and dental measurements of the five individuals of *H. lankadiva* from Myanmar considerably

TABLE 1. Continued

4MT	5MT	3D1P	3D2P	4D1P	4D2P	WINGSPAN	BL
			Hipposideros lankadiva gyi subsp. nov. Myanmar				
66.5, 1.9	60.9, 2.6	31.7, 0.5	31.6, 1.5	22.9, 0.5	14.8, 0.7	*	2.7, 2.8
64.0-68.6	57.2-63.3	30.9-32.1	30.1-33.8	22.5-23.6	13.7-15.3	*	*
67	61.4	31.4	30.3	24.6	15.2	*	*
			Hipposideros lankadiva gyi subsp. nov. North-east India				
*	*	*	*	*	*	460 (26)	*
*	*	*	*	*	*	440-470	*
*	*	*	*	*	*	450 (39)	*
*	*	*	*	*	*	420-460	*
			Hipposideros lankadiva indus Peninsular India				
59.5, 1.5 (9)	54.2, 2.3	27.3, 1.1	26.9, 1.3 (9)	20.2, 1.0	12.4, 0.9 (9)	*	*
57.2-61.8	50.7-56.9	25.4-28.5	24.4-28.4	19.0-21.8	11.2-14.0	*	*
60.2, 2.7	54.9, 3.0	27.6, 1.4	26.7, 1.3	20.3, 0.8 (7)	13.4, 0.6 (7)	*	*
55.3-63.6	49.7-58.6	26.0-30.0	24.5-28.8	19.4-21.1	12.5-14.1	*	*
			Hipposideros lankadiva lankadiva Sri Lanka				
64.8 (2)	59.8 (2)	30.8 (2)	29.9 (2)	22.2 (2)	14.1 (2)	*	2.65, 2.65
64.5-65.0	59.2-60.4	30.5-31.1	29.7-30.0	20.5-23.9	13.0-15.2	*	*
63.2, 1.1 (8)	59.2, 0.8 (8)	30.2, 1.3 (8)	30.4, 1.4 (8)	22.2, 1.2 (8)	14.5, 0.8 (8)	*	*
61.4-64.7	57.9-60.2	28.5-32.9	27.7-31.9	21.2-24.9	13.8-15.0	*	*

exceed in size those from peninsular India. There is little or no overlap in the length of the forearm, tibia, and the wing bones (Table 1). The situation is even clearer in the cranial and dental characters with no overlap in the length of the skull (GTL and CCL), mandible, and upper and lower toothrows or in the breadth of the zygomata and braincase (Table 2). The Myanmar specimens are comparable in size to specimens of *H. lankadiva* from Sri Lanka and also those reported in the literature from north-east India (Tables 1 and 2, and Fig. 1). This is the case in respect of external (Table, 1) and cranial and dental measurements (Table 2), although the data sets for north-east India are small and are based on descriptive statistics (means and ranges) provided in the literature (Agrawal et al., 1992; Das et al., 1995; Sinha, 1999b; Mandal et al., 1997). A bivariate comparison, based on two cranial measurements illustrates the affinities of the Myanmar specimens with those from north-east India and Sri Lanka as compared to those from peninsular India (Fig. 2).

Size apart, there are no visible external characters which can be used to discriminate between specimens from different parts of the species's range. In all five specimens seen from Myanmar, the noseleaf has three supplementary leaflets (Fig. 3); elsewhere in India and Sri Lanka it has three or sometimes four leaflets, but the fourth is always very small. The septum is not inflated; and the lappets are well developed. In the wing, the fifth metacarpal is shorter than the third and fourth. Similarly in the skull and dentition, there are no obvious discriminating characters. In all specimens

TABLE 2. Cranial and dental measurements (mm) of *Hipposideros lankadiva* – acronyms explained in methods – includes means, ranges, and standard deviations. Numbers in parentheses refer to sample size where they differ from those stated in column 1.

n	sex	GTL	SL	CBL	CCL	ZB	BB
			Hipposideros lankadiva gyi subsp. nov. Myanmar				
4	♂	34.1, 1.2	33.0, 1.5	30.7, 0.9	30.2, 0.9	19.9, 0.4	13.2, 0.1
		32.8-35.1	31.2-34.6	29.8-31.7	29.1-31.2	19.4-20.3	13.1-13.3
1	♀	33.9	32.3	30.3	30.1	18.9	13
			Hipposideros lankadiva gyi subsp. nov. North-east India				
15	♂	32.5 (14)	*	*	30.0 (1)	20.2	13.3 (6)
		31.3-35.3	*	*	*	19.9-20.6	12.0-14.0
6	♀	31.8	*	*	27.9 (1)	19.4 (5)	13.7 (2)
		30.1-33.1	*	*	*	19.0-20.0	13.7, 13.7
			Hipposideros lankadiva indus Peninsular India				
10	♂	30.6, 1.1 (5)	*	*	27.3, 1.1 (9)	17.6, 0.7 (8)	11.5, 0.3 (8)
		28.7-31.2	*	*	24.8-28.5	16.1-18.3	11.0-11.9
8	♀	30.9, 0.7 (4)	29.6 (1)	28.2 (1)	27.1, 0.4 (7)	17.5, 0.4 (7)	11.7, 0.3 (7)
		30.2-31.8	*	*	26.6-27.8	16.9-18.0	11.2-12.0
			Hipposideros lankadiva lankadiva Sri Lanka				
3	♂	35.8 (2)	35.3 (2)	32.2 (2)	31.2, 0.3	20.3, 0.2	13.2, 1.1
		35.6, 36.1	35.0, 35.6	32,1, 32.3	31.0-31.5	20.2-20.5	12.0-14.0
13	♀	34.9, 0.7 (8)	34.1, 0.2 (4)	31.2, 0.3 (3)	30.5, 0.3 (8)	19.8, 0.4 (11)	13.1, 0.5 (10)
		34.1-36.1	33.9-34.3	30.9-31.4	30.2-31.0	19.2-20.6	12.2-13.9

from throughout the range the rostrum is inflated and robust and without a posterior depression and the second lower incisor is characteristically large. In this latter character, those from Myanmar are particularly large, exceeding in size those from peninsular India but comparable to those from Sri Lanka (Fig. 4). In the baculum, there does appear to be a difference between those from Myanmar (n=2) and those from Sri Lanka (n=2), most particularly in the proportional length of the distal processes relative to the size of the base (Fig. 5). No specimens from peninsular India were available to the authors for examination.

On the basis of their geographical isolation from Sri Lanka and their distinctly larger size in comparison to specimens from peninsular India, specimens from Myanmar are here referred to a new subspecies of *H. lankadiva.* Specimens from north-east India are also referred to this new taxon. For, although no material from this latter region was available to the authors, the measurements and the descriptions in the literature strongly indicate that they belong to this new subspecies. Unfortunately, no information was available for material collected in the Sundarban area of West Bengal (Mandal and Nandi, 1989) or Bangladesh (Khan, 2001) and it is therefore not possible to determine whether these represent a north-eastern extension of the peninsular race, *H. l. indus,* or rather that they are a southern extension of the new subspecies. It is possible that future genetic research may show that the new subspecies has been isolated for sufficient period of time to have triggered speciation.

TABLE 2. Continued

MW	PC	RW	C-M^3	C^1-C^1	M^3-M^3	ML	C-M$_3$
			Hipposideros lankadiva gyi subsp. nov. Myanmar				
15.0, 0.4	3.5, 0.2	9.3, 0.2	14.1, 0.5	8.7, 0.3	12.9, 0.4	24.6, 0.5	15.8, 0.3
14.7-15.5	3.3-3.7	9.2-9.6	13.5-14.6	8.4-9.2	12.5-13.5	23.9-25.2	15.6-16.3
14.1	3.5	8.9	14.3	7.8	13	24.3	15.9
			Hipposideros lankadiva gyi subsp. nov. North-east India				
15.1 (6)	3.6	*	14.1	8.4 (5)	13	24.8	15.9 (9)
15.0-15.2	3.3-4.0	*	14.0-14.5	7.9-8.9	12.6-13.4	24.0-25.5	15.2-16.0
15.1 (2)	3.7	*	13.6	7.7 (3)	12.9 (7)	23.7	14.6 (3)
15.0, 15.2	3.4-4.0	*	13.2-14.1	7.2-8.0	12.3-13.4	23.0-25.0	14.2-15.0
			Hipposideros lankadiva indus Peninsular India				
*	3.6, 0.3 (8)	9.7 (1)	12.7, 0.5	8.4 (1)	12.7 (1)	22.2, 1.2	14.1, 0.7
*	3.1-4.1	*	11.6-13.3	*	*	20.1-23.6	12.6-14.8
*	3.5, 0.1 (7)	8.7 (1)	12.5, 0.1	8.2 (1)	12.5 (1)	22.3, 0.4	13.7, 0.6
*	3.3-3.7	*	12.4-12.8	*	*	21.7-22.9	12.4-14.5
			Hipposideros lankadiva lankadiva Sri Lanka				
15.9 (2)	3.9, 0.1	10.3 (2)	14.4, 0.1	9.0 (2)	12.9, 0.7	25.8, 0.4	16.2, 0.3
15.7-16.1	3.8-4.0	10.2, 10.4	14.3-14.6	8.8, 9.1	12.1-13.3	25.6-26.2	15.9-16.5
15.3, 0.4 (4)	3.9, 0.3 (11)	10.0, 0.4 (4)	14.1, 0.2	8.6, 0.1 (4)	12.5, 0.4	25.2, 0.5 (12)	15.7, 0.3 (12)
15.1-15.9	3.4-4.4	9.5-10.4	13.7-14.5	8.6-8.7	11.9-13.0	24.3-25.9	15.2-16.2

Hipposideros lankadiva gyi subspp. nov.

Holotype. — HZM.10.40222 (OMT 110105.1), adult ♂, body in alcohol, skull extracted and cleaned, collected by MMA and OMT on 5 January, 2011. Currently deposited in the Harrison Institute, UK. Pawtawmu Cave, Karmine Township, Kachin State, Myanmar, 25°26′ 11.4″N, 96°41′ 29.8″E.

Paratypes. — OMT 110105.2, OMT 110105.4 and OMT 110105.5, adult ♂♂ and OMT 110105.3, adult ♀; all bodies in alcohol, skulls extracted and cleaned, collected by MMA, and OMT on 5 January, 2011. Deposited at the Zoology Department, University of Mandalay, Myanmar. Pawtawmu Cave, Karmine Township, Kachin State, Myanmar, 25°26′ 11.4″N, 96°41′ 29.8″E.

Etymology. — The name '*gyi*' is used to honour the contribution of Professor Head of Department (retired) Khin Maung Gyi who assisted and encouraged a new generation of bat researchers at the Department of Zoology, University of Mandalay. It is also fitting that the Myanmar word 'gyi' means 'large' in English, reflecting the relative size of the subspecies in comparison to *H. lankadiva indus* in India. The common name is 'Stanley's leaf-nosed bat'; Stanley is the given name of Professor Khin Maung Gyi and the name by which he is known by all who work with him.

Diagnosis. — This is a large subspecies of *H. lankadiva* with an average forearm length of 91.8 mm (89.2–94.0 mm: based on the holotype and four paratypes from Myanmar, Table 1). There are three supplementary

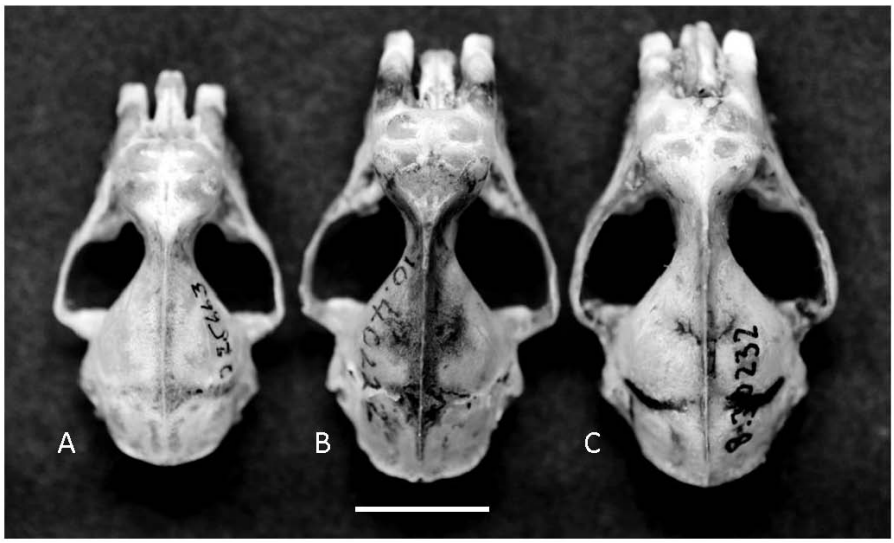

FIGURE 1. Skulls of three *Hipposideros lankadiva.* A: *H. l. indus,* HZM.2.25663, ♀, Mandu, Madhya Pradesh, India; B: *H. l. gyi,* HZM.10.40222 (OMT 110105.1) (holotype), ♂, Pawtawmu Cave, Karmine Township, Kachin State, Myanmar C: *H. l. lankadiva,* HZM.8.30232, ♂, Gampaha, Uva Province, Sri Lanka. Scale = 10 mm.

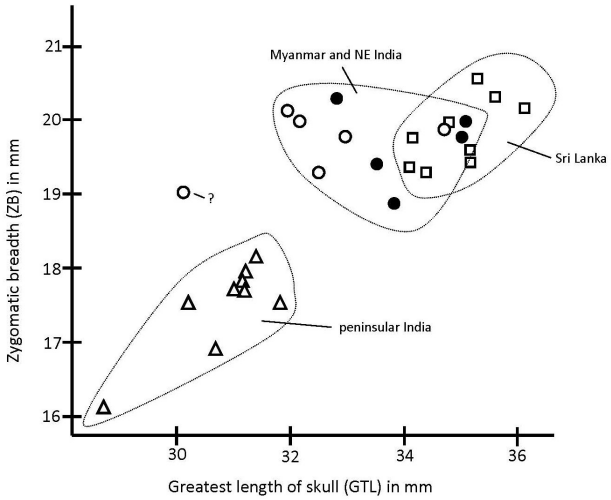

FIGURE 2. Comparison of two cranial characters of *Hipposideros lankadiva* showing geographical affinities, based on adult individuals of both sexes. Open squares: specimens from Sri Lanka; closed circles: Myanmar; open circles: north-east India (based on means of measurements from Agrawal et al., 1992; Das et al., 1995; Sinha 1999b; Mandal et al., 1997); open triangles: peninsular India. ?: refers to an apparently aberrant individual included in Das et al. (1995).

leaflets (Fig. 3). The average condylo-canine length of the skull is 30.2 mm (29.1-31.2 mm, Table 2). The baculum has two long, ventrally curved, distal processes and a small base (Fig. 5). The second lower incisor is relatively very large (Fig. 4).

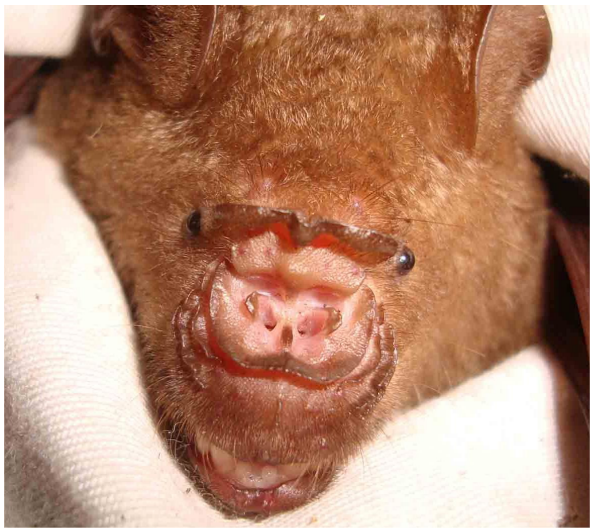

FIGURE 3. *Hipposideros lankadiva gyi* from Pawtawmu Cave, Karmine Township, Kachin State, Myanmar. Not to scale.

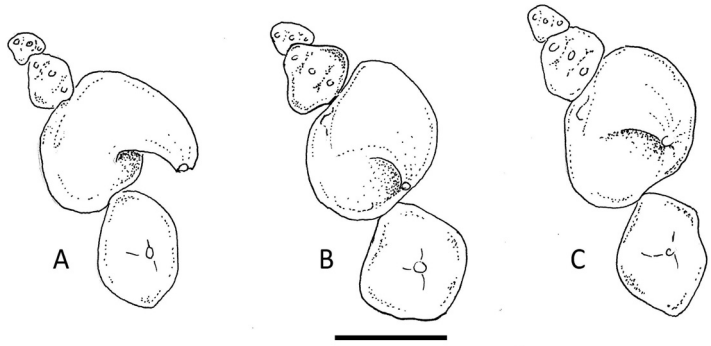

FIGURE 4. Right lower incisors, canine and first premolar of three *Hipposideros lankadiva.* A: *H. l. indus,* HZM.3.25664, ♂, Mandu, Madhya Pradesh, India; B: *H. l. gyi,* HZM.10.40222 (OMT 110105.1) (holotype), ♂, Pawtawmu Cave, Karmine Township, Kachin State, Myanmar; C: *H. l. lankadiva,* HZM.6.27328, ♂, Wavulpane, Sabaragamuwa, Sri Lanka. Scale = 1 mm.

Measurements (in mm) of the holotype are as follows: external - FA: 92.8; TL: 54.2; TIB: 36.7; HF: 15.2; EAR: 27.6; ANW (greatest width across the anterior noseleaf): 8.5; INW (greatest width across the intermediate noseleaf): 7.1; PNW (greatest width across the posterior noseleaf): 9.9; 3MT: 68.6; 4MT: 66.5; 5MT: 61.8; 3D1P: 31.7; 3D2P: 33.8; 4D1P: 23.6; 4D2P: 15.3; baculum - BL: 2.7; cranial and dental – GTL: 35.1; SL: 34.6; CBL: 31.3; CCL: 30.7; ZB: 20.0; BB: 13.2; MW: 14.9; PC: 3.6; RW: 9.2; C-M^3: 14.6; C^1-C^1: 8.8; M^3-M^3: 12.8; ML: 25.2; C-M_3: 16.3.

Descriptive characters. — The following description is based on the five recently collected specimens from Myanmar. This is a large *Hipposideros* with an average forearm length (for both sexes combined) of 91.8 mm (89.2-94.0 mm, Table 1). The

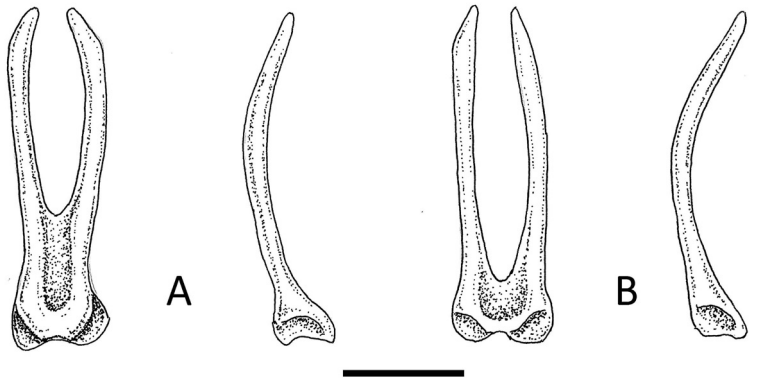

FIGURE 5. Dorsal and lateral view of the baculum of two *Hipposideros lankadiva.* A: *H. l. lankadiva,* HZM.8.30232, Gampaha, Uva Province, Sri Lanka. B: *H. l. gyi*, HZM.10.40222 (OMT 110105.1) (holotype), Pawtawmu Cave, Karmine Township, Kachin State, Myanmar. Scale = 1 mm.

noseleaf has three supplementary leaflets (Fig. 3).The anterior leaf is without an emargination but has a small process; there is also a small process situated in the midpart between the upper lip and the base of the anterior noseleaf; the septum is not inflated but the narial lappets are well developed. The intermediate leaf averages 6.9 mm (6.3-7.2 mm) in width and is narrower than the posterior leaf, 9.7 mm (9.2-10.0 mm). The pelage colour is a rich fulvous brown (Fig. 3). It is darker on the dorsal surface, including the head and shoulders, than on the underside. In the wing, the fifth metacarpal is shorter than the third and fourth. The third metacarpal exceeds the combined length of its phalanges. The baculum has a small base with two long, ventrally curved distal processes (Fig. 5).

The skull is large and robust with an average condylo-canine length of 30.2 mm (29.1-31.2 mm, Table 2). The frontal region of the rostrum is inflated and convex; there is no posterior depression. The mesopterygoid space is V-shaped anteriorly. Upper toothrow length (C-M^3) is 14.1 mm (13.5-14.6 mm, Table 2). The upper incisor is relatively robust and bifurcated. The first upper premolar (P^2) although small is well developed for a hipposiderid and situated slightly external to the toothrow. The crown area of the second lower incisor (I_2) is about three times that of the first (I_1) (Fig. 4). The first lower premolar (P_2) is about half the height and crown area of the second (P_4).

Echolocation. — *Hipposideros lankadiva gyi* uses the typical multiharmonic calls of hipposiderid bats with the maximum energy in the second harmonic. Each signal comprises two components: a long component of constant frequency and a short terminal frequency-modulated component. The constant frequency component for three males averaged 69.7 kHz with a range of 68.8-69.8 kHz; for the female, it was 70.7 kHz.

Distribution. — *Hipposideros lankadiva gyi* is known from Myanmar and north-east India. In addition, the species is recorded from Sri Lanka, India, and Bangladesh (Fig. 6, for details see Appendix 1).

Remarks. — Although genetic data are not currently available for *H. l. gyi,* a follow-up study of *Hipposideros lankadiva* from throughout its range is being planned. This will include morphometric, genetic and

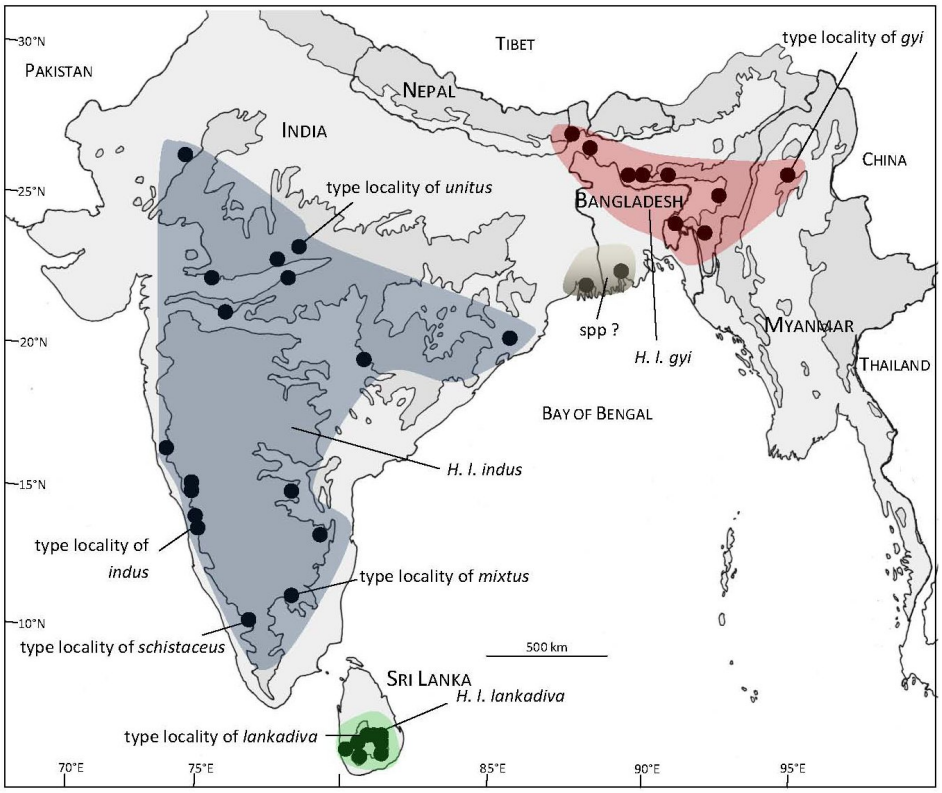

FIGURE 6. Distribution of *Hipposideros lankadiva.* Red shading: distribution of *H. l. gyi*; brown shading: subspecies not known; blue shading: distribution of *H. l. indus*; green shading: distribution of *H. l. lankadiva.* Shading is for indicative purposes only; locations based on specimen data, either collected personally or from the literature, are shown as solid circles.

acoustic data sets and will review in detail the phylogeny of three subspecies.

The colony of *H. l. gyi* at Pawtawmu Cave was estimated to number about 1,000 individuals, although no precise count could be made. In addition, there were about 20,000 fruit bats, *Eonycteris spelaea,* and a few individuals of the small leaf-nosed bat, *Aselliscus stoliczkanus.* The cave, which is at an elevation of 245 metres (798 feet) above sea level, is situated in a limestone outcrop. It comprises two stories with the main chamber measuring about 260 m in length, 6 m in width and 11 m in height. The outcrop is surrounded by heavily disturbed evergreen forest, which includes wild banana and coconut (MMA and OMT, pers. observations).

Material from Mizoram State, here referred to *H. l. gyi,* was collected at an elevation of about 250 metres beside a bamboo plantation (Mandal et al., 1997) whilst that from Manipur State was collected at 175 metres on a hill-top with rubber plantations (Mandal et al., 1993). In Meghalaya, it was found in 'incredible numbers, closely covering the entire walls and the roof' at the end of a tunnel some 360 metres from the entrance of Siju Cave (Kemp, 1924).

Information about the ecology of *H. lankadiva indus* and *H. l. lankadiva* in peninsular India and Sri Lanka is included in Bates and Harrison (1997).

Conservation status. — The conservation status of *Hipposideros lankadiva* is listed by the IUCN Red List as 'Least Concern' (Molur et al., 2008). According to Bates and Harrison (1997), it is known from a relatively small number of colonies but many of these are large. One colony of over 11,000 individuals is known from Sri Lanka and a colony of about 6000 individuals was observed in Meghalaya (Molur et al., 2008).

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APPENDIX I

Localities of ***Hipposideros lankadiva gyi***: Myanmar: Kachin State: Pawtawmu Cave in Karmine Township (25°26′N, 96°41′E) (this paper); Bhamo (24°17′N, 97°14′E) (Andersen, 1907: but see Introduction). India: West Bengal: Darjeeling (27°03′N, 88°17′E); Khuntimari in Jalpaiguri District (26°31′N, 88°50′E) (Agrawal et al., 1992); Meghalaya: Siju Cave in South Garo Hill District (25°21′N, 90°41′E) (Sinha, 1999a); Rongmachok in West Garo Hill District (approx. 25°31′N, 90°05′E) (Das et al., 1995); Nonthymmai near Shillong in East Garo Hills District (25°34′N, 91°54′E) (Sinha, 1999b); Tripura [locality not specified] (c.o. 24°00′N, 91°58′E) (Das et al., 1995); Manipur: Jiribam in Imphal District (24°48′N, 93°07′E) (Mandal et al., 1993); Mizoram: Teirei in Aizawl District (23°44′N, 92°42′E) (Mandal et al., 1997).

Localities of ***H. lankadiva*** (subspecies not known): India: West Bengal: Sundarbans [no exact locality] (c.o. 22°07′N, 88°48′E) (Mandal and Nandi, 1989). Bangladesh: 'Sunderbans and adjacent areas' [no exact locality] (c.o. 22°05′N, 89°30′E) (Khan, 2001).

Localities of ***H. lankadiva indus***: India: Rajasthan: Bhimbharak (approx. 26° 09′N, 73° 08′E) (Wason, 1978); Madhya Pradesh: Mundra (approx. 23°50′N, 78° 44′E) (type locality of unitus); Sohagpur (22°42′N, 78°12′E) (Wroughton, 1913); Mandu [22°22′N, 75°24′E] (Brosset, 1962); Balharshah (not located) (Gopalakrishna, 1986); Saugar (not located) and Bhopal (23°16′N, 77°25′E) (Sinha, 1999b); Maharastra: Chandrapur (19°57′N, 79°21′E) (Sapkal and Bhandarkar, 1984); Sangameshwar (17°10′N, 73°30′E) (Muni et al., 1994); Satpura Hills 21° 24′N, 77° 20′E) (Sinha, 1999b); Orissa: Khandagiri in Puri (20°08′N, 85° 47′E) (Das et al., 1993); Andra Pradesh: Palakonda Hills (approx. 18°36′N, 83°46′E) (Sinha, 1999b) Kurnool (15°48′N, 78°02′E) (FMNH); Karnataka: Belgaum (15°51′N, 74°30′E) and Kanara (this is not located, probably refers to former state name) (Sinha, 1999b); Kolar (13°08′N, 78°08′E) (type locality of mixtus); Gersoppa (14°15′E, 74°39′E) (type locality of indus); Vijayanagar (12°20′N, 76°37′E) (type locality of schistaceus); Muroor (14°26′N, 74°29′E) (Hungarian Natural History Museum collection); Talewadi (15°42′N, 73°58′E) (Muni et al., 1994).

Localities of ***H. lankadiva lankadiva***: Sri Lanka: Central Province: Kandy (07°17′N, 80°40′E) (type locality of H. l. lankadiva); Kumbalgamuwa (approx. 07°08′N, 80°50′E) (Phillips, 1980); Western Province: Kitulgala(07°00′N, 80°22′E); Labugama (approx. 06° 55′N, 80° 11′E) (Phillips, 1980); Uva Province: Medagama (07° 02′N, 81° 17′E) (Phillips, 1980) Haputale (06°46′N, 80°58′E) (Eckrich and Neuweiller, 1988); Gampaha (07°05′N, 79°59′E) (Harrison Institute collection); Eastern Province: Inginiyagala (07° 16′N, 81° 30′E) (Natural History Museum London collection); Sabaragamuwa Province: Bogala (07°02′N, 80°15′E); Wavulpane (06° 25′N, 80° 40′E) (Harrison Institute collection); Southern Province: Yala (06°22′N, 81°30′E) (Phillips, 1980). Wavulgalge (province not known; Yapa et al., 1999).