

Status and population trend of chiropterans in Southern Assam, India

Abstract

Population survey plays an important role in understanding the census structure of any species in a particular area. Chiropterans are an important groups of mammals found almost all part of India. Chiropterans (including Mega and Microchiroptera) are important as they have ubiquitous distribution in almost all the states of India, from Kashmir to Kanyakumari and from Gujarat to Arunachal Pradesh. They play important roles in all types of ecosystems. Mega chiropterans largely help in pollination, while microchiropterans help in pest control through insectivory. To understand the population structures, the status of bat population and its trend in Cachar district (Assam) north East India was studied. A total of six species and 97 roosting sites were found over approximately 3786 square kilometer of area. The colony size of *Pteropus giganteus* was found to consist of 13 to 723 individuals, for *Cynopterus sphinx* it was recorded as 2-9 groups having 8 to 51 individuals (with group size 3 to 8 individuals), for *Eonycteris spelae* it was 400-600 individuals, for *Pipistrellus coromandra*, it was very less, as group size was found to be of 3 to 6 individuals and for *Megaderma lyra* the number recorded was 5 to 128 individuals. Population structure and the prevalence indicate this zone to be a potential area for maintaining a viable population of bat species. Since no prior systematic information on the Chiropteran population is available from the area, the present study will help in formulating conservation plan of the much neglected group of nocturnal mammals.

Keywords: barak valley, habitat fragmentation, megachiroptera, microchiroptera, population

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Introduction

India is blessed with 430 species of mammalian fauna belonging to 49 families and 185 genera.¹ Northeast India encompassing seven sister states are the least explored regions of India, and is located in between Indo-Himalayas and Indo-China sub-regions, and contains 269 mammalian species harboring 62.56% of Indian's mammalian diversity.² Megachiroptera (megabat) and Microchiroptera (microbat) are the two suborders of the order Chiroptera to which all bats belong.³ The sub order Megachiroptera (also known as old world fruit bat) has only one family; Pteropodidae which encompasses 42 genera and 166 species.⁴ Microchiroptera, on the other hand consists of seventeen families and are the greater group of bats (with 834 species incorporated into 137 genera) that occur from the tropics to temperate regions of the world. Microbats bear sophisticated laryngeal echolocating capability and hence orient acoustically.⁵

According to modern taxonomy (which is based on molecular genetic data) the order Chiroptera is divided into two suborders i. e., Yinpterochiroptera and Yangochiroptera.⁶ The suborder Yinpterochiroptera includes all the fruit bats that live in the old World tropics and subtropics but are not found in North and South America, except the Egyptian fruit bat of Europe.⁷ Five microbat families such as Rhinopomatidae, Rhinolophidae, Hipposideridae, Craseonycteridae, and Megadermatidae are also included in this newly proposed suborder.⁸ The remaining families of microbats are grouped under the suborder Yangochiroptera and include the bats that were previously grouped as Yinchoiroptera. Yinpterochiroptera bats are herbivores and depend on vision as well as smell detection capability to find foods.⁹ The Yangochiroptera bats rely on laryngeal echolocation system to navigate.

The Indian subcontinent is the home of 119 different species of

bats belonging to 8 families and 3 genera.¹⁰ Chiropterans are found in almost every part of India. In India they have been reported from Andhra Pradesh,^{11,12} Baksa district of central Assam,¹³ Delhi,¹⁴ Hyderabad,¹⁵ Jaisalmer,¹⁶ Jammu and Kashmir,¹⁷ Kalakad Mundathurai tiger reserve, Southern India,¹⁸ Karnataka,¹⁹ Kerala,²⁰ Lakshadweep archipelago,²¹ Manipur,²² Masinagudi village, eastern part of Mudumalai Tiger Reserve,²³ Meghalaya,²⁴ Mizoram,²⁵ Mysore city,²⁶ Nagaland,²⁷ Rajasthan,²⁸ Sikkim,²⁹ Sundergarh district of Odisha,³⁰ Tamilnadu,³¹ Tripura.³² Northeast India harbours 65 bats species out of which 28 bat species have been reported from Assam.³³

Barak valley is in the southernmost part of Assam located around 328 km away towards southeast of Guwahati city, the state capital. The area comprises three district viz., Cachar, Karimganj and Hailakandi covering an area of 6922 km². Although the area has one wildlife sanctuary and many reserve forests including the Inner line reserve forest (the largest reserve forests of Assam), hitherto no significant study has been done on the chiropteran diversity of Barak valley. Faunal inventory acts as an important task for precise taxon-specific and area-specific conservation efforts,³⁴ the present study therefore aims to document the chiropteran fauna of Cachar district with an aim to formulate proper management strategy to conserve the species in a pragmatic way.

Materials and methods

Study area

The study in Cachar districts was done covering as many as 895 revenue villages and towns for three years (from 2013 to 2015). Cachar is one of the three districts of Barak Valley situated in the southern Assam (India), a state known for its greeneries. The district is located within 24°22' to 25°08' N latitude and 92°25' to 93°15' E

longitudes, covering an area of 3786sq. km (Figure 1). Altitude varies from 39-40m above sea level. Climatic condition of the area is sub-tropical, warm and humid. Most of the precipitation occurs from May to September, which is mainly controlled by the southwest monsoon. The district experiences very hot and humid climate during the major part of the year (April to October). Average rainfall of this area is about 2600-2700mm. Temperature ranges between 9-38°C. The district is bounded by state border with Mizoram in the South, Manipur in the south-east, North Cachar Hills and Jaintia Hills in the north and in the west by Hailakandi and Karimganj districts of Assam. Silchar is the head quarter of the district and is the second most important economic centres in the state, after Guwahati.

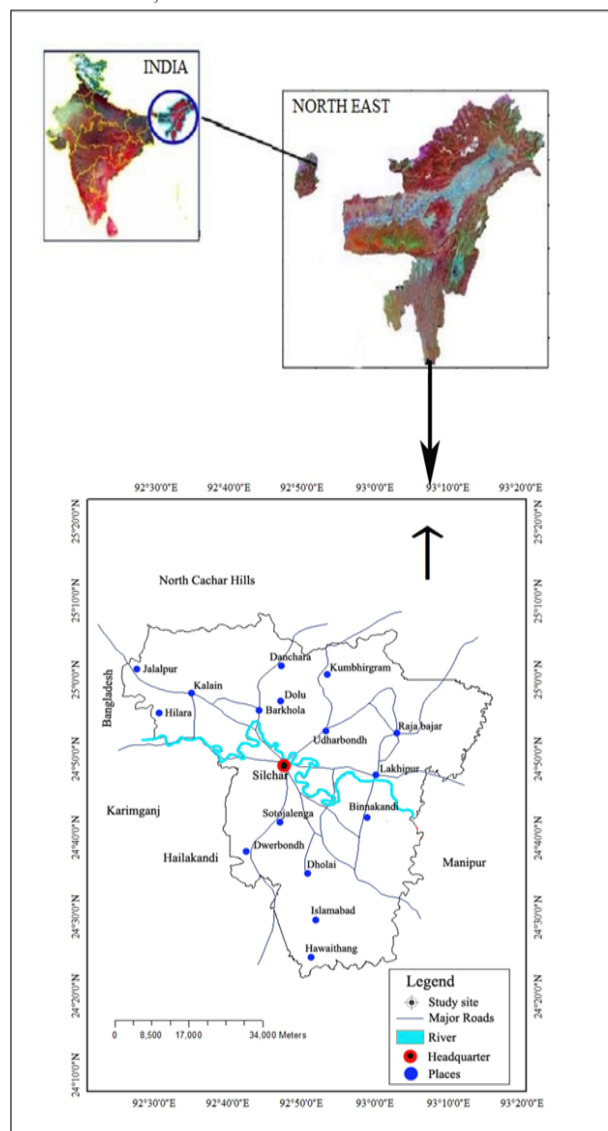


Figure 1 The Study area.

Survey on population status Chiropterans was conducted across the study area for three consecutive years (from January 2013 to December, 2015). Bat roosting sites were located through local enquiries in course of questionnaire survey. This was followed by extensive field survey. Periodic observations along with population count were made throughout the study area. Diurnal roosts of *Pteropus giganteus*, *Cynopterus sphinx* and *Megaderma lyra* were

visited once in a month during the study period. Data on population status was collected during daytime preferably in the morning and evening hours. As local migration from colony to colony occurs in bat,³⁵ we have tried to complete the monthly population estimation for each species within 1-3 day in all roosting sites of the study area, to avoid the fluctuation in colony size due to inter-colony migration. The first week of each month were chosen for *Pteropus giganteus*, second weeks were chosen for *Cynopterus sphinx* while the third weeks were chosen for *Megaderma lyra*. For enclosed roosting species (*Megaderma lyra*) precaution was taken to minimize the disturbances. While entering the roosting place, attention was given so that minimal noise and disturbance occur. Commonly after entering the roosting area (that cause a slight disturbance) bats usually start moving haphazardly, some even exit the roosting area, thus, it is required to stay calm and quiet for about 30 minutes before counting is started. Within this period, bats get accustomed to the intruder and stop moving. Then direct numerical counting was started as per Thomas³⁶ and Barlow³⁷ followed by photographic count.³⁸ Direct numerical counting was done to count *Pteropus giganteus*, *Cynopterus sphinx* and *Megaderma lyra*. For small colonies, direct visual counting method was used to determine the number of individuals, while surface area estimates were made in the case of large and densely packed colonies. Binoculars were used to count of bats in colonies with inaccessible heights. Before entering each of the habitats, prior permission from the land owners was obtained, if the study site was found to be under human occupancy.

Result

The present study has documented six bat species in the Cachar district of southern Assam. The Megachiropteran species found in the study area are *Pteropus giganteus*, *Cynopterus sphinx* and *Eonycteris spelaea* while the microchiropteran species found in the area are *Megaderma lyra*, *Scotophilus kuhlii*, and *Pipistrellus coromandra*. All these species belong to two families and six genera. Among the bat species found in the area, three have been put under schedule V of Indian Wildlife Protection (Act) 1972. Of these one bat have been categorized as Appendix II species of CITES. As per IUCN list of threatened species, each bat species encountered during this study period have been categorized as least concern species. Morphological features, conservation status and population trend of all the bats that are documented during the study are discussed below.

Pteropus giganteus brunnich, 1782 (Indian flying fox)

Morphology

Indian flying fox has reddish-brown fur on its head and possesses long, black and pointed ear.¹⁰ The belly is orange in color whereas the colour of the back is deep blackish brown, with a slight mixture of white hairs (Figure 2/A). The shape of the head of *Pteropus giganteus* is similar to a fox, after which it has been named. The blackish patagium allows covering the whole body during rain and also flip on sunny days, thus, it protects the bat from rain as well as in extreme hot condition. The forearm and head-body length of Indian flying fox usually measure 17.2-17.5cm and 21.1-24.3cm respectively. Body weight for males varies from 500-1600gm (Figure 2A-2F).

Conservation status

According to IUCN (Version 3.1), the Indian flying fox is categorised as least concern species. It has been categorised as the least concern species under the Red list category of IUCN (Version 2011.2) and mentioned that the population of the species is declining

in a notable manner due to the destruction of the habitat. CITES recognised it as a species of Appendix II. As per Indian Wildlife (Protection) Act, 1972, the species falls under Schedule V. However Vendan³⁹ marked the Indian flying fox as the conservation dependent endangered flying mammal in Southern India.

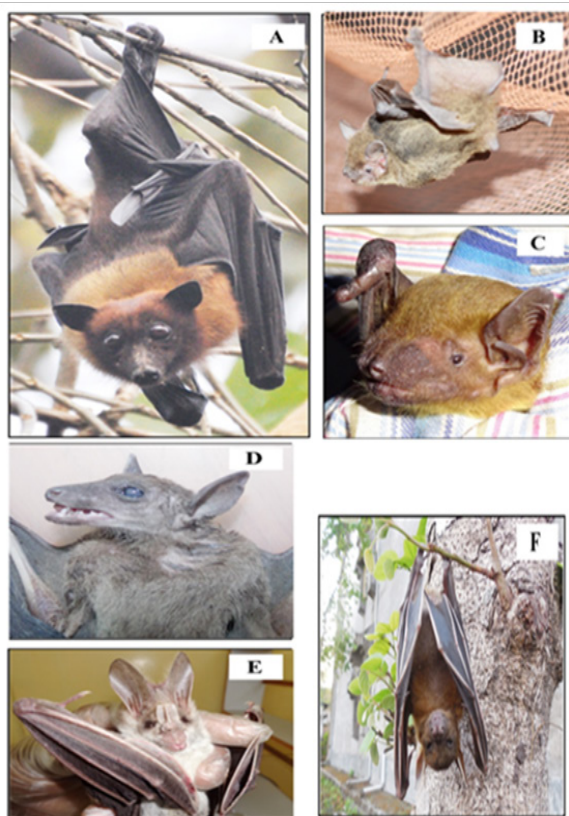


Figure 2 Bats of the study area A, *Pteropus giganteus*; B, *Pipistellus coromandra*; C, *Scotophilus kuhlii*; D, *Eonycteris spelaea*; E, *Megaderma lyra*; F, *Cynopterus sphinx*.

Table 1 *P. giganteus* observed in different sites of Cachar District

Sl. no	Name of the roosting site	Geographical coordinates	Type of roosting	Number of individuals		
				2013	2014	2015
1	Algapur, Gobindapur	24°46'49.0" N 92°52'51.0" E	Irregular	72	12	0
2	Barkhala part I	24°55'52.0" N 92°44'37.4" E	Irregular	33	19	0
3	Baskandi	24°55'52.0" N 92°44'37.4" E	Regular	237	210	189
4	Bethukandi	24°49'58.6" N 92°50'11.2" E	Regular	468	450	380
5	Bhakatpur	24°52'28.4" N 92°52'46.1" E	Irregular	48	0	0
6	Boraitoli	24°57'25.9" N 92°34'08.8" E	Irregular	78	54	49
7	Borjurai	24°49'47.3" N 92°51'33.1" E	Irregular	34	23	18

Population status

During the present study, population of *Pteropus giganteus* in all roosting sites was estimated which reveals 6370 individuals in the year 2013 while in the year 2014 and 2015 it was estimated to be 5403 and 5033 respectively. Mean population size of *P. giganteus* in various roosting locations of the study area during 2013-2015 was calculated as 144.77 ± 1.72 (mean \pm SE, n=44), 122.79 ± 1.79 (mean \pm SE, n=44), and 114.38 ± 1.85 (mean \pm SE, n=44) (Table 1). Maximum individuals (482) of *Pteropus giganteus* were observed in Dulalgram in the year 2013 while the minimum was in Hawaithang and Charmail (24). In the year 2014, the maximum number of the individual was recorded in Raninagar (560) and the minimum was recorded in Algapur (12). In the year 2015, the maximum individual counted in Raninagar (723) while the minimum was recorded for Laikon basti (13). During the study period, six roosting locations were spotted where a trend of population increase was observed while rest all sites were observed to maintain the decreasing trend. In the study area, 26 locations were documented where bats used to stay for a long time but later on left the area due to felling of roosting trees. Indian flying fox is a colonial species (Figure 2/A) and during the present study the minimum number of *P. giganteus* in a diurnal roost was recorded as 13 while maximum number was 723 individuals (Figure 3A-3C).

Cynopterus sphinx Vahl, 1797 (the greater short-nosed fruit bat)

Morphology

This species is identified by large ears with a pale and distinct outline. It is a medium size bat having a distinct claw on the first as well as second digit, characterized by the projecting nostril.¹⁰ The adult male poses orange colour on the either side of the chest, chin, shoulder, thigh, belly and forehead whereas the female has a brown collar with a grey belly⁴⁰ (Figure 2/F). The forearm and head-body length of adult Greater short-nosed fruit bat usually measure 6.4-7.9cm and 7.6-11.3cm respectively. The body weight for males varies from 28.0- 70.0gram and of female from 34.5-53.0gm.⁴¹

Table Continued..

Sl. no	Name of the roosting site	Geographical coordinates	Type of roosting	Number of individuals		
8	Buribail Part I	24°52'51.2" N 92°41'50.6" E	Tree cutting	46	0	0
9	Burunga Part II	24°55'55.3" N 92°36'07.2" E	Regular	138	190	218
10	Charmail	24°51'23.1" N 92°51'02.4" E	Irregular	24	0	0
11	Dhanehari Part 2	24°43'58.8" N 92°49'51.7" E	Regular	80	76	92
12	Dolugram	24°47'21.8" N 92°56'38.6" E	Regular	78	51	28
13	Dulalgram	24°51'23.1" N 92°51'02.4" E	Regular	482	426	430
14	Goroirkandi	24°42'49.7" N 92°57'40.0" E	Regular	80	65	48
15	Gosaipur Part I	24°51'13.5" N 92°51'00.2" E	Irregular	34	0	0
16	Gumra	24°58'38.6" N 92°31'04.1" E	Regular	220	195	209
17	Hawaithang	24°32'08.9" N 92°48'36.5" E	Irregular	24	32	0
18	Hawaithang West	24°31'52.8" N 92°48'29.8" E	Irregular	46	30	0
19	Jodanpur	24°32'18.8" N 92°48'36.3" E	Regular	70	86	80
20	Jogodishpur Part V	24°54'17.6" N 92°33'31.1" E	Regular	380	350	206
21	Kanakpur (Jaipur)	24°53'04.1" N 93°04'02.6" E	Regular	70	59	83
22	Kuriabasti	24°48'59.3" N 92°40'47.7" E	Regular	320	287	212
23	Laikon Basti	24°46'24.8" N 92°58'15.4" E	Irregular	52	23	13
24	Madhabbari	24°52'28.4" N 92°52'46.1" E	Tree cutting	58	42	0
25	Masughat	24°51'31.0" N 92°46'06.7" E	Tree cutting	120	0	0
26	Muniarkhal	24°34'53.3" N 92°57'32.3" E	Irregular	64	33	0
27	Natanpur	24°56'23.0" N 92°33'38.5" E	Regular	160	190	272
28	Puthirkhal, lakhipur	24°46'35.0" N 92°59'08.2" E	Tree cutting	86	0	0
29	Rajnagar (Pailapool)	24°51'29.6" N	Regular	180	160	224

Table Continued..

Sl. no	Name of the roosting site	Geographical coordinates	Type of roosting	Number of individuals		
		92°41'15.2" E				
30	Rajnagar (Faruk Res)	24°55'08.2" N	Tree cutting	26	0	0
		92°42'59.7" E				
31	Rajobari (Jalenga)	24°49'47.3" N	Irregular	190	120	62
		92°51'33.1" E				
32	Raninagar	24°54'30.9" N	Regular	470	560	723
		92°42'45.7" E				
33	Rengti	24°47'00.9" N	Regular	380	410	425
		92°45'35.1" E				
34	Rukni Part I	24°39'52.8" N	Irregular	62	48	0
		92°52'42.7" E				
35	Sewti Part I	24°56'37.2" N	Regular	182	152	135
		92°38'49.1" E				
36	Shivnarayanpur	24°52'32.4" N	Regular	80	146	160
		92°37'20.9" E				
37	Silkoorie	24°46'35.0" N	Irregular	76	56	0
		92°59'08.2" E				
38	Manipuribasti, Jalenga	24°52'28.4" N	Regular	260	234	183
		92°52'46.1" E				
39	Sewti Part IV	24°54'52.7" N	Regular	156	160	167
		92°38'49.9" E				
40	Suklabaigyapara	24°40'00.2" N	Irregular	70	0	0
		92°52'49.0" E				
41	Tulargram	24°55'08.2" N	Regular	46	0	0
		92°42'59.7" E				
42	Tupkhana	24°51'25.8" N	Regular	170	120	86
		92°45'57.5" E				
43	Udharbandh	24°52'28.4" N	Regular	330	278	310
		92°52'46.1" E				
44	Ujangram	24°52'38.9" N	Regular	90	56	31
		92°44'18.4" E				
		Grand total		6370	5403	5033
		Mean roosting size		144.77	122.79	114.38
		(mean ± SE)		±1.72	±1.79	±1.85

Conservation status

Currently, the Short-nosed Fruit Bat has been classified 'Least Concern' under the IUCN red list (Version 3.1) category and declared as the species to have an increasing trend of population. As per Wildlife protection (act) 1972, this species falls under scheduled V. However this bat species has not been listed in CITES.

Population status

Population estimation of *Cynopterus sphinx* documented 297 individuals in the year 2013, 231 individuals in the year 2014 and 221 individuals in the year 2015. The mean population size of *Cynopterus*

species during the study period was calculated as 27 ± 0.89 (mean \pm SE, $n=11$), 21 ± 0.98 (mean \pm SE, $n=11$) and 20 ± 1.91 (mean \pm SE, $n=11$) (Table 2).

Cynopterus sphinx is a foliage living species and maintains a group of 3 to 8 individuals (Figure 2/B). During present study a total of 11 palm trees (*Borassus flabellifer*) were detected with 2-9 groups in each tree having 8-51 individuals. The individuals in highest number were documented among all the roosting site for *C. sphinx* in the year of 2013 was Kumbhirgram (47) while the minimum was in Kajalbasti (17). In the year 2014, the maximum number of individual was recorded in Arunabandh tea estate (39) and the minimum

was recorded in Gumra Khelma Part-IV (8). In the year 2015, the maximum individual counted in Islamabad (51) while the minimum was recorded for Rukni Part-II (9). During the study period, 2 roosting

locations were documented having increasing number of individual while the rest were observed maintaining the decreasing rate of the individuals.

Table 2 *C. sphinx* observed in different sites of Cachar District

Sl. no	Name of the roosting site	Geographical coordinates	Type of roosting	Number of individuals in each tree		
				2013	2014	2015
1	Muniarkhal Tea Estate	24°34'35.3" N 92°57'00.8" E	Regular	22	17	12
2	Shalgonga	24°55'00.5" N 92°57'04.0" E	Regular	31	18	17
3	Kumbhiringam	24°54'48.4" N 92°58'28.2" E	Regular	47	36	28
4	Arunabandh Tea Estate	24°53'58.6" N 92°55'06.5" E	Regular	36	39	46
5	Rukni Part II	24°38'35.2" N 92°52'24.5" E	Regular	17	13	9
6	Islamabad	24°33'18.1" N 92°50'31.6" E	Regular	23	35	51
7	Gumra Khelma VI	24°58'44.3" N 92°31'12.8" E	Irregular	21	8	12
8	Simultola	24°54'29.7" N 92°40'23.7" E	Regular	29	23	17
9	Kajalbasti	24°49'31.6" N 93°06'56.8" E	Irregular	19	14	12
10	Dharamkhal	24°34'37.1" N 92°56'56.9" E	Irregular	22	16	17
11	16 Nombor basti	24°38'59.1" N 92°50'30.5" E	Irregular	30	12	0
Total				297	231	221
Mean individual (mean ± SE)				27 ±0.89	21 ±0.98	20.09 ±1.91

***Eonycteris spelaea* Dobson, 1871 (the cave nectar bat)**

Morphology

The eyes of Cave nectar-feeding bat are large and have a long reversible tongue with papillae on it. The ears are simple with no ear border and tragus is absent. Belly is pale in colour and the dorsal pelage is dark brown. Neck of the adult males has a fur collar and is darker than the rest of the body whereas the females bear scrubby hairs rounding their neck. The forearm and head-body length of adult bat usually measure 6-7.9cm and 8.5-12.5cm respectively. The body weight for males varies from 55.0-82.0gram and of female from 35.0-78.0gm (Figure 2/D).

Conservation status

The Cave Nectar Bat has been categorized as the least concern species under the Red list category of IUCN (Version 3.1) and it is mentioned that the species has the available population, not declining

in a notable manner as compared to the other bat species. As per Indian Wildlife (Protection) Act, 1972, the species falls under Schedule V. However Bumrungsri et al.⁴² found the species is decreasing in number in Thailand whereas Mickleburgh et al.⁴³ marked cave tourism and collection the bat for bushmeat as the common threat to the cave nectar bats that belong to Southeast Asia.

Population status

The study also estimates the population of *Eonycteris spelaea* in the study area which documented maximum in Bororodmukh (600+) and minimum in Sotorodmukh (400+) (Table 3).

***Pipistrellus coromandra*, gray 1838 (the Indian pipistrelle)**

Morphology

The wing membrane of Indian pipistrelle bat is naked and mid to dark brown in colour. The brown ear is triangular in shape while

the tip is round. Anterior portion is generally dark-brown in colour ranging from chestnut to clove brown while the posterior surface paler or beige brown.⁴⁴ The forearm and of adult *Pipistrellus coromandra* usually measure 2.5-3.4cm while head-body length measure 3.4-4.9cm respectively.⁴¹ The average body weight varies between 3-6gram (Figure 2/B).

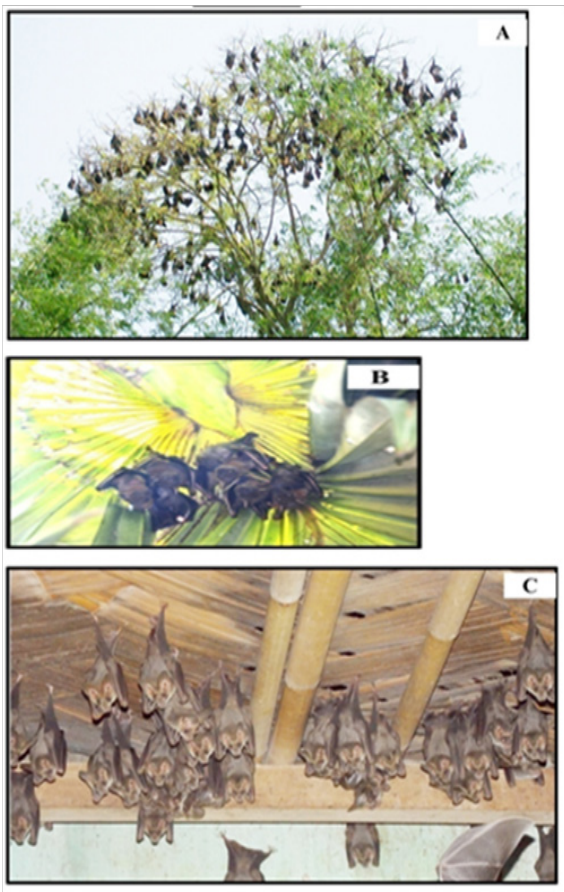


Figure 3 Roosting colony and groups of bats A, *Pteropus giganteus*; B, *Cynopterus sphinx*; C, *Megaderma lyra*.

Table 3 *E. spelaea* observed in different sites of Cachar District

SI No	Locality	Coordinates		No. of individuals	Mean
1	Soto Rodmukh	24°38'58.4" N	93°01'19.1" E	400	500
2	Boro Rodmukh	24°38'53.3" N	93°01'20.8" E	600	
				1000	

Table 4 *P. coromandra* observed in different sites of Cachar District

SI no	Locality	Coordinates	No. of individuals	Mean
1	Dargakona	24°41'59.51" N 92°45'18.8" E	8	6.5 ± 0.46 (mean ± SE)
2	Hathitilla	24°42'14.21" N 92°44'06.5" E	7	
3	Rosekandy	24°41'44.03" N 92°42'38.7" E	9	
4	Silcorie	24°43'26.83" N 92°47'07.2" E	5	
5	Sonabarighat	24°45'29.53" N	8	

Conservation status

The Indian Pipistrelle bat is categorised as the least concern species by IUCN and declared its current population trend as “unknown”. However this species of bat has not been listed in Indian Wildlife (Protection) Act, 1972 as well as in the CITES appendices.

Population status

During the study we checked 10 randomly selected villages. In all places the species was available (Table 4). The group size for *P. coromandra* was recorded as 3 to 5 individuals in the study area. Population estimation of *Pipistrellus coromandra* was also calculated for the year 2013 which reveals a mean group size of 6.5 (±0.46). The present study documented maximum individuals in Rosekandy (9) and minimum in Katakhal (3). During present study the individuals were observed to stay both in solitary as well as in group. The lowest group size ranged between three to six individuals.

Megaderma lyra geoffroy, 1810 (the greater false vampire bat)

Morphology

The Greater False Vampire bat can be distinguished by the large and straight nose leaf with a rounded base which is extended up to the above line of the eye. Ear are large, joined and fringed with white hair (Figure 2/E). The eyes are small while the face is bearded and a naked snout on it. The Greater false vampire bat poses a large body as compared to most of the insectivorous bats. The belly is whitish in colour while the colour of the body is grayish brown with a paler underside. Body colour of young bat is darker than adults. The forearm and head-body length of adult Greater false vampire bat usually measure 6.5- 7.2cm and 6.5-9.5cm respectively. The body weight varies from 40.0-60.0gram. (Figure 3/C)

Conservation status

In view of the widespread distribution of the species the Red list category of IUCN (Version 3.1), has categorized the Greater false vampire bats as the least concern species but the current population trend remains unknown. However, this species of bat has not been listed in Indian Wildlife (Protection) Act, 1972.

Table Continued..

SI no	Locality	Coordinates	No. of individuals	Mean
6	Sildubi	92°50'02.9" E	9	
		24°43'01.29" N		
7	Ramnagar	92°49'16.8" E	5	
		24°53'04.95" N		
8	Pailapool	92°45'56.4" E	4	
		24°49'53.09" N		
9	Kamranga	93°01'51.1" E	7	
		24°51'27.70" N		
10	Katakhal	93°03'37.1" E	3	
		24°38'41.77" N		
		92°50'34.5" E		

Population status

The roosting locations of *Megaderma lyra* hold approximately 1073 individuals in the year 2013 which came down to 853 (in 2014) and 543 (in 2015). The mean population size *M. lyra* was found as 46.65 ± 1.21 (mean \pm SE, $n=23$), 37.08 ± 1.11 (mean \pm SE, $n=23$) and 23.61 ± 1.03 (mean \pm SE, $n=23$) (Table 5). Observation on the roosting locations of *Megaderma lyra* during 2013 revealed that the roosting site (Malugram, Dhalai) provided shelter to maximum (128) number of individuals while minimum (8) number of individuals was recorded

in Silcoorie (Dharamkhal). In the year 2014, highest (91) number of individuals was documented in Dhalai (near bridge) and the lowest (5) was recorded in Silcoorie (Dharamkhal). Natun Ramnagar (Site - I : Pritam's residence) recorded maximum (92) number of individuals while minimum (7) was recorded in Borjalengah Part-I during the year 2015. In the year 2013, the active roost of *Megaderma lyra* in Cachar was found to be 23 which decreased to 18 (in 2014) and 16 (in 2015). The Greater false vampire bat is a colonial species ((Figure 3/C) and during the present study the number of individuals in a diurnal roost was ranged from 5 to 128.

Table 5 *M. lyra* observed in different sites of Cachar District.⁴⁷

SI. no	Name of the roosting site	Geographical coordinates	Type of roosting	Number of individuals		
				2013*	2014	2015
1	Baladhan banglow, Jaipur	24°52'51.80"N 93°05'15.70"E	Regular	19	11	14
2	Binnakandi Model H.S. School	24°42'26.75"N 92°58'19.37"E	Regular	39	27	31
3	Borojalengah (Near block)	24°40'12.94"N 92°43'56.37"E	Regular	48	57	38
4	Borojalengah Part-I	24°40'12.73"N 92°43'38.10"E	Regular	21	14	7
5	Dhowarbandh H. S. School	24°36'42.81"N 92°43'16.69"E	Regular	43	32	37
6	Buribail Part - I (R.C.C. culvert)	24°52'57.12"N 92°41'54.87"E	Irregular	21	7	0
7	Chandpur (religious place)	24°59'30.70"N 92°30'21.60"E	Irregular	26	10	0
8	Dhalai (Near Dhalai Bridge)	24°35'02.92"N 93°50'23.14"E	Regular	54	91	18

Table Continued..

Sl. no	Name of the roosting site	Geographical coordinates	Type of roosting	Number of individuals		
9	Dhalai H. S. School	24°35'43.51"N 92°50'45.68"E	Regular	63	51	24
10	Dhowarbondh Tillabasti	24°36'40.12"N 92°42'56.89"E	Regular	UN	UN	UN
11	Eureka English School, Jaipur	24°52'54.15"N 93°03'55.29"E	Regular	62	43	28
12	Jaipur Bridge	24°52'52.36"N 93°04'13.19"E	Regular	UN	UN	UN
13	Malulgram, Dhalai	24°37'17.91"N 92°51'03.96"E	Regular	128	76	0
14	Natun Ramnagar (Site-I:Pritam's residence)	24°42'52.60"N 92°57'35.60"E	Regular	72	60	92
15	Natun Ramnagar (Site-II:Engineer's residence)	24°42'36.46"N 92°58'05.49"E	Regular	113	83	29
16	Natun Ramnagar(Site-III: State dispensary)	24°42'49.70"N 92°57'40.00"E	Regular	81	62	36
17	Palonghat H. S. School	24°38'47.94"N 92°53'09.58"E	Regular	34	42	27
18	Pangram	24°54'43.13"N 92°54'07.37"E	Regular	77	58	69
19	Puthikhal Medical Sub-centre	24°39'45.41"N 92°48'41.87"E	Regular	23	17	0
20	Raja G. C. Memorial H. S. School, Borkhola	24°55'47.68"N 92°44'44.65"E	Regular	58	49	53
21	Rajnagar, Dhalai (religious place)	24°13'18.10"N 92°50'59.00"E	Irregular	16	0	0
22	Silcoorie (Dharamkhal)	24°35'43.51"N 92°50'45.68"E	Irregular	8	5	0
23	Sotojalengah	24°38'53.40"N 92°43'00.10"E	Regular	67	58	40
Total				1073	853	543
Mean roosting size				46.65	37.08	23.61
(mean ± SE)				±1.21	±1.11	±1.03

Scotophilus kuhlii Leach, 1821 (the lesser Asiatic yellow house bat)

Morphology

The Lesser yellow house bat is a small bat with a long tail which is covered with a membranous structure called inter femoral membrane between the rear legs. They are easily recognized by the brownish coat on the belly and yellowish brown colour on the back.⁴⁵ The facial structure resembles a dog with a dull muzzle. Ears of the lesser Asiatic yellow house bat are pointy in shape. Forearm and head-body length of adult *Scotophilus kuhlii* usually measure 4.7–4.9 cm and 5.95–6.22 cm respectively.⁴⁶ The average body weight is about 16 gm (Figure 2C).

Conservation status

The Lesser yellow house bat is categorised as the least concern species by IUCN and declared as a stable species. However this species of bat has not been listed in Indian Wildlife (Protection) Act, 1972 as well as in the CITES appendices.

Population status

Observations were made in 7 randomly selected villages for the availability of *Scotophilus kuhlii* which documented the presence of species in all the villages (Table 6). The population estimation of *Scotophilus kuhlii* also calculated in the year 2013 revealed a mean individuals of 6.42 (± 0.77). The present study recorded a maximum number of *Scotophilus kuhlii* in Binnakandi (14) and minimum in Khasiapunji (2) (Table 6).

Table 6 *S. kuhlii* observed in different sites of Cachar District

Sl no	Locality	Coordinates	No. of individuals	Mean
1	Dargakona	24°41'5.51" N 92°45'18.8" E	7	6.43 \pm 0.77 (mean \pm SE)
2	Khasiapunji	24°52'48.91" N 93°06'37.2" E	2	
3	Binnakandy	24°43'18.91" N 92°58'48.1" E	14	
4	Katakhal	24°38'24.10" N 92°50'37.9" E	6	
5	Sonai	24°44'04.26" N 92°53'30.8" E	9	
6	Rosekandy	24°41'44.03" N 92°42'38.7" E	4	
7	Sildubi	24°43'01.29" N 92°49'16.8" E	3	

Discussion

The information presented in this paper is the baseline work and is the first of its kind covering all the herbivorous as well as the insectivorous bat species of Cachar district belonging to one of the most important mammalian order Chiroptera. Mazumdar et al.³⁴ reported on the sighting of the three bat species (i.e., *Pteropus giganteus*, *Rousettus leschenaultia* and *Pipistrellus coromandra*) from degraded forest habitat around Assam University, Silchar but the

present study did not document *R. leschenaultia* from this region.

Habitat loss in the form of fragmentation, cutting of roosting trees, disturbances at roosting sites and destruction of old structure are considered to be the significant threat to the survival of chiropterans in the study area. The present study documented 37 incidences of habitat loss in or near the roosting sites which cause a tremendous impact on the population of the bat. In many instances, it was observed that people produce smoke using tobacco and dry chilly to drive away bats (*Megaderma lyra* in particular) from their vicinity. Sometimes they even use fire and kill the species including their siblings. The immediate effect of disturbance to the roost is the evacuation of the roosting place for a short duration but if the disturbance continues for long, bats leave the roost permanently and move elsewhere.

On many instances, it has been observed that people from Assam-Mizoram border including some local medicine man kill the bats irrespective of the species for consumption as bush meat. Medicine men preach that eating of bat meat would help in curing patients suffering from prolonged asthma. Such concepts have no scientific footings. Again, there are people, who consume bat, as they think it as a good source of protein with some medicinal properties.

Although many tribal communities (Mizo, Tiprai, Tea tribe) involve in consuming bats, there are some other non tribal communities (Hindu, Muslim) who banking on the religious faith, offer community protection and thus help in the survival of bats in the region. The authors have organized a few bat awareness programmes in the area. It is also suggested that more and more awareness programs among the communities living adjoining to the roosting site would be of immense help in conserving the chiropterans in the study area in particular and their entire range in general.⁴⁷

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Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

1. Choudhury A. The mammals of India. Gibbon books ISBN-9789380652047. 2016.
2. Choudhury A. *The Mammals of North-East India*. 1st ed. Gibbon Books and the Rhino Foundation for nature. Guwahati, India; 2013. p. 432.
3. Dobson GE. Description of a new Species of the Genus *Natalus* (Vespertilionidae). *Annals and Magazine of Natural History*. 1875;16:260–262.
4. Koopman KF. *Order Chiroptera in Mammal species of the world: a taxonomic and geographic reference*. In: Wilson DE, Reeder DM, editors. Smithsonian Institution Press, Washington, USA; 1993. p. 137–241.
5. Jones G, Teeling EC. The evolution of echolocation in bats. *Trends in Ecology and Evolution*. 2006;21(3):149–156.
6. Bussche VRA, Hofer SR. Phylogenetic relationships among recent chiropteran families and the importance of choosing appropriate out-group taxa. *Journal of Mammalogy*. 2004;85(2):321–330.

7. Bats of the world. *An introduction to the amazing variety of bats*. Bat Conservation Trust, Quadrant House, 250 Kennington Lane, London SE11 5RD, USA; 2015.
8. Springer MS, Teeling EC, Madsen O, et al. Integrated fossil and molecular data reconstruct bat echolocation. *Proceedings of the National Academy of Sciences*. 2001;98(11):6241–6246.
9. Teeling EC, Madsen O, Bussche VRA, et al. Microbat paraphyly and the convergent evolution of a key innovation in Old World Rhinolophid microbats. *Proceedings of the National Academy of Sciences of the USA*. 2002;9(3):1431–1436.
10. Bates PJJ, Harrison DL. *Bats of the Indian Subcontinent*. Harrison Zoological Museum, Sevenoaks, Kent, UK; 1997. p. 258.
11. Srinivasulu C, Srinivasulu B. First record of *Hipposideros ater* Templeton, 1848 from Andhra Pradesh, India with a description of a new species. *Zoos' Print Journal*. 2006;21(5):2241–2244.
12. Srinivasulu C, Srinivasulu B, Kaur H, et al. New distribution record and a review on *Hipposideros fulvus* Gray, 1838 (Mammalia: Chiroptera: Hipposideridae) distribution from Andhra Pradesh, India. *Check List*. 2013;9(1):139–141.
13. Boro AR, Saikia U, Sikia PK. First report of *Saccolaimus saccolaimus* Temminck, 1838 (Chiroptera: Emballonuridae) from Assam, northeast India. *Small Mammal Mail*. 2013;5(1):2–3.
14. Mishra R, Dookia S. Bats of Delhi. *Small Mammal Mail*. 2015;7(1):15.
15. Suthari S, Raju VS. Ecology and conservation status of canebrakes in Warangal District of Andhra Pradesh, India. *Journal of Threatened Taxa*. 2012;4(15):3426–3432.
16. Purohit A, Senacha KR. Distribution of bats in and around Jaisalmer of the Great Indian Desert, India. *Vespertilio*. 2004;8:99–104.
17. Saikia U, Sharma RM, Sharma DK. Record of Fulvous Leaf-nosed bat *Hipposideros fulvus* Gray, 1838 from Jammu and Kashmir, India. *Zoos' Print Journal*. 2006;21(3):2197.
18. Balasingh J, Ronald J, Nathan PT, et al. Occurrence of *Cynopterus brachyotis* (Chiroptera Pteropodidae) in Kalakkad Mundanthurai Tiger Reserve, Southern India. *Current Science*. 1999;76(12):1542.
19. Shah TS, Srinivasulu C, Kaur H, et al. New distribution records of *Tadarida aegyptiaca* E. Geoffroy, 1818 (Mammalia: Chiroptera: Molossidae) from Karnataka. *International Journal Fauna and Biological Studies*. 2014;1(5):41–43.
20. Padmanabhan P. *Documentation and conservation of small mammals in the sacred groves of Kerala, Peninsular India*. KFRI research report no: 406, 2005. p. 1–39.
21. Deshpande K, Gangal M, Kelkar N. First record of a bat from the Lakshadweep archipelago, southwestern India. *Mammalia*. 2015;80(2).
22. Mandal AK, Poddae AK, Bhattacharyya TP. Records of *Megaerops niphanae* yenbutra and felten, 1983 (Mammalia: Chiroptera: Pteropodidae), *Hipposideros lankadiva* keller, 1850 and *Hipposideros armiger* (Hodgson, 1835) (Chiroptera: Rhinolophidae) from Manipur, India, with taxonomic notes. *Records of the Zoological Survey of India*. 1993;93(3–4):355–359.
23. Nachiketha SR, Sreepada KS. Occurrence of Indian Painted Bat (*Kerivoula picta*) in dry deciduous forests of Mudumalai Tiger Reserve, Southern India. *Small Mammal Mail*. 2013;5(1):16–17.
24. Basumatary SK, Bera SK. Modern pollen record on bat guano deposit from Siju Cave and its implication to palaeoecological study in South Garo Hills of Meghalaya, India. *Journal of Cave and Karst Studies*. 2014;76(3):173–183.
25. Mandal AK, Poddae AK, Bhattacharyya TP. Further new records of bats from Mizoram, India. *Records of the Zoological Survey of India*. 2000;98(2):147–154.
26. Murthy MVK, Predeep M, Harshavardhan J, et al. Biodiversity of bats in Mysore city. *Journal of Environmental Science, toxicology and food technology*. 2014;8(11):2319–2402.
27. Srivastava JP, Mandal AK, Biswas DK. New records of Bats from Nagaland, India. *Records of the Zoological Survey of India*. 2000;98(4):83–87.
28. Sinha YP. The Bats of Rajasthan; Taxonomy and Zoogeography. *Records of the Zoological Survey of India*. 1980;76:7–63.
29. Ghose RK, Ghosal DK. Record of the Fulvous Fruit Bat, *Rousettus lesehena* (Desmarest, 1820) from Sikkim, with notes on its interesting feeding habits and status. *Journal of Bombay natural History Society*. 1984;81:178–179.
30. Debata S, Palei HS, Mohapatra PP, et al. First record of Lesser False Vampire bat (*Megaderma spasma*, Linnaeus, 1758) from Sundergarh, Odisha, India. *Small Mammal Mail*. 2013;5(1):26–27.
31. Tangavelou AC, Rani PJ, Karthikeyan S. Conservation of Sacred Indian flying fox (Bat) at sacred landscape of Pudukottai district, Tamil Nadu, India. *Asian Journal of Conservation Biology*. 2013;2(2):178–180.
32. Majumder J, Majumdar K, Bhattacharjee PP, et al. Inventory of mammals in protected reserves and natural habitats of Tripura, northeast India with notes on existing threats and new records of Large Footed Mouse-eared Bat and Greater False Vampire Bat. *Check list*. 2015;11(2):1611.
33. Ruedi M, Khlor D, Mukhim B, et al. Discovery of new colonies of the rare Wroughton's Free-tailed Bat *Otomops wroughtoni* (Mammalia: Chiroptera: Molossidae) in Meghalaya, northeastern India. *Journal of Threatened Taxa*. 2014;6(14):6677–6682.
34. Mazumdar K, Soud R, Gupta A. Mammalian Diversity of Degraded Forest Habitats around Assam University Campus, Cachar, Assam, India, with Notes on Conservation Status. *Our Nature*. 2011;9(1):119–127.
35. Bastawde DB, Mahabal A. Some behavioral aspects of Indian flying fox (*Pteropus meanteus simntes*). *Bio - Vignanam* 2 1976;(2):209–212.
36. Thomas DW, Fenton MB, Barclay RMR. Social behaviour of the little brown bat, *Myotis lucifugus*. I. Mating behaviour. *Behavioral Ecology and Sociobiology*. 1979;6(2):129–136.
37. Barlow K. *Expedition Field Techniques: Bats*. Expedition Advisory Centre, Royal Geographical Society (with The Institute of British Geographers) London, UK; 1999. p. 22–30.
38. Thomas DW, Laval RK. *Survey and census Methods (Chapter 5), Ecological and Behavioral Methods for the Study of Bats*. Washington Smithsonian, USA; 1998. p. 77–89.
39. Vandan SE, Kaleeswaran B, Baskar K, et al. Conservation Status of Indian flying fox, *Pteropus giganteus* in Tamil Nadu, South India. In: Vikram Reddy M, editor. *Wildlife Biodiversity Conservation*. Daya Publishers, New Delhi, India; 2008. p. 81–91.
40. Menon V. *Indian mammals-A field guide*. Hachette Book Publishing India Pvt Ltd, India; 2014.
41. Kitchener DJ, Maharadatunkamsi D. Description of a new species of *Cynopterus* (Chiroptera: Pteropodidae) from Nusa Tenggara, Indonesia. *Research Western Australian Museum, Australia*; 1991;15:307–363.
42. Bumrungsri S, Harbit A, Benzie C, et al. The pollination ecology of two species of *Parkia* in southern Thailand. *Journal of Tropical Ecology*. 2008;24:467–475.
43. Mickleburgh S, Waylen K, Racey PA. Bats as bushmeat: a global review. *Oryx*. 2009;43:217–234.

44. Smith AT, Xie Y, Hoffmann RS, et al. *A guide to the mammals of China*. Princeton University Press, Princeton, USA; 2008. p. 576.
45. Sharma G, Kamalakannan M, Dam D, et al. Status and conservation of Mammalian diversity in Indian Himalaya. *Biological Forum*. 2015;6(2):273–299.
46. Srinivasulu C, Racey PA, Mistry S. A key to the bats (Mammalia: Chiroptera) of South Asia. *Journal of Threatened Taxa*. 2010;2(7):1001–1076.
47. Rahman A, Choudhury P. Status, distribution and roosting habitat of Greater false vampire bat (*Megaderma lyra*) in Cachar districts of Barak Valley, Assam. In: Dutta BK, Choudhury P, editors. Sustainable biodiversity. 2015. p. 335–342.
48. Van Loon JC. *Selected methods of trace metal analysis: Biological and environmental samples*. John Wiley and Sons, New York, USA; 1985. p. 365.