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Review Article

Species diversity of bats (Mammalia: Chiroptera) in Assam, Northeast India

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Abstract

Bats are known to occur all over the world except in the Arctic and Antarctic regions and a few isolated oceanic islands. Bats have been on Earth for more than 50 million years. Currently, there are more than 1,400 species on the globe. They are the second-largest order of mammals and are widely dispersed across six continents. According to the South Asian Chiroptera Conservation Assessment and Management Plan Workshop report, India has 114 species of bats of which 13 species are under the suborder Megachiroptera. The species *Latidens salimalii* (Salim Ali's fruit bat) found in Madurai district of Tamil Nadu and *Otomops wroughtonii* (Wroughton's free-tailed bat) found in Belgaum of Karnataka are the two only Indian bat species that are listed on Schedule I of the Wildlife (Protection) Act of India, 1972 amended up-to-date. Bats or chiropteran studies at Assam along with other northeast Indian counterparts are very meager and there is no continuous study data from any places of Assam. Besides some detailed studies on the Indian flying fox (*Pteropus giganteus giganteus*) most of the other studies are based on opportunistic random catches. On the basis of the available research publications of a few bat researchers of Assam, it can become to the conclusion that currently, Assam's counterpart of Northeast India has about a total of 39 different bat species under 16 genera. Out of those 39 species, five species are recorded as Megachiropteran species (fruit bats) along with 34 numbers of Microchiropteran species. Most of the Microchiroptera species are insectivorous in nature with a few being carnivorous. All the recorded species of the Suborder-Megachiroptera were found to be included under a single family called Pteropodidae. However, Microchiroptera species recorded from Assam were found to be spread into five different families such as Emballonuridae, Megadermatidae, Rhinolophidae, Hipposideridae, and Vespertilionidae. The highest numbers of species were recorded under the family Vespertilionidae which is commonly known as "Evening bats". To date, 19 species are recorded under this family followed by Rhinolophidae with six species. The rest of the recorded families shared 2-4 species.

Keywords: Assam, Bats' diversity, Chiroptera, Megachiroptera, Microchiroptera, Northeast India

Introduction

Bats are known to occur all over the world except in the Arctic and Antarctic regions and a few isolated oceanic islands (Mickleburgh et al., 2002). Bats have been on Earth for more than 50 million years. Old World fruit bats (megachiropterans) are restricted to the Old-World tropics and subtropics and are almost exclusively phytophagous, whereas microbats are cosmopolitan and insectivorous (Marshall, 1983).

As per standard classification, the bats belong to the order "Chiroptera" (From the Greek *Chier*-"Hand" and *pteron*-"winged") as forelimbs are modified into simple leathery wings. The order Chiroptera is again subdivided into two suborders, "Megachiroptera" (known as the Old-World fruit bats) with 167 species and Microchiroptera with 834 species including all the insectivores and carnivores' bats according to their food habits and morphological adaptations (Chandrasekharan, 2003). However, currently, there are reports of more than 1,400 species of bats available globally. They are regarded as the second largest order of mammals and are widely dispersed across six continents. Globally, bats provide vital ecosystem services in the form of insect pest consumption, plant pollination, and seed dispersal, making them essential to the health of global ecosystems (BCI, 2022).

The status of chiropterans as per the IUCN Red Data Book listed as threatened species in 2004 South Asia recorded 123 species of bats and almost all of them reside in India. They account for one–fourth of India's mammal fauna and more than one-tenth of the world's bat species (Mistry, 2003). According to the South Asian Chiroptera Conservation Assessment and Management Plan (C.A.M.P) Workshop report (Molur et al., 2002), India has 114 species of bats of which 13 species are under the suborder Megachiroptera. The species *Latidens salimalii* (Salim Ali's fruit bat) found in Madurai district of Tamil Nadu and *Otomops wroughtonii* (Wroughton's free-tailed bat) found in Belgaum of Karnataka are the two only Indian bat species that are listed on Schedule I of the Wildlife (Protection) Act of India, 1972 amended up to date. The remaining112 species are unprotected. In fact, the 12 fruit bat species of the suborder Megachiroptera are listed under schedule–V of Wildlife (Protection) Act of India, 1972, where they are termed as "Vermin". Saikia et al. (2015) have mentioned that about 70 bat species are from northeastern parts of India. They also added that compared to the northeastern region as a whole, the bat diversity of Assam is seemingly poor at about 30 species which may partly be attributed to the lack of field studies in the state. Ecologically bats have a tremendous role to play in the ecosystem where they live. The simple contribution is that the fruit

bats play the role of flower pollinators and seed dispersers and that the microchiropterans greatly contributed to being insectivorous bats in controlling some of the insect pest population. Although fruit bats damage a small percentage of agricultural crops their role in forest regeneration compensates for this loss in the long run (Molur et al., 2002).

Materials and methods

The current review is a compilation of the various works carried out on the bat species of Assam (Northeast India) counterparts of the Indian subcontinent. All the latest taxonomical survey and review reports were analyzed thoroughly to list them in the table1and 2 with their every distributional record. The distributional records of each and every mentioned bat species are completely based on the currently available up-to-date publications which were made by bat researchers of the state such as Ali (1999, 2010, 2012, 2013, 2014, 2016, 2020); Boro et al. (2013, 2018); Saikia et al. (2015); Rahman and Choudhury (2017) along with the specific information as described in the two important publications on bat fauna from Indian subcontinents and Northeast Indian counterparts by the authors like Bates and Harrison (1997) and Sinha (1999) respectively.

Results and discussion

After reviewing the available bat references till 2020 from Assam, Northeast India, and the Indian subcontinent, it has been found that currently, the state of Assam has a total of 39 different bat species under 16 genera. Out of those, five species are recorded as fruit bat species which fall under the Suborder-Megachiroptera (Table 1) and 34 numbers of insectivorous and carnivorous species are included under the Suborder-Microchiroptera (Table 2).

Table 1. Fruit bat species (megachiroptera) distributed at the study area

Sl. No.	Family	Name of the Species		Distribution
		Common Name	Scientific name	
1.	Pteropodidae (Old world fruit bats)	Indian flying fox	*Pteropus giganteus giganteus* Brunnich, 1782	Dalgaon, Darrang district (Mandal, 1964) as mentioned in Sinha, 1999); Mahuri para, Kamrup (Sinha, 1999); Rongjuli, Goalpara (Sinha, 1999); Kacharighat, Guwahati, Kamrup Metro (Ali and Basistha, 1999; Ali, 2013; Ali, 2014 a,b,c,d; Ali, 2017a, b); Lakhimpur (ZSI Calcutta, 1920 as mentioned in Sinha, 1999) Cachar (Andersen,1912); Golaghat, Doom Dooma (Hinton and Lindsay, 1926); Palasbari (FMNH as mentioned in Bates and Harrison, 1997).
2.	Pteropodidae	Indian Fulvous fruit bat	*Rousettus leschenaultia leschenaultia* (Desmarest, 1820)	Nagaon and Darrang (Sinha, 1999)
3.	Pteropodidae	Short-nosed fruit bat	*Cynopterus sphinx* Vahl, 1797	Srimantapur, Guwahati, Kamrupmetro(Ali and Basistha, 1999; Ali, 2014a); B.N. College, Dhubri (Ali, 2020); Golaghat (Hinton & Lindsay, 1926 as mentioned in Bates and Harrison, 1997); Cachar (Anderson, 1881 as mentioned in Sinha, 1999).
4.	Pteropodidae	Lesser Dog-faced fruit bat	*Cynopterus brachyotis* (Muller, 1838)	Cachar (Sinha, 1986); Assam (Bates and Harrison, 1997).
5.	Pteropodidae	Dawn bat or Dobson's Long-tongued fruit bat	*Eonecteris spelaea* (Dobson, 1871)	Kherkheria, Assam (Ghosh and Bhattacharyya, 1974)

Table 2. Insectivorous and carnivorous bat species (microchiroptera) in the study area

Sl. No.	Family	Name of the species		Distribution
		Common name	Scientific name	
1.	Emballonuridae (Sheath-tailed Bats)	Long-winged Tomb bat	*Taphozous longimanus longimanus* Hardwicke, 1825	Assam (no specific location mentioned by Sinha,1999)
2.	Emballonuridae	Black-bearded tomb bat (New record for Assam)	*Taphozous melanopogon* Temminck, 1841	Baksa district, Western Assam (Saikia et al., 2015)
3.	Emballonuridae	Pouch-bearing bat (New record for Assam)	*Saccolaimus saccolaimus* Temminck, 1838 *or* *Taphozous (Saccolaimus) saccolaimus* Temminck, 1838	Balahati Village Tamulpur, Baksa District) (Boro et al., 2013); Nathpara village (Dhubri district) (Ali, 2016)
4.	Megadermatidae (False Vampire Bats)	Greater False Vampire bat	*Megaderma lyra* E. Geoffroy, 1810	Guijan, Tinsukia (Sinha, 1999); Angarakhta, Polahbari (Hinton & Lindsay, 1926)

5.	Megadermatidae	Lesser False vampire bat	*Megaderma spasma* Linnaeus, 1758	Kulsi, Rajapara (Hinton & Lindsay, 1926)
6.	Rhinolophidae (Horseshoe bats)	Trefoil Horseshoe bats	*Rhinolophus trifoliatus trifoliatus* Temminck, 1834	Sibsagar district, Assam (Sinha, 1999)
7.	Rhinolophidae	Wolly Horseshoe bats	*Rhinolophus luctus luctus* Temminck, 1835	Ganjam, Cachar district (Sinha, 1973)
8.	Rhinolophidae	Least Horseshoe bats	*Rhinolophus pusillus blythi* Andersen, 1918	Sibasagar district, Assam (Andersen, 1918; Corbet & Hill, 1992)
9.	Rhinolophidae	Little Indian Horseshoe bats	*Rhinolophus lepidus lepidus* Blyth, 1844	Sibasagar district, Assam (Kurup, 1968; Sinha, 1999)
10.	Hipposideridae (Leaf-nosed bats)	Fulvous Leaf-nosed bat	*Hipposideros fulvus pallidus* Andersen, 1918	Gauri Sagar Temple, Sibasagar (Collector J. M. Foster, 1875, ZSI, Calcutta); Cachar (1868, ZSI Calcutta)
11.	Hipposideridae	Least Leaf-nosed bat	*Hipposideros cineraceus cineraceus* Blyth, 1853	Sibasagr, lakhimpur (Kurup, 1968)
12.	Hipposideridae	Andersen's Leaf-nosed bat	*Hipposideros pomona gentilis* Andersen, 1918	Assam (Hinton and Lindsay, 1926)
13.	Hipposideridae	Cantor's Leaf-nosed bat	*Hipposideros galeritus* Cantor, 1846	Assam (Tate, 1941)
14.	Hipposideridae	Himalayan Leaf-nosed bat	*Hipposideros armiger armiger* Hodgson, 1835	Rajap[ara (Hinton and Lindsay, 1926); Kamrup district (Sinha, 1999; Kurup, 1968)
15.	Hipposideridae	Horsfield's Leaf-nosed bat	*Hipposideros larvatus leptophyllus* (Horsfield, 1823)	Orang National Park (Ali personal collection, 1998), Rajapara Hinton and Lindsay, 1926); Kamrup, Goalpara (Kurup, 1968)
16.	Vespertilionidae (Evening Bats)	Hodgson's evening bat	*Myotis formosus formosus* (Hodgson, 1835)	Assam (Blanford, 1891) Goalpara (Sinha, 1986)
17.	Vespertilionidae	Nepalese Whiskered bat (New record for Assam)	*Myotis muricola* (Gray, 1846)	Baksa district, Western Assam (Saikia et al., 2015)
18.	Vespertilionidae	Horsfield's bat (New record for Assam)	*Myotis horsfieldii* (Temminck, I840)	Baksa district, Western Assam (Saikia et al, 2015)
19.	Vespertilionidae	Bamboo bat (New record for Assam)	*Tylonycteris* sp. Peters, 1872	Baksa district, Western Assam (Saikia et al., 2015)
20	Vespertilionidae	Club-footed Bat (New record for Assam)	*Tylonycteris fulvida* (Reported as *T. pachypus* in Bates and Harrison, 1997)	Balahat Village of Baksa District (Boro et al., 2018)
21.	Vespertilionidae	Common Pipistrelle	*Pipistrellus Pipistrellus* (Schreber, 1774)	Rajapara (BMNH=British Museum Natural History)
22.	Vespertilionidae	Mount Popa Pipistrelle	*Pipistrellus paterculus* Thomas, 1915	Rajapara (BMNH; Palasbari (FMNH)
23.	Vespertilionidae	Javan Pipistrelle	*Pipistrellus javanicus* (Gray, 1838)	Rajapara (Hinton and Lindsay, 1926)
24.	Vespertilionidae	Coromandel Pipistrelle	*Pipistrellus coromandra coromandra* (Gray,1838)	Golaghat, Sadiya (Kurup, 1868); Palasbari (FMNH)
25a	Vespertilionidae	Indian Pygmy bat (In Bates and Harrison, 1997)	*Pipistrellus tenuis* (Temminck, 1840)	Gauhati, , Golaghat, rajapara, Angarakhata (Hinton and Lindsay, 1926); Palasbari (FMNH)
25b	Vespertilionidae	Indian Pygmy Pipistrelle (same species was projected by Sinha,1999)	*Pipistrellus mimus* (Wroughton, 1899)	Kamrup (Sinha, 1999)

26.	Vespertilionidae	Babu Pipistrelle	*Pipistrellus babu* Thomas,1916	Kamrup (Kurup 1968); (Specimen from Sibsagar was catalogued by Anderson in 1881 as *Pipistrellus abramus* and after reexamination Sinha, 1999 has identified it as *Pipistrellus babu*)
27.	Vespertilionidae	Kuhl's Pipistrelle	*Pipistrellus kuhliikuhlii* (Kuhl)	Cachar (Andersen, 1881; Kurup, 1968)
28a.	Vespertilionidae	Kelaart'sPipistrelle	*Pipistrellus ceylonicus*	
28b	Vespertilionidae	Serotine bat (In Bates and Harrison, 1997)	*Eptesicus serotinus* (Schreber, 1774)	Darrang (Kurup, 1968)
29.	Vespertilionidae	The same species was projected by Sinha (1999) as a different subspecies	*Eptesicus serotinus pachyomus* (Tomes, 1857)	Darrang district, (cataloged, 1881; Blanford, 1891)
30.	Vespertilionidae	Asiatic lesser yellow house bat	*Scotophilus kuhlii kuhlii* Leach, 1821	Guwahati, Goalpara (Kurup, 1968)
31.	Vespertilionidae	Asiatic greater yellow house bat	*Scotophilus heathi heathi* Horsfield, 1831	Rajapara, Margheretia (Hinton and Lindsay, 1926), Palasbari (FMNH), Guwahati, Marampur, Darangar, Kaliani, Golaghat (Kurup, 1968)
32.	Vespertilionidae	Hutton's Tube-nosed bat	*Murina huttoni huttoni* (Peters, 1872)	Ripu (Kurup, 1968)
33.	Vespertilionidae	Painted bat	*Kerivoula pictapicta* (Pallas, 1767)	Hapjan Tea Estate, Lakhimpur (Chaturvedi, 1969)
34.	Vespertilionidae	Hardwicke's forest bat	*Kerivoula hardwickei* (Horsfield,1824)	Rajapara (Hinton and Lindsay, 1926), Sibsagar (Sinha, 1999, ZSI Calcutta)

All the recorded species of the Suborder-Megachiroptera were found to be included under a single family called Pteropodidae. However, Microchiroptera species recorded from Assam were found to be spread into five different families such as Emballonuridae, Megadermatidae, Rhinolophidae, Hipposideridae, and Vespertilionidae. The highest numbers of species were recorded under the family Vespertilionidae which is commonly known as "Evening bats". To date, 19 species are recorded under this family followed by Rhinolophidae with six species. The rest of the families shared the other species which ranged between 2-4 species (Table 2).

It has been revealed from the recent references that there is an addition of 7 different species from the state of Assam under the suborder Microchiroptera in this new millennium (Boro et al., 2013; Saikia et al., 2015; Ali, 2016; Boro et al., 2018). Out of those seven, four species such as *Taphozous melanopogon*, *Myotis muricola*, *Myotis horsfieldii*, and a *Tylonycteris* sp. were recorded from the state of Assam in a single field study conducted in the Baksa district of Western Assam by ZSI, Shillong (Saikia et al., 2015). *Saccolaimus saccolaimus* Temminck, 1838 or *Taphozous (Saccolaimus) saccolaimus* Temminck, 1838 was first recorded in Assam at Balahati Village of Tamulpur area under Baksa District (Boro et al., 2013). Later it was again reported from the Nathpara area of Dhubri district of Assam which confirmed its extended distribution towards the westernmost part of Assam (Ali, 2016). Recently Boro et al. (2018) reported on two species. Two adult individuals

of Club-footed Bat *Tylonycteris fulvida* were caught on the evening of 24 July 2017, by mist-netting inside a bamboo grove at Balahat Village of Baksa District in western Assam (Boro et al., 2018). However same species was reported as *T. pachypus* (Temminck, 1840) in Bates and Harrison (1997) from Meghalaya, Mizoram, and Manipur states of northeast India. Saikia et al, (2015) reported about an individual from the genus *Tylonycteris* Peters, 1872 from the Baksa district of Western Assam.

Boro et al., (2018) have also reported another new species namely *P. ceylonicus* from the periphery of Burachapari Wildlife Sanctuary in Sonitpur District of Central Assam, which was caught at Sisuwati Village at the southern edge of the Sanctuary on 28th November 2016. The village is situated on the sandy riverbank of the Brahmaputra with scattered human settlements. The individual was captured while flying inside a school building by sweeping a butterfly net.

However, most of the newly described species were already been reported from some other states of Northeast India (NEI) which were explained beautifully in the works of Bates and Harrison (1997) and Sinha (1999). So it has been proved that bat field study is still very less in the state of Assam and an increase in field studies in the future will boost up our species number from Assam, a biodiversity-rich zone of northeast India. The latest complete species list of Chiroptera of Assam with their available old and new distributional records are shown in table1 and 2.

Amongst the fruit bat species, *Pteropus giganteus* or *Pteropus giganteus giganteus* which is commonly known as the Indian flying fox has been extensively studied by Dr. Azad Ali from 2000 to 2007 at different roosting sites in three districts of lower Brahmaputra valley of Assam namely Kamrup, Barpeta, and Dhubri (Ali, 2013). Interestingly Ali happens to be the first Ph.D. degree holder from Assam who worked elaborately on the fruit bat species (*Pteropus giganteus*) of Assam. Recently a comparative study on the roosting sites of the Indian Flying Fox (*Pteropus giganteus* Brunnich, 1782) in and around the Fakiragram area (BTAD) of Assam was conducted by Khatun and Ali (2017). Roosting tree species of that locality were *Eucalyptus* sp., *Shorea robusta*, and *Ficus bengalensis*. The fruit bat (*Pteropus giganteus*) population was found to range between 217 and 432 in the Fakiragram area of BTAD. However, the study revealed that Indian flying fox (*Pteropus giganteus*) colonies at Singimari (Bairagipara) roosting site were found vacated in January 2017 which was with a moderate population size of 283 bats in 2015; that means we are losing fruit bat roosting sites at a rapid rate (Khatun and Ali, 2017). Therefore, we need more research-oriented field studies to know the exact population size of all the chiropteran species of Assam including the very important fruit bat species, the Indian flying fox (*Pteropus giganteus*).

Conclusion

The state of Assam, a part of the global biodiversity hotspot "Northeast India' has been found very rich in bat fauna. A total of 39 species have been reported from this area so far. Out of those 39 species, five species are fruit bats along with other 34 numbers of insectivorous bats which are distributed under the suborder Microchiroptera. Indian flying fox (*Pteropus giganteus*) has been recognized as the largest fruit bat species in Assam (Ali, 2013). As far as insectivorous species are concerned, the highest numbers of species were recorded under the family 'Vespertilionidae' which are also known as "Evening bats". To date, 19 species are recorded under this family.

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References

Ali, A. (2010). Population trend and conservation status of Indian Flying Fox *Pteropus giganteus* Brunnich, 1782 (Chiroptera: Pteropodidae) in Western Assam. The Eco Scan, 4(4), 311-312

Ali, A. (2012b). Roosting ecology of Indian Flying Fox (*Pteropus giganteus*) colonies in the western part of Assam with special reference to their conservation. Small Mammal Mail, 4 (2), 35-36.

Ali, A. (2013). Indian Flying Fox of Assam. Scholar's Press, Omni Scriptum GmbH & Co.KG, Germany. 128pp.

Ali, A. (2014a). Common Indian Megachiroptera. Small Mammal Mail, Z.O.O., Tamil Nadu, 5(2), 9-8.

Ali, A. (2014b). Taxonomy and External morphology of Indian Flying Fox *Pteropus giganteus* Brunnich 1782 of Assam. Indian Journal of Research in Multidisciplinary Studies, 1(1), 23-28.

Ali, A. (2014c). Interaction of Indian Flying Foxes *Pteropus giganteus* (Brunnich, 1782) with the plant species in the Lower Brahmaputra Valley of Assam. Small Mammal Mail, Z.O.O., Tamil Nadu, 6(1), 12-14.

Ali, A. (2015). New roosting site of Indian flying fox (*Pteropus giganteus*) located at Bilasipara, Dhubri, Assam. Small Mammal Mail, Z.O.O., Tamil Nadu, 7(1), pp. 23.

Ali, A. (2016a). New Distributional Record of Pouch-bearing Bat *Saccolaimus saccolaimus* Temminck, 1838 from Assam, India. Small Mammal Mail, Z.O.O., Tamil Nadu, Volume 8(1), 14 pp.

Ali, A. (2016b). Distribution and Population size of Indian Flying Fox (*Pteropus giganteus* Brunnich, 1782) in and around the Fakiragram area of Assam. Small Mammal Mail, Z.O.O., Tamil Nadu, 8(1), 22-23.

Ali, A. (2017a). Guwahati City Fruit Bat Roosting Site Permanently shifted to a New Location: A major Ecobiological event for Fruit Bat Community in the New Millennium in Assam, India. Proceeding Volume of UGC sponsored National Seminar entitled "Environmental Conditions and Biodiversity Status in the New Millennium" organised and published by Dept. of Zoology, B. N. College, Dhubri, Assam.

Ali, A. (2020). First distributional record of short-nosed fruit bat *Cynopterus sphinx* (Vahl, 1797) (Chiroptera: Pteropodidae) from Dhubri district of Assam, Northeast India. International Journal of Applied Research, 6(10), 554-556.

Ali, A., Basistha, S.K. (1999). Fruit Bats in and around Guwahati city, Assam. ZOOS' Print Journal, I-XIV(1- 10):136.

Ali, A., T.C., Deka, Deka, R. (2012a). Breeding and parental care of Indian Flying Fox *Pteropus giganteus* Brunnich, 1782 (Megachiroptera-Pteropodidae) in the Lower Brahmaputra Valley of Assam. Proceedings of the National seminar "Biodiversity Spectrum of North-East India", Department of Zoology, Arya Vidyapeeth College, Guwahati, Assam, 81-86.

Andersen, K. (1912). Catalog of the chiroptera in the collection of the British Museum, Volume 1, Megachiroptera. British Museum National History, London. 854pp.

Andersen, K. (1918). Diagnoses of new bats of the families Rhinolophidae and Megadermatidae. The Annals and magazine of natural history, 2, 374-384

Anderson, J. (1881). Catalogue of the Mammalia in the Indian Museum, Calcutta. Part 1: Primates, Prosimiae, Chiroptera and Insectivora. Calcutta.

B.C.I. (2022). Bats 101-An Unlikely Hero with Global Impact. Bat Conservation International (BCI), Downloaded from https://www.batcon.org/about-bats/bats-101/.

Bates, P.J.J., D.L. Harrison (1997). Bats of The Indian Subcontinent. Harrison Zoological Museum Publications, Sevenoaks, United Kingdom, 258pp.

Blanford, W. T. (1891). The fauna of British India. Mammalia. Taylor & Francis, London. 617 pp

Boro, A.R., Saikiaand, U.P. Saikia, K. (2013). First report of *Saccolaimus saccolaimus* Temminck, 1838 (Chiroptera: Emballonuridae) from Assam, northeast India. Small Mammal Mail, 5(1), 2-3.

Boro, A. R.,P. K. Saikia& U. Saikia (2018). New records of bats (Mammalia: Chiroptera) from Assam, northeastern India with a distribution list of bat fauna of the state. Journal of Threatened Taxa, 10(5), 11606-11612.

Chakraborty, R and A. Ali (2015). Current Population Status and Habitat Condition of Indian Flying Fox (*Pteropus giganteus*) Colonies at the Kacharighat Roosting Site of Dhubri District of Assam. Published in Proceeding Volume of UGC sponsored National Seminar entitled "Anthropogenic Threats to Biodiversity" organised and published by Dept. of Zoology, Morigaon College, Morigaon, Assam. Vol .1, pp 94-98. .

Chandrasekharan, M.K., (2003). Chronobiology, Ecology, and Behaviour of some insectivorous bats of Southern India. Journal of the Bombay Natural History Society., 100 (2&3), 250 – 283.

Chaturvedi, Y. (1969). Two new records of bats from Assam and Andaman Islands. LABDEV journal of science and technology, India, Kanpur, 7B:74-75

Corbet, G. B. and J. E. Hill (1992). The mammals of the Indomalayan Region: A systematic review. Oxford University Press, New Work.

FMNH (Field Museum of Natural History) (2008). The Collection of Mammals Database, Division of Mammals, Zoology Department, Field Museum of Natural History, Chicago. http:// emuweb.fieldmuseum.org/mammals/ Query.phpKurup

Ghosh, R. K. and T. P. Bhattacharyya (1974). The occurrence of Dobson's Long-tongued Fruit Bat, Eonycterisspelaea (Dobson.) in Assam, India. Journal of Zoological Society, India, 26(1-2), 152-153

Hinton, M. A. C. and H. M. Lindsay (1926). Report No. 41: Assam and Mishmi Hills. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. J. Bombay Natural History Society. 31, 383-403.

Khatun, A., Ali, A. (2017b). A comparative study on the roosting sites of Indian Flying Fox (*Pteropus giganteus* Brunnich, 1782) in and around the Fakiragram area (BTAD) of Assam. Proceeding Volume of UGC sponsored National Seminar entitled "Environmental Conditions and Biodiversity Status in the New Millennium" organised and published by Deptment of Zoology, B. N. College, Dhubri, Assam. pp 201-206.

Khatun, M., Ali, A., Sarma, S. (2014d). Population fluctuation at Indian Flying Fox (*Pteropus giganteus*) colonies in the Kacharighat Roosting Site of Dhubri district of Assam. Indian Journal of Pure & Applied Biosciences, 2 (4), 184-188.

Kurup, G.U. (1968). Mammals of Assam and adjoining area. 2. A distributional list. Proceedings of the Zoological Society of Calcutta 21, 79-99

Marshall, A.G., (1983). Bats, Flowers, and Fruits: evolutionary relationships in the Old World, Biological Journal of the Linnean Society, 20, 115 – 135

Mickleburg, S.P., Hutson, A.M., Racey, P.A. (1992). Old World Fruit Bats: An action plan for their conservation, IUCN, Gland 252pp

Mistry, S. (2003). Protecting the bats of India. BATS, Vol. 21, No. 2.

Molur, S., Marimuthu, G., Srinivasulu, C., Mistry, S., Hutson, A.M., Bates, P.J.J., Walker, S., Priya, K.P., Priya, A.R.B. (2002). Status of South Asian Chiroptera: Conservation Assessment and Management Plan (C.A.M.P.) Workshop Report. Zoo Outreach Organization, Conservation

Breeding Specialist Group South Asia, and Wildlife Information & Liaison Development Society, Coimbatore, India,154pp.

Rahman, A., Choudhury, P. (2017). Status and population trend of chiropterans in Southern Assam, India. Biodiversity International Journal, 1(4), 121-132.

Saikia, U., Boro, A., Saikia, P.K. (2015). A preliminary assessment of bat diversity and people's attitude towards their conservation in Baksa District, western Assam. Keanean Journal of Science, 4, 3-8.

Sinha, Y.P. (1986). The bats of Bihar: Taxonomy of Field Ecology Records Zoological Survey of India Miscellaneous Publication, Occasional Paper No. 77, 1 – 60

Sinha, Y.P. (1999). Contribution to the knowledge of Bats (Mammalia: Chiroptera) of North East Hills, India. Records of the Zoological Survey of India. Occasional Paper No. 174, Zoological Survey of India, Kolkota, 52pp

Tate, G.H.H. (1941). Review of the Genus *Hipposideros*. Bulletin of the American Museum of Natural History, 78, 353-393.