

BATS OF THE SIJU CAVE, SOUTH GARO HILLS DISTRICT, MEGHALAYA, INDIA : TAXONOMY AND BIONOMICS

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INTRODUCTION

The Siju Cave, in Meghalaya, is situated in a cliff on the right bank of the Someswari river, between the villages of upper and lower Siju (25°21'N and 90°41'E). The exact area of the cave is yet to be ascertained. It is about 25.9 metres above the level of the river, in dry season and approximately 289.7 metres above the mean sea-level. A good description of the topography of the Siju cave is available (Kemp 1924 a).

The entrance of the cave measures 106.7 m long, 8.5 to 10.7 m broad and 6.7 to 7.6 m in height. The floor is nearly horizontal with an underground water-course running through it. Day-light enters about 45.7 m inside. Between 45.7 m to 106.7 m inside is the region of twilight, and beyond 106.7 m is total darkness. A cavern, the habitat of the fruit bats begins at the end of the entrance. Unavailability of necessary equipments did not allow any further entry inside.

Three species of bats from the Siju cave, viz. *Cynopterus sphinx gangeticus* Andersen, *Rhinolophus subbadius* Blyth and *Hipposideros lankadiva* Kelaart have already been reported (Kemp 1924 b, Kurup 1968).

During November, 1990, June-July and October, 1991, February, June and August, 1992, 413 examples comprising six species of bats (including suckling young ones) were collected from the Siju cave and a nearby garden.

The following species of bats were collected :-

Rousettus l. leschenaulti (Desmarest), *Eonycteris spelaea* (Dobson), *Cynopterus s. sphinx* (Vahl), *Hipposideros lankadiva* Kelaart, *Myotis longipes* Dobson, *Miniopterus schreibersi fuliginosus* (Hodgson).

Cynopterus s. sphinx was collected only from the garden, while other species were netted from the cave itself. Additional species of bats collected by others from the Siju Cave have also been incorporated. Name of the collector for specimens collected by the author has not been given.

Rhinolophus subbadius Blyth, *Rhinolophus pusillus blythi* Andersen and *Kerivoula hardwickei* (Horsfield) were not found in and around the cave, but noted here on the basis of a single specimen of *Kerivoula hardwickei* available in ERS., Shillong and one each of *Rhinolophus blythi* and *Rhinolophus subbadius* studied in ZSI., Calcutta.

In the present paper, taxonomy and distribution of the above nine species of bats from the Siju Cave and environs were studied. Also bionomics of the six species of bats collected has been discussed. A key to identification, diagnosis, distribution, bio-taxonomic observation of each species and a general discussion have been provided. All measurements are taken in millimetres and the figures in parentheses refer to arithmetic mean values.

The following abbreviations have been used in the text :

<i>ad.</i>	Adult.
<i>App.</i>	Approximate.
<i>c-m¹ or c-m² or c-m³</i>	Length of upper tooth row.
<i>c-m₂ or c-m₃</i>	Length of lower tooth row.
<i>CR.</i>	Length of cranial rostrum.
<i>cw.</i>	Width of brain case.
<i>db.</i>	Depth of brain case
<i>E.</i>	Length of ear.
<i>ERS.</i>	Eastern Regional Station, Zoological Survey of India.
<i>ex.</i>	Example
<i>f.</i>	Length of forearm.
<i>ft.</i>	Length of foot including claws.
<i>HB.</i>	Length of head and body.
<i>hbc.</i>	Height of brain-case.
<i>iof.</i>	Infraorbital foramen
<i>iow.</i>	Interorbital width.
<i>hm.</i>	Height of muzzle.
<i>l</i>	Total length of skull.
<i>ml.</i>	: Length of mandible
<i>m¹-m¹</i>	Maxillary width in fruit bats. Rostral width in <i>Hipposideros</i>
<i>m³-m³</i>	Maxillary width in insectivorous bats.
<i>mw.</i>	Mastoid width.
<i>pen.</i>	: Length of penis.
<i>Subad.</i>	Subadult
<i>Suck. y.</i>	Suckling young

<i>t.</i>	Length of tibia
<i>Tl.</i>	: Length of tail
<i>Tr.</i>	Length of tragus
<i>ws.</i>	Wing span
<i>ww.</i>	Width of wings.
<i>ZSI, Cal</i>	Zoological Survey of India, Calcutta.
<i>zw.</i>	: Zygomatic width.
<i>III'</i>	: First phalanx of third finger.
<i>IIF</i>	Second phalanx of third finger.

KEY TO THE BATS OF THE SIJU CAVE AND ENVIRONS

1. Tragus and nose-leaf both absent.....2
 Either tragus or nose-leaf absent.....4
2. Second finger without claw.....*Eonycteris spelaea*
 Second finger with claw.....3
3. Margin of ear white.....*Cynopterus sphinx sphinx*
 Margin of ear not white.....*Rousettus l. leschenaulti*
4. Nose-leaf present, tragus absent.....5
 Nose-leaf absent, tragus present.....7
5. Larger (forearm more than 80.0 mm).....*Hipposideros lankadiva*
 Smaller (forearm less than 42.0 mm).....6
6. Upper tooth-row less than 6.0 mm.....*Rhinolophus pusillus blythi*
 Upper tooth-row more than 6.0 mm.....*Rhinolophus subbadius*
7. Ear funnel-shaped*Kerivoula hardwickei*
 Ear not funnel-shaped..... 8
8. Second phalanx of third finger nearly three times as long as first.....
*Miniopterus schreibersi fuliginosus*
 Second phalanx of third finger not elongated.....*Myotis longipes*

TAXONOMY AND BIONOMICS

Suborder MEGACHIROPTERA

Family I. PTEROPODIDAE

Genus (1) *Rousettus* Gray1 *Rousettus leachenaulti leachenaulti* (Desmarest)

1820. *Pteropus leachenaulti* Desmarest, *Encycl. Meth Mammal.*, 1 : 110 (Environments of Pondichery, India)

Common name Indian Fulvous Fruit Bat (English).

Material examined: 11 (Ms) (*ad.*), 2 (Ms) (*Subad.*), 1 (M) (*Suck.y.*), 20 (Fs) (*ad.*), 16-19 Feb 1992; 1 (F) (*ad.*), G. M. Yazdani, 21 Feb 1971; 3 (Ms) (*ad.*), 7 (Fs) (*ad.*), A. s. Rajgopal, 5 Mar 1965; 1 (F) (*ad.*), C. B. Srivastava, May 1961; 4 (Ms) (*ad.*), 1 (M) (*Suck.y.*), 14 (Fs) (*ad.*), 2 (Fs) (*Suck.y.*), 3-5 Jun 1992; 3 (Ms) (*ad.*), 3 (Fs) (*ad.*), 27-28 Jun 1991, 7 (Ms) (*ad.*), 21 (Ms) (*Suck.y.*), 41 (Fs) (*ad.*), 14 (Fs) (*Suck.y.*), 7-9 Aug 1992; 11 (Ms) (*ad.*), 4 (Ms) (*Subad.*), 1 (M) (*Suck.y.*), 16 (Fs) (*ad.*), 1 (F) (*Subad.*), 23-26 Oct 1991; 2 (Ms) (*ad.*), 4 (Ms) (*Subad.*), 1 (M) (*Suck.y.*), 1 (F) (*ad.*), 1 (F) (*Subad.*), 1 (M) (*Suck.y.*), 20-23 Nov. 1990.

Measurements External 39 (Ms) (*ad.*) *HB.* 100.0-130.0 (118.0); *E.* 19.0-21.0 (20.0); *TL.* 13.0-21.0 (17.1); *f.* 77.0-90.0 (85.2); *t.* 33.0-43.0 (39.2); *ft.* 17.0-24.0 (21.0); *ws.* 420.0-500.0 (455.0); *ww.* 90.0-117.0 (105.0). 105 (Fs) (*ad.*) *HB.* 95.0-135.0 (110.0); *E.* 17.0-21.0 (20.0); *TL.* 11.0-18.0 (15.0); *f.* 68.0-85.0 (80.0); *t.* 29.0-39.0 (35.0); *ft.* 15.0-24.0 (20.0); *ws.* 410.0-490.0 (435.0); *ww.* 87.0-113.0 (98.0). Skull 5 (Ms) (*ad.*) *l.* 36.0-38.0 (37.4); *zw.* 22.5-24.0 (23.2); *cw.* 15.5-16.5 (15.9); *m'-m'* 11.5-12.0 (11.9); *c-m'* 14.0-14.5 (14.3); *c-m*, 15.0-16.0 (15.6); *ml.* 28.5-30.0 (29.1). 6 (Fs) *l.* 36.5-38.0 (36.9); *zw.* 22.0-23.0 (22.4); *cw.* 15.0-16.0 (15.4); *m'-m'* 10.5-11.4 (10.9); *c-m'* 13.3-14.0 (13.7); *c-m*, 14.7-16.5 (15.3); *ml.* 28.5-30.0 (28.0).

Diagnosis: Size medium (forearm 68.9-90.0), muzzle long and eyes large; tail very small (length 11.0-21.0) and rod-like, ear with a notch at the lower edge; last lower molar elliptical.

Dental formula $i \frac{2}{2}, c \frac{1}{1}, pm \frac{3}{3}, m \frac{2}{3} = 34.$

Distribution INDIA Jammu and Kashmir (Chakraborty, 1983), Himachal Pradesh, Sikkim, Meghalaya, Nagaland, Assam, Arunachal Pradesh, Tripura, West Bengal, Bihar, Uttar Pradesh, Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Goa, Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Orissa. PAKISTAN, SRI LANKA, NEPAL, BHUTAN, MYANMAR (=BURMA), SOUTHERN CHINA including Tibet, HONGKONG, THAILAND, LAOS, possibly CAMBODIA, VIETNAM.

Remarks: In one of the specimens the lower portion of wing membrane between the third and fourth digits is completely white like the condition observed by Sinha (1994) in one specimen of *Miniopterus achreibersi fuliginosus* (Hodgson) from the same cave.

Females are smaller than males as reported by Khajuria (1979) for Madhya Pradesh population and by Sinha (1980, 1986) for Rajasthan and Bihar populations respectively.

The collection of the present species consists of individuals of different age groups. Possession of scrotal testes was considered as adult hood for male while the female was diagnosed as adult on the basis of discernible teats. Adult males collected in February, have forearm length 77.0 to 85.0 and females 72.0 to 80.0, in March, males have 82.0 to 83.0 and females 76.0 to 81.0, in May, male has 83.0 and females 71.0 to 80.0, in June, males have 79.0 to 89.0 and females 78.0 to 84.0, in August, males have 81.0 to 85.0 and females 72.0 to 80.0, in October, males have 80.0-90.0 and females 68.0 to 83.0 and in November, males have 77.0 to 81.0 and females 69.0 to 85.0.

Biology : Adult males collected in February, March, May, June, August, October and November had enlarged testes, scrotal in position and the glans penis exposed. Copulating pairs were observed during all these months. Males became aggressively possessive of females roosting near them. After copulation, males flew away for a few seconds and came back to the same cluster and copulated with some other female. Young adult females were found involved with older males also. Multiparous specimens had well developed teats whereas the primiparae possessed only spot in lieu of the usual teat. One young is born at a time.

Females in February had embryos (size 3.0 to 32.0) in the left horn of uterus, while in March, in the right horn (size 28.0 to 30.0), in May, in right horn (size 30.0), in June either in left or in right horn (size ranging from 21.0 to 32.0). Suckling youngs were collected in June and August (forearm 42.0 to 66.0). All of them had coagulated milk in their gut. The sex ratio of young ones in the collection was found to be 60% males and 40% females. All the females collected in November were subadult having only a spot in lieu of a teat. Suckling youngs were found in almost all the visiting months. Sinha (1981) found suckling young in September in Gujarat and Brosset (1962a) in March, April, May and August in central and western India.

It would, therefore, appear that copulation takes place in *R. l. leschenaulti* in the Siju Cave throughout the year. Gopalakrishna (1969) reported a gestation period of 125 days in the Aurangabad population. This indicates that the peak of copulation is probably in last week of December (maximum number of births was found in the first week of August).

The habit of cluster formation of the Indian Fulvous Fruit Bat was observed in the ceiling at the entrance of the Siju Cave during each visit from 6.00 to 11.00 hours.

Most of the Fulvous Fruit Bats were seen hanging from the branches and twigs of large trees near the entrance after the foraging and prior to entering the cave. The trees were sal (*Shorea robusta*), Kachnar (*Bahonia barrigata*), Shirish (*Albizza sp.*), *Eucalyptus sp.* and Amaltas.

Flying bats were found with the help of electric torch during the night among the Bair (*Zygyphus* sp.) trees, flowering *Musa* sp., wild *Ficus* sp. and Betal Nut (*Areca* sp.) grove.

These bats, after mastication, consume only the juice of fruits and other plant material, discarding the substance. Feeding on flowers and being covered with pollen were reported for *Rousettus* sp. (Start, 1972). Examination of the gut contents of five specimens disclosed unidentifiable gray liquid material. Arthropod fragments were detected in the stomach contents by Lim (1973). *Rousettus asgyptiacus* consumes leaves and fruits of *Ficus religiosa* (Lewis and Harrison 1962).

Genus (2) *Eonycteris* Dobson

2. *Eonycteris spelaea* (Dobson)

1871. *Macroglossus spelaeus* Dobson, *Proc. Asiat. Soc. Beng.*, 105, 106. (Farm Caves, Moulmein, Tenasserim).

Common name Dobson's Long-tongued Fruit Bat (English).

Material examined: 9 (Ms) (*ad.*), 3 (Fs) (*ad.*), 18-19 Feb 1992; 1 (M) (*Suck.y.*), 4 Jun 1992; 1 (M) (*ad.*), 1 (M) (*subad.*), 27-28 Jun 1991, 1 (M) (*ad.*), 9 (Ms) (*subad.*), 3 (Fs) (*ad.*), 7-9 Aug 1992; 2 (Ms) (*ad.*), 4 (Ms) (*subad.*), 1 (M) (*Suck.y.*), 13 (Fs) (*ad.*), 23-26 Oct 1991; 3 (Ms) (*ad.*), 13 (Ms) (*subad.*), 2 (Fs) (*ad.*), 14 (Fs) (*subad.*), 21-23 Nov. 1990.

Measurements External 16 (Ms) (*ad.*) *HB.* 91.0-126.0 (106.0); *E.* 16.5-22.0 (20.0); *TL* 8.6-19.0 (14.7); *f.* 68.0-75.0 (72.0); *t.* 29.0-37.0 (32.0); *ft.* 17.0-27.0 (19.8); *ws.* 340.0-440.0 (380.0); *ww.* 78.0-90.0 (83.3), 21 (Fs) (*ad.*) *HB.* 86.0-123.0 (100.0); *E.* 16.0-20.0 (18.0); *TL* 8.0-17.0 (14.5); *f.* 65.0-78.0 (69.5); *t.* 27.0-34.0 (32.0); *ft.* 16.0-20.0 (18.7); *ws.* 370.0-420.0 (394.0); *ww.* 72.0-83.0 (78.3). Skull 4 (Ms) (*ad.*) *l.* 35.2-36.0 (35.7); *zw.* 20.0-22.0 (21.0); *cw.* 15.0-16.0 (15.4); *m¹-m¹* 9.0-10.0 (9.5); *c-m²* 12.0-13.0 (12.5); *c-m₃* 13.7-14.0 (13.9); *ml.* 26.5-28.0 (27.0). 6 (Fs) (*ad.*) *l.* 33.0-35.5 (34.5) *zw.* 19.0-20.0 (19.2); *cw.* 14.0-15.0 (14.4); *m¹-m¹* 8.3-9.2 (8.8); *c-m²* 12.0-13.0 (12.3); *c-m₃* 13.0--13.6 (13.3); *ml.* 25.0-27.0 (26.2).

Diagnosis Externally very similar to *Rousettus leachenaulti* (Desmarest) except that its muzzle is more elongate; index finger without a claw; tail and calcar well developed; and tongue sharply pointed and much extensible. Skull also very much similar to *R. leachenaulti* except the occipital region which is more deflected; molars and incisors smaller in size; mandible less heavy and upper surface of its symphysis parallel with alveolar line. Dental formula as in *Rousettus*.

Distribution INDIA Meghalaya (Sinha, 1990), Nagaland (Sinha 1994c), Manipur (Sinha 1994c), Assam, Uttar Pradesh, Karnataka and Andaman Islands. MYANMAR (BURMA), THAILAND, LAOS, VIETNAM, CAMBODIA, MALAYSIA, INDONESIA and the PHILIPPINES.

Remarks All adult females (*f.* 68.0-75.0) have large genitals, projecting fleshy kidney-shaped para-anal glands and discernable mammae. Neonate females (*f.* 55.0-58.0) have small

genitals, para-anal glands and mammae not discernible and juveniles (*subad.*) (*f.* 57-64) have flat and dry kidney-shaped para-anal glands and mammae not discernible. All adult males (*f.* 68.0-75.0) have large testes (scrotal) para-anal glands projecting and fleshy, juveniles (*subad.*) (*f.* 56.0-67.0) have small testes (abdominal); para-anal glands flat and dry and neonates (young) (*f.* 55-58) have small testes (abdominal); para-anal glands flat and dry and neonates (young) (*f.* 55.0-58.0) have small testes (abdominal) and para-anal glands discernible. Neonates have clotted milk in the stomach.

Like *Rousettus l. leschenaulti*, females become adults earlier than the males. The forearm of adult females are ranges from 65-78 and that of males 68-75.

Biology Females collected in February and August were pregnant. Each female had an embryo either in left or right horn of uterus. Size of embryo was 3.0 in February and 27.0 to 35.0 in August.

Suckling young (coagulated milk was present in the gut) were found in June and October Neonates and subadults were found in June, August, October and November.

It can be concluded from these observations that the gestation period in this bat is about 5 months with two litters, one in May and other in November. Bhat *et.al.* (1980) mention that this species breeds throughout the year. From my observation made during different months, it is supposed that there is no definite rutting season in this bat like *Rousettus l. leschenaulti*.

Stomach contents of five specimens were examined. It had only half digested pollen grains and brown undigested liquids. Medway (1969) mentions that the diet of this species consists chiefly of pollen and nectar.

Genus (3): *Cynopterus* Cuvier

3. *Cynopterus sphinx sphinx* (Vahl)

1797. *Vespertilio sphinx* Vahl. *Skr. nat. selsk. Copenhagen.* 4 (1) : 123 (Tranquebar, S. India).

Common name Shortnosed Fruit Bat (English).

Material examined : 2 (Ms) (ad.), 3(Ms) (subad.), 1(M) (suck.y.). 7 (Fs) (ad.), 2(Fs) (subad.), 26-29 Jun 1991

Measurements: External 2(Ms): *HB.* 70.0, 79.0; *E.* 19.0, 22.0; *TI.* 7.0, 14.0; *f.* 66.0, 73.0; *t.* 24.0, 29.0; *ft.* 14.0, 18.0; *ws.* 360.0, 440.0; *ww.* 80.0, 85.0. 7 (Fs) *HB.* 75.0-97.0 (85.9); *E.* 19.0-23.0 (21.0); *TI.* 9.0-17.0 (12.6); *f.* 65.0-76.0 (69.1); *t.* 24.0-30.0 (26.5); *ft.* 14.0-17.0 (15.9); *ws.* 340.0-420.0 (378.0); *ww.* 81.0-86.0 (84.0). Skull 2 (Fs) *l.* 30.5, 33.2; *zw.* 18.0, 20.5; *cw.* 13.0, 14.0; *m¹-m¹* 9.5, 10.0; *c-m¹* 11.0, 11.5; *c-m₂* 12.0, 12.5; *CR.* 7.0, 8.0; *ml.* 23.5, 25.0, 5(Fs) : *l.* 30.0-33.0 (31.6); *zw.* 18.0-21.0 (19.7); *cw.* 13.0-14.0 (13.8); *m¹-m¹* 9.5 10.0 (9.9); *c-m¹* 11.0 (in all); *c-m₂* 12.0-12.5 (12.3); *CR.* 7.5-8.0 (7.8); *ml.* 23.5-25.0 (24.0).

Diagnosis Smaller than *Rousettus leschenaulti*, forearm 65.0 to 76.0, ear margin white, metacarpals and phalanges whitish; nostril divergent with deep inter-narial groove. Skull

smaller than *R. leschenaulti*. Dental formula $i \frac{2}{2}, c \frac{1}{1}, pm \frac{3}{3}, m \frac{1}{2} = 30$.

Distribution INDIA Jammu & Kashmit (Chakraborty, 1983), Arunachal Pradesh, Meghalaya, Tripura, Manipur, Nagaland, Sikkim, West Bengal, Bihar, Uttar Pradesh, Rajssthan, Madhya Pradesh, Gujarat, Maharashtra, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Goa, Kerala, Andaman Island. PAKISTAN (Anderson, 1881), SRI LANKA, NEPAL (Fry, 1925), BANGLADESH AND MYANMAR (=BURMA).

Remarks The newly pregnant females have only spots in place of mammae. The grown up females which became pregnant more than once have well developed teats. The subadult males have testes inguinal in position while grown up males have well developed testes scrotal in position.

Biology: Females collected in June near Siju cave were pregnant, (size of embryo ranging from 14.0 to 17.0), except one which had a suckling young (f. 59.0) clinging to the right teat and attached vento-ventrally between right arm and abdomen. Sinha (1986) found suckling youngs (f. 60-80% of the mother) in April, May and July in Bihar. Gopalakrishna (1969) mentions that it breeds throughout the year and its gestation period is 115 to 125 days.

The gut contents of five specimens collected in the morning, show only blackish liquid material, which could not be identified. Lim (1970), after examining the stomach contents of a large series of *Cynopterus brachyctis*, determined that the fruit and floral parts constituted a major part of their diet, although some insect parts were also observed.

On the basis of collection made from different foraging grounds near the Siju cave, its favourite food can be determined as follows.

The bat was collected between 26 to 29 June, 1991 in the mist-nets set outside the Siju cave in the flowering garden containing Jack fruit (*Artocarpus integrifolia*), Rose (*Rosa* sp.), Plantains (*Musa* sp.), Lantana plant (*Lantana aculeata*), Indian Oleander (*Nerium* sp.) Bair (*Zygyphus* sp.), China-rose (*Hibiscus mutabilis*) etc. Most of the specimens were collected in the mist-nets set up near the flowering china-rose bushes.

Family II. RHINOLOPHIDAE

Genus (4) *Rhinolophus* Lacepède

4. *Rhinolophus subbadius* Blyth

1844. *Rhinolophus subbadius* Blyth, *J. Asiat. Soc. Beng.*, 13 : 486. (Nepal).

1872. *Rhinolophus garoensis* Dobson, *J. Asiat. Soc. Beng.*, 41 : 337. (Garo Hills, Meghalaya).

Common name Nepal Horse-shoe Bat (English).

Material examined 1(F), Siju cave, coll. S. W Kemp & B. N. Chopra, 1921 and 1(F)

(Holotype of *R. garoensis*, in spirit) Meghalaya Garo Hills present in *Z.S.I. Cal.*

Measurements External 2(Fs): *f.* 34.0, 37.3; *tl* (1) 16.0; *t.* 12.6, 13.5; *ft.* 6.5, 7.0. Skull : 2 (Fs): *l.* 14.0, 15.9; *zw.* (1) 7.3; *cw.* (1) 6.5; m^3-m^3 5.6 (2); $c-m^3$ 5.3, 5.6; $c-m_3$ 5.9, 6.1

Diagnosis : This is the smallest form among Indian species of *Rhinolophus*. Its forearm length ranges from 34.0-37.9 and total length of skull 14.0-15.2.

Distribution INDIA Meghalaya, Uttar Pradesh. NEPAL, MYANMAR (Hill, 1962), VIETNAM.

Remarks This bat was not observed by me in the Siju Caves. It is mentioned here on the basis of Kemp (1924b). According to Kemp (1924 b) this bat is rare in the Siju Cave and solitary in habit. He obtained one specimen which was shot at dusk at the entrance. Nothing is known about its ecology.

5. *Rhinolophus pusillus blythi* Andersen

1918. *Rhinolophus blythi* Andersen, *Ann. Mag. nat. Hist.* 2 : 376, 377 (Almora, 5,500, Kumaon, Northern India-Almora c, 676m, Almora district, Uttar Pradesh, India).

Common name : Least Horse-shoe Bat (English).

Material examined : 1 (unsexed, *ZSI. Cal.*) · Meghalaya : Garo Hills : Siju Cave (no date).

Measurements External *f.* 40.0; *Tl.* 19.0; *t.* 16.0; *ft.* 6.5.

Diagnosis: Size small, forearm 35.0-40.0; tibia short, 16.0 or less in length; horizontal base of sella arched and equal in width to vertical part; connecting process triangular in lateral view.

Distribution INDIA Assam, Meghalaya, West Bengal, Uttar Pradesh, NEPAL, MYANMAR (=BURMA), THAILAND and SOUTHERN CHINA, including Tibet.

Genus (5) *Hipposideros* Gray

6. *Hipposideros lankadiva* Kelaart

1850. *Hipposideros lankadiva* Kelaart, *J. Ceylon Brch R. Asiat. Soc.*, 2 : 216. (Kandy, Ceylon (=Sri Lanka).

Common name: Sri Lanka Gigantic Leaf-nosed Bat or Kelaart's Leaf-nosed Bat (English).

Material examined · 10 (Ms) (*ad.*), 3 (Fs) (*ad.*) A.S. Rajagopal, 6-7 Mar 1965; 1 (M) (*ad.*), J.R.B. Alfred, 23 Feb 1991, 10 (Ms) (*ad.*), 28(Fs) (*ad.*), 3-5 Jun 1992; 4(Ms) (*ad.*), 1(M) (*suck.y.*), 8 (Fs) (*ad.*), 1(F) (*suck.y.*), 26-29 Jun 1991; 1(F) (*ad.*), 7 Aug 1992.

Measurements External 26(Ms) (*ad.*) *HB.* 85.0-100.0 (92.0); *E.* 23.0-30.0 (26.2); *Tl.* 40.0-54.0 (48.7); *f.* 83.6-92.0 (88.2); *t.* 32.0-37.0 (34.5); *ft.* 15.0-19.0 (16.4); *ws.* 440.0-470.0 (460.0); *ww.* 95.0-100.0 (97.1). 39(Fs) (*ad.*) *HB.* 90.5-95.0 (92.4); *E.* 24.0-30.0 (27.0); *Tl.* 42.5-54.0 (49.2); *f.* 79.5-91.0 (88.0); *t.* 30.0-36.0 (34.2); *ft.* 15.0-18.0 (16.6); *ws.* 420.0-460.0 (450.0); *ww.* 95.0-100.0 (97.0). Skull 6(Ms) (*ad.*): *l.* 31.3-32.8 (32.0); *zw.* 20.0-20.6 (20.1); *cw.* 13.2-14.1 (13.8); m^3-m^3 12.8-13.3 (13.0); m^1-m^1 10.9-11.2 (11.0); $c-m^3$ 14.0-14.5 (14.1);

c-m, 15.2-16.0 (15.8); *ml*. 24.0-25.5 (24.7); *mw*. 15.0-15.2 (15.1); *iow*. 3.6-4.0 (3.9); *iof*. 3.0-3.7 (3.4). 2(Fs) (*ad.*) 1.30.1, 31.8; *zw*. 19.0, 20.0; *cw*. 13.0, 13.7; *m*¹-*m*³ 13.0, 13.1; *m*¹-*m*¹ 11.0, 11.0; *c-m*³ 13.2, 14.1, *c-m*, 14.5, 15.0; *ml*. 23.2, 25.0; *mw*. 15.0, 15.2; *iow*. 3.8, 4.0; *iof*. 3.0, 3.5.

Diagnosis In size, this bat is very much similar to that of *H. armiger* (Hodgson); forearm 79.0-92.0 vs. 87.5-91.5 (4 exs.) and length of skull 30.1-33.0 vs. 29.1-31.0. Marginal leaflets prominently seen in three numbers and the fourth one is very minute or rudimentary and in some it is not seen, also mentioned by Hill (1963). Some male specimens have reduced frontal sac in the form of pore behind the posterior nose-leaf but most of them have no frontal sac. Females have no sign of frontal sac. One male specimen from Puri, Orissa (*ZSI. Cal. Reg. No. 9195*) has well developed frontal sac without tuft of hairs. Wroughton (1918), Brosset (1962 *b*) and Hill (*loc. cit.*) have not mentioned about frontal sac in this species. Posterior nose-leaf broader than horse-shoe in all specimens as mentioned by Wroughton (*loc. cit.*). Anterior leaf has no median emargination; its internarial septum not inflated; and the narial lappets well developed. The intermediate part of noseleaf expanded, its central part flattened and swollen but not forming median ridge. Posterior leaf high and broad, its upper margin semicircular with a swollen median projection, flanked by narrow notches and supported by three well-defined septa enclosing small cells, which are four in number.

Rostral region of skull well flatted (width 7.8-9.3) but narrower than *H. armiger* (width 8.8-10.4). Zygoma (18.1-20.6) and palate (6.3) broad; sagittal crest high; interorbital region compressed. Infraorbital foramina very large and closed; length of slender bar is about 4.0.

Distribution INDIA Meghalaya, West Bengal, Madhya Pradesh, Orissa, Maharashtra, Karnataka. SRI LANKA.

Biology The bat was collected in the mist-net along with *Rousettus l. leschenaulti*, *Eonyctaris spelaea* and *Miniopterus schreibersi fuliginosus*. Mature female collected in the month of March and June had well developed (a pair of) pectoral and inguinal teats. Males had well developed testes, scrotal in position. None of the females collected was pregnant. In last week of June one male and one female suckling young and in first week of August one subadult male were collected.

The sex ratio was, as per collection made, 10(Ms), 3 (Fs) in March, 14(Ms), 36(Fs) in June and 4(Ms), 1(F) in September. Among 91 specimens captured by Brosset (1962b) in Mandu, Madhya Pradesh in the month of March, only 19 were females. As per above observation in the Siju Cave females outnumbered males in the breeding season in June and males outnumbered females in March and September as also observed by Brosset (*loc. cit.*). Since suckling young were found in the last week of June, it can be concluded that birth of a young takes place in the month of June. Brosset (*loc. cit.*) also found young in Gersoppa, Karnataka in the middle of June. Bhat and Sreenivasan (1981) found pregnant females with an embryo each in the month of February and the neonates during the latter half of May and earlier half

of June in Karnataka. According to Sapkal and Bhandarkar (1984) copulation occurs in this species in the latter half of August. The early development of embryo is usually slow nearly two months. Even the post-implantation development is also considered retarded until the limb-bud stage of development. Consequently, the gestation of this bat lasts for about 260 to 270 days.

Carnivorous tendency of this bat was observed on 5th June, 1992. To collect the bats trapped in mist-nets we entered the Siju Cave at about 14.00 hours. As we entered we saw a headless *Minopterus schreibersi fuliginosus* on the ground below the net and a living *Hipposideros lankadiva* moving slowly near it with some portions of mist-net attached to its body. It was also observed that this bat is more furious than *Megaderma lyra*. During an earlier visit, while handling this bat, it buried its canine very deep in my index finger piercing the nail. Therefore, this bat may be considered occasional predator of other bats.

Gut contents of three specimens of this bat, collected in the last week of June were examined. Among gut contents about 50 antennal parts and muscular portions of carabid beetle (Coleoptera) had been observed. It shows that bat feeds heavily on beetles particularly during the rainy season (June) when a large number of nocturnal flying carabid beetles are available.

Family III. VESPERTILIONIDAE

Genus (6) *Myotis* Kaup

7 *Myotis longipes* Dobson

1854. *Vespertilio macropus* Dobson, 1872, *Proc. Asiat Soc. Beng.*, **209**. Not of Gould, 1854. Type-loc. (Caves of Bhima Devi, 6,000 ft., Kashmir).

1873. *Vespertilio longipes* Dobson, *Proc. Asiat. Soc. Beng.*, **110**. (Renaming of *macropus*, preoccupied).

Common name : Kashmir Cave Bat (English).

Material examined. 2(Fs), 17 Feb 1992; 3(Ms), 2(Fs), 5 Jun 1992.

Measurements External 3 (Ms) *HB*. 42.0-44.0 (43.5); *E*. 10.0-11.0 (10.7); *Tr*. 7.0-8.0 (7.6); *Tl*. 32.0-36.0 (34.5); *f*. 34.5-35.5 (34.8); *t*. 15.0-17.0 (15.6); *ft*. 10.0-11.0 (10.6); *ws*. 180.0-200.0 (190.0). 4(Fs): *HB*. 43.0-46.0 (44.5); *E*. 13.0 (in all); *Tr*. 6.0-8.0 (7.3); *Tl*. 32.0-40.0 (35.5); *f*. 36.0-38.0 (36.9); *t*. 15.0-17.0 (16.3); *ft*. 10.0-11.0 (10.6); *ws*. 210.0-230.0 (220). Skull 1(M), 1(F) *l*. 13.0, 13.0; *zw*. 8.0, 9.0; *cw*. 8.0, 7.0; *m*³-*m*³ 6.0, 6.0; *c*-*m*³ 5.5, 6.0; *c*-*m*₃ 6.0, 6.5; *ml*. 10.0, 11.0.

Diagnosis Check teeth six in number, on each side above and below; forearm 34.5-38.0; dorsal colour pale, ventral silvery; skull length 13.0-14.0.

Distribution INDIA Kashmir, Meghalaya (Sinha, 1994a). AFGHANISTAN.

Remarks Males observed were newly turned adults having smaller body size than females and also tender phalanges.

Biology This bat is a crevice dweller and came from the outside of the cave and entangled in the mist-net set inside the cave at about 18.00 hours. In collection, females outnumbered the males. Gut contents were examined but found nothing except unrecognisable parts of insects. There were plenty of small and big fishes, crustaceans, molluscs and micro dipteran flies in the water and surrounding environments of the cave. Brosset (1966) and Brosset and Deboutville (1966) mentions that *Myotis daubentoni* does feed naturally to some extent upon small fish.

Genus (7) *Miniopterus* Bonaparte

8. *Miniopterus Schreibersi fuliginosus* Hodgson

1835. *Vespertilio fuliginosa* Hodgson, *J. Asiat. Soc. Beng.*, 4 : 700. (Nepal).

Common name Indian Long-winged Bat (English).

Material examined 2(Ms) (*ad.*), 22 Nov 1990; 15 (Ms) (*ad.*), 6(Fs) (*ad.*) 26-30 Jun 1991; 8(Ms) (*ad.*), 11 (Fs) (*ad.*), 23-26 Oct 1991, 4(Ms) (*ad.*), 17 Feb 1992; 2(Ms) (*ad.*), 2 (Fs) (*ad.*), 3 Jun 1992; 2(Ms) (*ad.*), 4 (Fs) (*ad.*), 7-9 Aug 1992.

Measurement: External 33 (Ms) (*ad.*); *HB*. 50.0-63.0 (56.5); *E*. 11.0-14.5 (12.1); *Tr*. 5.0-7.0 (5.5); *Tl*. 55.0-67.0 (61.5); *f*. 49.0-52.0 (51.1); *III*¹ 11.0-14.1 (12.2); *III*² 35.0-43.0 (39.0); *t*. 20.0-23.0 (22.1); *ft*. 10.0-12.0 (11.6); *ws*. 300.0-350.0 (330.0); *ww*. 52.0-61.0 (57.0); *Pen*. 9.0-15.0 (12.1). 23 (Fs) (*ad.*) *HB* 54.0-58.0 (57.0); *E*. 11.0-12.0 (11.7); *Tr*. 5.0-7.0 (6.1); *Tl*. 56.0-64.0 (58.2); *f*. 47.0-53.0 (50.5); *III*¹ 10.8-13.0 (12.1); *III*² 37.0-41.0 (40.2); *t*. 21.0-22.2 (21.6); *ft*. 10.0-11.0 (10.6); *ws*. 310.0-340.0 (330.0); *ww*. 55.0-59.0 (57.0). Skull 5 (Ms) (*ad.*) 1 16.6-17.7 (17.1); *zw*. 9.5-10.0 (9.9); *cw*. 8.0-8.7 (8.4); *m*¹-*m*¹ 7.3-8.0 (7.6); *c-m*¹ 7.0 (in all); *c-m*₃ 7.3-7.6 (7.4); *ml*. 12.7-13.5 (13.1); *hbc*. 9.0-10.0 (9.7); *hm*. 5.5-6.2 (5.9), 5 (Fs) (*ad.*) *i*. 16.5-17.1 (16.9); *zw*. 9.4-10.0 (9.8); *cw*. 8.2-9.0 (8.6); *m*¹-*m*¹ 7.5-8.3 (7.8); *c-m*¹ 6.9-7.1 (7.0); *c-m*₃ 7.1-7.3 (7.2); *ml*. 12.1-12.5 (12.3); *hbc*. 9.0-10.5 (9.7); *hm*. 5.0-6.1 (5.7).

Diagnosis: Nostrils not elongated; ears not funnel shaped; second phalanx of third finger nearly three times as long as first; size larger, forearm above 45.0; hair not extending on to inter femoral membrane.

Distribution : INDIA Meghalaya (Sinha, 1994b), West Bengal (Allen, 1908), Uttar Pradesh, Maharashtra and Karnataka. SRI LANKA and NEPAL.

Remarks The tip of the right tragus in one specimen and that of both tragi in other specimen are found abnormally white. Colour blackish brown throughout. In one specimen partial albinism is observed in right wing between lower portion of the third and fourth finger.

Biology · It was observed that the colony fluctuates seasonally. Only male was observed and collected in February (4 exs) and November (2 exs) while both sexes were abundant in June and October. The males outnumbered the females.

The ecological condition of the Siju Cave with a subterranean river rushing through it, is an ideal habitat for this bat. A similar observation was made by Brosset (1962b) for Robber's cave which constituted a "mother house" with another cave at Panchgani within a radius of 70km which served as secondary habitat for the bat. However, I did not get the opportunity to find out secondary habitat.

The Long-winged Bat was observed together with *Eoncyteris spelaea* (Dobson), *Rousettus l. leachenaulti* (Desmarest) and *Hipposideros lankadiva* Kalaart at the time of their emergence and collected altogether in the mist-nets in June and only with *E. spelaea* (Dobson) and *R. l. leachenaulti* (Desmarest) in November and February. This type of association has not been mentioned by Brosset (1962b) in Robber's cave near Mahabaleshwar in Maharashtra.

Miniopterus s. fuliginosus was the first to emerge from the cave in the evening. The Long-winged Bat was found to emerge from the cave 5 minutes after sun-set in October, 8-10 minutes in November, 25 minutes in February and 12-15 minutes in June. It emerges early in the evening in October and November and late in the evening in February and June. It was not found hanging from ceiling near the entrance of the cave prior to emergence but it suddenly dispersed in all directions among trees which formed its hunting territory. While flying, individuals of this bat keep close to each other in many rows. It was observed living in big crevices in the side wall of the cave in many places.

The gut contents of this species contained small wings of dipterans and portions of small coleopteran, isopteran and hymenopteran insects. The dentition is sharp but weak for bigger insects. Huge quantity of very small dipteran flies were observed in an around the cave.

All the females collected in the first and last week of June had well developed teats, although none was found pregnant or with young. Brosset (1962b) observed that the birth of young takes place in June but the females did not carry them in flight. Instead, the young ones were put together in an enormous group.

Genus (8) *Kerivoula* Gray

9. *Kerivoula hardwickei* (Horsfield)

1824. *Vespartilio hardwickii* Horsfield, *Zool. Res. Java* (unpaginated Java).

Common name Hardwicke's Bat (English).

Material examined 1(F), A.S. Rajagopal, 18 Feb. 1982.

Measurements External 1(F). *E.* 13.0; *f.* 34.5; *t.* 16.7; *ft.* 7.4; *ws.* 210.0; *ww.* 54.0. Skull 1(F) *l.* 14.0; *zw.* 8.7; *cw.* 6.9; *db.* 5.5; *m¹-m¹* 5.4; *c-m¹* 5.6; *c-m₃* 5.9; *ml.* 9.9.

Diagnosis Nostrils not elongated; ears funnel shaped;; structurally very similar to *Kerivoula picta*; size smaller, forearm 35.0 or less; ear larger, length 11-13; skull length 13.0-14.0.

Distribution INDIA Assam, Jammu & Kashmir, Meghalaya, Nagaland, West Bengal and Karnataka. MYANMAR (=BURMA).

Remarks The specimen from the Siju cave has been identified by me as *Kerivoula hardwickei* Horsfield. But according to Ellerman and Morrison-Scott (1951) and Agrawal *et.al.* (1992) three subspecies are found in India as follows

K. h. hardwickei (Horsfield) INDIA West Bengal, MALAYASIA, BORNEO, JAVA, BALI and CELEBES.

K. h. dapressa Miller-INDIA Assam, West Bengal, Jammu & Kashmir (Chakraborty 1983), Meghalaya, Nagaland (Khajuria 1953). MYANMAR (=BURMA), Southern CHINA, VIETNAM, CAMBODIA and Western THAILAND.

K. h. crypta Wroughton & Ryley-INDIA Karnataka. Range includes MYANMAR (=BURMA).

Biology Gut contents show only rudiments of unidentifiable soft insect parts.

The bat could not be seen in and around cave. Therefore, ecological observation on this bat was not possible. Nothing is known about its breeding and feeding habits. This bat is rare.

GENERAL DISCUSSION AND CONCLUSION

Of the nine species and subspecies, recorded so far, from the Siju Cave and its adjoining areas, three belong to each the families Pteropodidae, Rhinolophidae and Vespertilionidae.

Family Pteropodidae comprises three species, *Rousettus l. leschenaulti*, *Eonycteris spelaea* and *Cynopterus s. sphinx*. *Rousettus l. leschenaulti* and *Eonycteris spelaea* are cave dwellers, and gregarious, and form a large colony during the day, *Cynopterus s. sphinx* could not be detected inside the cave. *C. s. gangeticus* (= *C. s. sphinx*) has been reported to inhabit in the cavern and in a very large number. A single specimen of this species of bat could not be collected using the mist-nets set inside the cave. However, this species was found hanging from the ceiling of the discarded buildings in Bihar (Sinha, 1986). Initially this bat was reported as a tree dweller and found modifying its roost according to the available environment (Kunz, 1982).

Among the three species of Rhinolophidae *Rhinolophus subbadius* was reported solitary in the cave by Kemp (1924b). Whereas, this habit of *R. pusillus blythi* could not be detected in the present study. *Hipposideros lankaidiva* was found inside the cave in a large number, hanging from various points implying its gregarious habit.

Of the three species of the family Vespertilionidae, *Myotis longipes* appeared crevices dweller, because in a small group of 2 to 5, this species was trapped from outside the cave in the mistnet. *Kerivoula hardwickei* was collected singly, in the mist-net. *Miniopterus schreibersi fuliginosus* was found inside the cave in a large group confirming its nature of cave dwelling and gregarious habit.

The present study indicates that *Rhinolophus subbadius*, *R. pusillus blythi* and *Kerivoula hardwickei* are rare in this area and their ecology is yet to be clearly known. Therefore, much precaution deserves to be taken for the conservation of three species. *Myotis longipes* is found outside the cave and in large numbers.

The enumeration of different species inside the cave is extremely difficult because they emerge simultaneously in the evening in swarms. One early evening at the mouth of the cave attempting to enumerate the different species and their emergence time were baffled because of a pungent odour of the bats emanated from inside the cave, ultimately became intolerable, as the bats came close to the observation spot.

The first bat to emerge was *Miniopterus schreibersi fuliginosus*, identified by its smaller size. The next ones were *Rousettus l. leschenaulti* and *Eonycteris spelaea*. *Hipposideros lankadiva* was seen in the mist-net very late in the evening.

The size of the colony of four species found in the cave is very difficult to ascertain. *Hipposideros lankadiva* was reported by Kemp (1924b). in great numbers, nearly covering the entire surfaces of the wall and roof (Kemp, 1924b). The present study indicated the approximate size of the colony and the ratio of the above noted four species fluctuated in different seasons. Among 379 specimens comprising four species, collected throughout the year in February, June, August, October and November (see Table I.) the ratio of *Rousettus l. leschenaulti*, *Eonycteris spelaea*, *Hipposideros lankadiva* and *Miniopterus schreibersi fuliginosus* is 67.30%, 23.07%, 1.92% and 6.79% in February; 26.23%, 2.80%, 48.59% and 23.36% in June, 71.55%, 11.20%, 0.86% and 16.37% in August; 55.93%, 33.98%, 0.00%, 10.16%, in October and 22.72%, 72.72%, 0.00%, 4.54% in November, respectively.

The data of Tables 1 and 2 indicate that a maximum number of *Rousettus l. leschenaulti* was found in the cave in August (71.55%) when all the females have suckling young in their arm, of *Eonycteris spelaea* in November (72.72%) when all the young separated from mother.

Among insectivorous bats, *Hipposideros lankadiva* is found in large number in June (48.59%) when the insect population became maximum (51.87%) than the other months of the year as in February (13.01%), in August (11.67%), in October (9.38%) and in November (14.04%). This bat species could not be captured in the mist-nets in October and November, when the insect population was found reduced appreciably, i.e., 9.38% and 14.07% respectively. A maximum number of *Miniopterus schreibersi fuliginosus* was also found in June (23.36%) and least in November (4.54%). The contents of *M. s. fuliginosus* consisted

of parts of dipteran, coleopteran, isopteran and hymenopteran insects.

Fruit bats had been collected from different groves or from the same foraging ground. Ripe fruits constituted their main meal however, occasionally they were found to consume, floral parts, soft unripe fruits. When fruits were not readily available they were found to thrive on soft leaves, twigs, etc., of the different trees and plants. They were found to carry fruits with them to different parts of their habitat where they consume the juice and discard the seeds, helping dispersal.

The insectivorous bats consumed various types of insects (Table 2). Their teeth are adapted for both soft or hard insect meal. Apart from the insects, occasionally the food of the large insectivorous bats comprised small animals like snail, prawn, fish, frog and even smaller bats and other small mammals (Hill and Smith, 1984; Sinha, 1986; Rasweiler, 1977).

Rousettus l. leschenaulti and *Eonycteris spelaea* were always found in the rut. The present study disclosed that they breed throughout the year. This supports the earlier observations of Bhat *et.al.* (1980) and Gopalakrishna (1969). In these species, the first lactation cycle overlaps the early pregnancy of second cycle. Each litter yielded one offspring. Months of May-June appeared to be the breeding season of *Hipposideros lankadiva* in the Siju cave. Bhat and Sreenivasan (1981) observed embryos in February and the neonates during the later half of May and earlier half of June. This suggested a gestation period of about 150 days for this species of bat.

Cluster formation till 11.00 hours of *Rousettus l. leschenaulti* and *Eonycteris spelaea* near the entrance of the cave had been observed. Prior to clustering the sequence of events were found to be (a) completion of foraging (b) hanging from the thin branches and twigs of big trees near entrance (c) subsequent entry inside the cave for safe day roosting making clusters in the ceiling.

Inter-relation of cave dwelling bats with the surrounding fauna: In month of February and October, a troup of monkey, *Macaca assamensis* M' Clelland, on the top branches of trees, above the entrance of the cave and Hoolock Gibbons *Hylobates hoolock* Harlan in deep forest, near the Siju cave were observed. Tree shrews, *Tupaia glis* Diard jumping on the branches of Jack fruit trees in February were also seen. These fruit eating mammals were the food competitor of the fruit bats. Domestic cats and dogs and Mongoose (*Herpestes* sp.) were also found inside the cave. Occasionally they captured young bats, falling on the floor and their mothers while coming to the rescue of their off springs. Inside the cave, tribal people were also seen consuming roast bats (generally fruit bats) and enjoying.

Nocturnal birds like owls (*Bubo* sp. and *Otus* sp.), Himalayan Jungle Night Jar (*Caprimulgus* sp.), lizard Hawk or Blyth's Baza (*Aviceda* sp.), Sparrow-Hawk (*Accipiter* sp.), Collared Scops Owl (*Otus* sp.) and Hodgson's Frogmouth (*Batrachestomus* sp.) were seen on the trees near the cave. These nocturnal birds appeared to be the predator of cave bats.

Some reptiles Banded Krait (*Bungurus fasciatus* Schneider), Black Krait (*Bungurus niger* Wall), Rat-snake (*Ptyas korros* Schlegel), Garden Lizard (*Calotes* sp.), Skink (*Sphenomorphus* sp.), Gecko (*Hemidactylus franatus* Schlegel), etc. were collected from the vicinity of the cave in October. In the morning of 16th February 1992, a medium sized *Varanus* sp. was seen moving towards the entrance of the cave from a big hole in the outer wall of the cave. These reptiles were the likely opportunistic predators on the bats.

Frogs were seen on the wall of the cave in the same manner as the bats clinging on the wall and caused confusion for the bat. Various other types of amphibians were also observed and collected from inside and outside the cave. These were *Rana cyanophlyctis*, *R. limnocharis* and *Bufo melanostictus*.

A variety of fishes such as *Labeo* sp., *Berilius* sp., *Puntias* sp., *Osteobrama* sp., *Heteropneustea* sp. were observed and collected from the running water of the cave.

Insects, such as cockroaches (*Periplaneta* sp.) and Harvester ants (*Pheidole smythiesi*) were seen in a large number in the cave. A dead bat was seen on the surface of the ground, covered entirely with ants, implying food chain relationship of bat and ant.

SUMMARY

The taxonomy and bionomics of nine species and subspecies of bats, found in and around the Siju cave have been given. They comprised three fruit bats of the family Pteropodidae, and six insectivorous bats, three each of the family Rhinolophidae and the Vespertilionidae.

A synoptic key to these nine species for easy identification has been prepared and synonyms, common names, diagnosis and geographical distribution have been given.

Feeding and breeding habits of *Rousettus l. leschenaulti*, *Eonycteris spelaea*, *Cynopterus s. sphinx*, *Hipposideres lankadiva* and *Miniopterus schreibersi fuliginosus* have been given in detail.

The inter-relationships of these bats with the surrounding fauna and flora have been discussed.

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TABLE 1.
Fluctuation of bats population among total collections of 379 specimens
made during different months of the year in the Siji Cave.

	February	June	August	October	November
All the four species	12.94%	26.87%	28.86%	14.68%	10.95%
<i>R. l. leschenaulti</i>	67.30%	26.23%	71.55%	55.93%	22.72%
<i>Eonycteris spelaea</i>	23.07%	2.80%	11.20%	33.98%	72.72%
<i>Hipposideros lankadiva</i>	1.92%	48.59%	0.86%	0.00%	0.00%
<i>Miniopterus schreibersi fuliginosus</i>	6.79%	33.36%	16.37%	10.16%	4.54%

TABLE 2.
Fluctuation of insect population among total collections of 1045
specimens made during different months of the year near the Siju Cave.

	February	June	August	October	November
Total insects	13.01%	51.87%	11.67%	9.38%	14.07%
Odonata	7.35%	8.49%	15.57%	10.20%	8.84%
Orthoptera	0.00%	2.77%	18.03%	10.20%	20.41%
Grylloidea	5.88%	4.43%	0.00%	0.00%	0.00%
Phasmida	0.00%	1.85%	0.81%	0.00%	0.00%
Dermaptera	3.68%	7.56%	1.64%	0.00%	0.00%
Dictyoptera	0.00%	1.66%	2.46%	1.00%	8.40%
Isoptera	66.18%	0.00%	0.00%	0.00%	6.30%
Hemiptera	0.00%	4.05%	18.03%	41.84%	8.16%
Neuroptera	0.00%	0.18%	0.00%	0.00%	0.68%
Coleoptera	5.88%	16.24%	5.74%	3.06%	8.84%
Diptera	0.00%	4.98%	0.00%	1.02%	0.00%
Lepidoptera	11.03%	20.48%	18.03%	32.65%	15.65%
Hymenoptera	9.35%	27.31%	21.31%	1.02%	34.69%