



Some noteworthy bat (Mammalia: Chiroptera) records from Manipur State, Northeastern India

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Abstract

Specimen based records of five species from Manipur state namely *Rhinolophus sinicus*, *R. yunanensis*, *Kerivoula picta*, *Myotis muricola* and *Miniopterus magnater* is presented. The mensural data of the examined specimens from Manipur and comparative data from India and Nepal are also provided. With the current additions, the bat inventory of Manipur stands at 17 species. This also highlights the paucity of information on the bat species diversity and distribution of bat fauna in the state and calls for extensive field based studies.

Keywords: Biodiversity, Bat Species, Hotspots, Manipur, New Records

Introduction

The north eastern region of India constitutes a considerable part of the Himalaya and Indo-Burma biodiversity hotspots (Mittermeier *et al.*, 2004) and thus exhibits exceptional faunal diversity. The region harbours at least 74 recorded bat species which is about sixty percent of the 127 species of chiroptera reported from India (Bates & Harrison, 1997; Sinha, 1999; Mandal *et al.*, 2000; Ruedi *et al.*, 2012a, b; Saikia *et al.* 2017; Thong *et al.*, 2018; Saikia, 2018). Among the northeast Indian states, the bat fauna of Meghalaya has been fairly extensively documented with the reported occurrence of at least 65 species in 28 genera (Saikia *et al.*, 2018) and to some extent in Assam and Mizoram states (Boro *et al.*, 2018; Mandal *et al.*, 1997, 2000). In comparison, the diversity and distributional information on the bat fauna for rest of the northeastern states are largely lacking.

Field studies on the bat fauna of Manipur have been very few (*e.g.* Mandal *et al.*, 1993; Sinha, 1994) and consequently, reported bat diversity in the state is comparatively low. Sinha (1999) in his account of the bats of North East Hills of India mentioned ten species of bats

from Manipur. Based on filed surveys in 1992 and review of published literature, Mandal *et al.* (2005) compiled an inventory of the mammalian fauna of Manipur including 12 species of bats. During opportunistic surveys in a few areas in Tamenglong and Bishnupur districts of Manipur, authors (GN and ABM) collected some bat specimens, a few of which have not been hitherto recorded from the state. In this communication we report these new additions to the bat fauna Manipur state. These include three vespertilionid species namely *Kerivoula picta*, *Myotis muricola* and *Miniopterus magnater* and two rhinolophids *i.e.* *Rhinolophus sinicus* and *R. yunanensis*. With these additions, the reported bat diversity from the state has increased to seventeen species in 5 families.

Material and Methods

A small collection of bats including one adult specimen of each of the five abovementioned species collected in two localities of Manipur were presented to the first author. The formalin fixed and alcohol preserved specimens were later registered in the collection of Zoological Survey of India, Shillong (ZSIS). Standard morphological measurements of the specimens (post mortem) and

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craniodental measurements of the extracted skulls were taken using a digital caliper accurate to the nearest 0.1 mm and 0.01 mm respectively and were identified following: Bates and Harrison (1997), Csorba, *et al.* (2003); and Srinivasulu, *et al.* (2010). The acronyms of measurements are: Head and body length (HB); Tail length (T); Ear length (E); Tragus length (Tr); Hindfoot length, including claw (HF); Forearm length (FA); Tibia length (Tb); 3MT-3rd Metacarpel length; 4MT-4th Metacarpel length; 5MT-5th Metacarpel length; Greatest length of skull excluding and including incisors (GTL/GTLi); Condylbasal length (CBL); Condylcanine length (CCL); Maxillary toothrow length (CM³); Width across third molars (M³M³); Width across canines (C¹C¹); Zygomatic breadth (ZB); Postorbital constriction (POC); Mastoid breadth (MAB); Breadth of braincase (BB); Skull height (SKH); length of mandible excluding and including incisors (ML/MLi); Mandibular toothrow length (CM₃). The baculum was prepared by macerating the dissected penis in 6% KOH solution and stained with Alizarin Red S (Topal, 1958). The prepared baculum was measured and photographed under a stereo zoom microscope with 40-50x magnification.

Results

New records of bat species:

Rhinolophus sinicus Anderson, 1905

An adult female (V/M/ERS/453) was collected from a cave in Phalang I village (24.9711°N, 93.5638°E 1000m asl) in Tamenglong district of Manipur on 7th June, 2017. The topography around the cave is hilly dominated by deciduous forest and extensive bamboo growth (Figure 1).

Our preserved specimen had a fulvous brown back and lighter belly. The lancet had a well defined tip. In side view, the superior connecting process of the sella is bluntly rounded off and the base of the sella characteristically projects slightly forward and downwards while the base does not project downward in allied congener *R. rouxii* (Thomas, 2000). The mental grooves are three in numbers. The third metacarpal is shortest and the fourth and the fifth are sub equal. Since the skull was partially damaged, completed set of craniodental measurements could not be acquired. However, based on the obtainable mensural data (Table 1) which corresponds well with published data and characteristics shape of the lancet (Thomas, 2000; Csorba *et al.*, 2003), our specimen was assigned to *R. sinicus*.

This species was earlier recognized as a subspecies of *R. rouxii* i.e. *R. r. sinicus*. However, based on differences in a number of external, internal and molecular characters, it was elevated to full species rank (Thomas, 2000). Two subspecies are currently recognized of which *R. s. sinicus* has been reported from Himalayas and South East Asia (Csorba *et al.*, 2003).

Rhinolophus yunanensis Dobson, 1872

An adult male specimen (V/M/ERS/423) was collected by one of the authors (GN) from Lamtuai Kai cave at Dailong village (25.0080°N, 93.5231° E, 1260m asl) in Tamenglong district of Manipur on the 7th June, 2018. Dailong village is known for rich biodiversity and long tradition of conservation of forests (Birjit, *et al.* 2016) and has recently been declared as Biodiversity Heritage Site in Manipur by the state government. The cave is situated amidst tropical evergreen and semi-evergreen forest.

The live colouration of the individual was not noted. However, the dried fur appears to have a drab chestnut brown hue dorsally and a little paler venter. The upper surface of the interfemoral membrane is covered with hairs. The horseshoe had a breadth of 12mm and had one mental groove, a characteristic for the *pearsonii* group. *R. yunanensis* and *R. pearsonii* are very similar morphologically but cranial dimensions are larger in the former (Csorba *et al.*, 2003). Although our specimen has slightly smaller forearm length (54mm) than the average for *R. yunanensis* (56.6mm) (Bates and Harrison, 1997), the cranial dimensions (Table 1) are well beyond *R. pearsonii* and in conformity with that of *R. yunanensis* specimens from the Indian Subcontinent (Bates & Harrison, 1997).

The baculum of the Manipur specimen is 2.94mm in length while its width at the base is 1.03mm. It is similar to that of *R. pearsonii* in dorsal and ventral profile (vide Topal, 1975) and specialized. However, there are marked differences between the two when viewed laterally (Plate 2). The basal cone is large with a protruding basal knob however it is not as strongly projecting and as high as in *pearsonii*. The shaft is dorsoventrally flattened and blade like.

Wu *et al.* (2009) revisited specimens of *R. yunanensis* and *R. pearsonii* from Thailand and China. While maintaining the species identity of *R. pearsonii* and

Table 1. Comparative measurements of *R. sinicus* specimen from Manipur and Meghalaya

Mensural parameter	<i>R. sinicus</i> specimen from Manipur V/M/ERS/453 ♀ (skull partially damaged)	<i>R. sinicus</i> specimen from Meghalaya V/M/ERS/341 ♀	<i>R. sinicus</i> specimen from India and Nepal (Thomas, 2000)
TL		24.5	25.6
E	15.2	19.3	17.8
FA	49	46.7	47.5
TB	20.5	19	19.5
HFCL	9.6	9	8.6
3MT	37.7	36.2	36.3
4MT	38.9	36.9	37.1
5MT	39.2	37.7	38.3
1PH3MT	15.9	15.8	15.4
2PH3MT	25	24.8	22.5
GTLi		20.50	20.7
CCL		17.40	17.7
ZB		10.25	10.4
BB	8.9	8.27	-
MAB	9.83	9.33	9.5
POC		3	-
SKH		6.50	-
CM ³	7.65	7.51	7.7
M ³ M ³	8.06	7.70	8
C ¹ C ¹	5	5	5.3
M ¹ M ³	5.74	4.77	-
ML	14	13.18	-
MLi	14.28	13.64	13.8
CM ₃	8.22	7.94	8.3
M ₁ M ₃	5.80	5	-

yunanensis, they described a new species *R. thailandensis* within this group from Thailand and maintained that *R. yunanensis* is distributed in the Sichuan and Yunan provinces of China. However, they did not include specimens from India and Myanmar from where this species is reported. Pending further investigations, following Csorba *et al.* (2003) we provisionally retain this

species from northeastern India.

Kerivoula picta (Pallas, 1767)

An adult female specimen (V/M/ERS/502) was collected apparently inside a cow shed during day time at Toubul village (24.76055°N, 93.78916°E, 760 m) in Bishnupur district of Manipur on the 10th May, 2018. The village is situated on the bank of Loktak Lake and surrounded by farmlands on three sides. The live specimen had a distinctive light golden brown dorsal fur and ventral pelage was a little paler. The wing membrane was black except for the orange metacarpels and the adjacent skin. Ears and muzzle and interfemoral membrane were also orange coloured (Plate 1). Because of the unique colour pattern, this bat was easily identifiable and hence the cranium was not extracted. In South East Asia, this lesser known species was recorded in dry deciduous forests and found among dried leaves of banana, dry grass, flowers, and weaver bird nests and in sugar cane fields (Hutson *et al.*, 2008). Since the Manipur specimen was caught inside a shed without much natural vegetation around, this species also likely inhabit in anthropogenic landscape.



Plate 1. Landscape of the bat collection localities in Tamenglong district, Manipur.

Myotis muricola (Gray, 1846)

An adult female (V/M/ERS/450) was collected from Phalong III village (28.9766°N, 93.5558°E, 728 m) in Tamenglong District of Manipur on the 12th June, 2017. The animal was taken down by villagers during early evening flight by beating with a flexible bamboo stick. Locals in the area regularly use this technique to collect bats for consumption which usually gather around electric light sources for feeding insects. Phalong III has similar topography and vegetation structure as Phalong I.

When blow dried, the preserved specimen appeared dark brown dorsally. Ventral pelage was also dark but with some light brown tips. The upper lip had some whiskers. Feet small and the wings were attached to the base of the toes. The wings and the interfemoral membranes were dark brown. The braincase appeared flat compared to similar sizes species like *M. mystacinus* and *M. siligorensis* and the canine exceeds the length of third upper premolar (Plate 5).

Miniopterus magnater Sanborn, 1931

An adult female (V/M/ERS/431) was collected from Phalong III village in Tamenglong District of Manipur on the late evening of 12th June, 2017 also by beating with a bamboo stick. Although the roosting site of the bat was not ascertained, a number of small caves in the nearby areas could serve as a roost for this cave dwelling bat. When blow dried, the preserved specimen appeared to have a dark pelage dorso-ventrally. Wings, interfemoral membranes were also dark. The second phalanx of the third metacarpal was characteristically very long at 42.7mm. Although externally very similar to congener *M. fuliginosus*, the mensural parameters of *M. magnater* exceed the former. Our Manipur specimen had a CCL and CM3 of 16.05 and 6.87mm (Table 3) respectively which exceeds that of *M. fuliginosus* (CCL 14.1 and CM3 6.1mm) in Indian Subcontinent (As *M. schreibersii* in Bates & Harrison, 1997). The other craniodental measurements of this specimen also correspond well to the relevant measurements of specimens from Meghalaya (Table 2&3).

Discussion

Among these newly reported species, *Miniopterus magnater* is widely distributed from Myanmar in the west through southern China and much of Southeast Asia, as far east as the island of New Guinea (Bonaccorso & Reardon, 2008). It has recently been recorded from several localities in Meghalaya (earlier records of *M. schreibersii fuliginosus* from Meghalaya are referred to this species) but thus far unknown from any other parts of India (Ruedi *et al.*, 2012; Saikia *et al.*, 2018). Therefore, the occurrence of the species in Manipur indicates that this bat may be more widely distributed in other parts of the northeastern India. The Nepalese whiskered bat *Myotis muricola* is a widespread species known throughout much of northern South Asia, central and southern

Table 2. Morphological and cranio-dental measurements of some of the newly reported bat species from Manipur

Mensural parameter	<i>Kerivoula picta</i> from Manipur V/M/ERS/502 ♀ (Skull not extracted)	<i>R. yunanensis</i> from Manipur V/M/ERS/423 ♀	<i>M. muricola</i> from Manipur V/M/ERS/450 ♀
TL	48	22	
E	14	22	9.4
TR	7.1		4.3
FA	48.7	54	36.8
TB	24	14.4	17.2
HFCL	11.1	14.4	6.4
3MT	45.8	39.6	36.5
4MT	44.7	42.52	35.3
5MT	44.6	44.86	35.2
1PH3MT	19.5	14.11	17
2PH3MT	16.8	22.9	19.5
GTL		26.63	13.24
GTLi		26.30	14.07
CCL		22.83	12.32
ZB		12.86	8.75
BB		10.14	6.37
MAB		11.42	7.02
POC		3.20	3.29
SKH		8	5.10
CM3		10.38	5.24
M3M3		9.37	5.72
C1C1		6.30	3.72
M1M3		5.81	3.40
ML		18.04	10.32
MLi		18.20	10.76
CM3		11.32	5.57
M1M3		6.45	3.58

China and most of Southeast Asia (Bates *et al.*, 2008). In India, it is reported from Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Jharkhand, Sikkim, West Bengal, Assam, Meghalaya, Mizoram (Molur, 2002). Therefore, its occurrence in Manipur state is quite expected. The painted bat *Kerivoula picta* is a widely distributed species in South and Southeast Asia. In India, this species is

Table 3. Comparative measurements of *Mi. magnater* specimen from Manipur and Meghalaya

Mensural parameter	<i>M. magnater</i> from Manipur V/M/ERS/431 ♀	<i>M. magnater</i> specimens from Meghalaya "Saikia et al. 2020"
TL	44	57.0 (55.5-60.0)
E	10.3	12.9 (10.5-14.2)
TR	4.7	45.7 (4.1-6.8)
FA	50.8	50.6 (48.8-52.4)
TB	21.8	21.6 (20.4-22.5)
HFCL	11	9.5 (9.0-10.4)
3MT	48	-
4MT	45.5	-
5MT	41.5	-
1PH3MT	12.7	-
2PH3MT	42.75	-
GTL	16.70	16.7 (16.5-16.8)
GTLi	17.02	17.0 (16.9-17.1)
CCL	16.05	15.66 (15.5-15.9)
ZB	9.85	9.82 (9.8-10.2)
BB	8.58	8.57 (8.5-8.7)
MAB	9.13	9.33 (9.2-9.5)
POC	4.28	4.29 (4.2-4.4)
SKH	7.12	-
CM ³	6.87	6.85 (6.8-7.1)
M ³ M ³	7.50	7.46 (7.0-7.7)
C ¹ C ¹	5.27	5.23 (5.2-5.3)
M ¹ M ³	3.88	3.85 (3.8-3.9)
ML	12.87	12.81 (12.7-12.9)
MLi	13.14	13.19 (12.9-13.3)
CM ³	7.23	7.28 (7.2-7.4)
M ¹ M ³	4.41	4.21 (4.0-4.4)

known from a number of states like Andhra Pradesh, Assam, Goa, Karnataka, Kerala, Maharashtra, Orissa, Rajasthan, Sikkim, Tamil Nadu and West Bengal (Molur *et al.*, 2002). However, in northeastern India, this bat is known only by two locality records in Lakhimpur and Golaghat districts in eastern Assam (Chaturvedi, 1969; Boro *et al.*, 2018). Thus, the present specimen record from Manipur assumes significance.

An Oriental species, *Rhinolophus yunanensis* in India was earlier known from two localities in Eastern

**Plate 2.** Lateral view of *Kerivoula picta* specimen from Manipur (V/M/ERS/502).**Plate 3.** Dorsal, ventral and lateral view of cranium and lateral view of mandible of *R. yunanensis* (ZSIS-423).

Arunachal Pradesh and Mizoram (Dobson, 1874; Hinton & Lindsay, 1926) and possibly has not been extended further west. This species is very similar to *R. pearsoni* except for its larger size and many authors treated it as a synonym of *R. pearsoni* (Ellerman & Morrison-Scot, 1951; Sinha, 1973). However, most of the subsequent authors consider it as a distinct species (Hill, 1986; Koopman, 1994; Bates & Harrison, 1997; Csorba *et al.*, 2003). There has been very little ecological information on this species in India (Bates & Harrison, 1997). As reported, our specimen was also caught inside a cave which it shared with other bat species and a piece of elytra recovered from inside its teeth indicate its food preference towards hard bodied insects like beetles.



Plate 4. Dorsal, ventral and lateral view of cranium and lateral view of mandible of *M. muricola* from Manipur (ZSIS-450).

Besides the above newly recorded species, the other species recorded during the surveys include *Cybopterus sphinx* (V/M/ERS/500-501) and *Rousettus leschenaulti* (Photographic evidence) from Zeilad WLS (24.91127°N, 93.38125°E, 260m) in Tamenglong district, *Hipposideros lankadiva* (V/M/ERS/432) from Lamtuai Kai cave (25.0080°N, 93.5231°E, 1260m asl) in Tamenglong district, *Pipistrellus coromandra* (V/M/ERS/503-506) from Ningthoukhong (24.57005°N, 93.76563°E 770m) in Bishnupur district and *Tylonycteris fulvida* (V/M/ERS/451) from Phalang III, Tamenglong District.

The small mammalian fauna of Manipur state is little explored and so far only 12 species of bats are recorded



Plate 5. Lateral, dorsal and ventral view of baculum of *R. yunanensis* specimen from Manipur (ZSIS-423).

from the state (Mandal *et al.* 2005). With the current additions, the bat inventory of the state stands at 17 species (Table 4). However, considering the very little filed studies conducted so far in the state, the species count will certain go up significantly with additional surveys? It is worth mentioning the formalin fixed specimens did not allow us to conduct any molecular investigations. Molecular data involving some of the complex genera like *Myotis* and some rhinolophids would have greatly complemented the morphological data in ascertaining the species identity and accurately determining bat diversity in the state. This remains our next priority.

Table 4. List of reported bat species from Manipur state

Sl No.	Family	Species	Locality records	Reference
1.	Pteropodidae	<i>Rousettus leschenaulti</i> (Desmarest)	Zeilad WLS, Tamenglong District	Present study
		<i>Pteropus giganteus</i> (Brunnich)	Imphal town, Imphal District	Roonwal, 1950
		<i>Cynopterus sphinx</i> (Vahl)	Churchandpur, Churchandpur district; Uchathal near Jiribam, Imphal District; Tamenglong, Tamenglong District	Sinha, 1999; Mandal <i>et al.</i> , 2005
		<i>Megaerops niphanae</i> Yenbutra & Felton	Uchathal near Jiribam, Imphal District and Tamenglong, Tamenglong District	Mandal <i>et al.</i> , 2005
		<i>Eonycteris spelaea</i> (Dobson)	Jiribam, Imphal District	Sinha, 1999
2.	Rhinolophidae	<i>Rhinolophus sinicus</i> Anderson	Phalang I village, Tamenglong District	Present study

		<i>Rhinolophus yunanensis</i> Dobson	Dialong village, Tamenglong District	Present study
3.	Hipposideridae	<i>Hipposideros armiger</i> (Hodgson)	Tharon Cave, Tamenglong District	Mandal <i>et al.</i> , 2005
		<i>Hipposideros lankadiva</i> Kelaart	Jiribam, Imphal District; Lamtuai Kai cave, Tamenglong District	Mandal <i>et al.</i> , 2005; Present study
4.	Vespertilionidae	<i>Myotis muricola</i> (Gray)	Phalang III, Tamenglong District	Present study
		<i>Pipistrellus coromandra</i> (Gray)	Imphal district, Ningthoukhong, Bishnupur district	Mandal <i>et al.</i> , 2005; Present study
		<i>Pipistrellus tenuis</i> (Temminck)	Uchathal, Imphal city, Imphal District	Mandal <i>et al.</i> , 2005 (as <i>P. mimus</i>)
		<i>Scotozous dormeri</i> (Dobson)	Uchathal, Imphal city, Jiribam, Imphal District	Sinha, 1999; Mandal <i>et al.</i> , 2005
		<i>Scotophilus heathii</i> (Horsfield)	Jiribam, Imphal District	Sinha, 1999
		<i>Tylonycteris fulvida</i> (Blyth)	No exact locality; Phalang III, Tamenglong district	Blanford, 1891 as <i>T. p. fulvida</i> ; Present study
		<i>Kerivoula picta</i> (Pallas)	Toubal village, Bishnupur district	Present study
5.	Miniopteridae	<i>Miniopterus magnater</i> Sanborn	Phalang III village, Tamenglong District	Present study

Acknowledgements

U.S. and A.B.M are grateful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata and the

Officer-in-Charge, ZSI, Shillong for encouragement and institutional facilities. We also acknowledge Premjit Elangbam for collecting the *K. picta* specimen and providing its photograph.

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