



## Distribution and population status of Fruit-bat (*Pteropus giganteus*) in district Lakhimpur-Kheri, Uttar Pradesh, India

Jitendra Kumar\* and Amita Kanaujia

Department of Zoology, University of Lucknow, Lucknow, U. P. INDIA

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### ABSTRACT

*Pteropus giganteus* commonly known as Indian flying fox, belongs to family pteropodidae of order megachiroptera (mammalian order). Family pteropodidae consists of 43 Genera and about 165 species which are distributed throughout the world. There are about 14 species of fruit bats, belonging to 8 genera, found in Indian subcontinent. Fruit bats play several major ecological roles such as pollination and seed dispersion. The Indian flying fox is widespread in Indian subcontinent. However, due to loss of habitats, scarcity of food sources, public disturbances and hunting, their population is declining day by day.

Thus a study has been carried out to find out the status of *Pteropus giganteus* in district Lakhimpur-Kheri of Uttar Pradesh with special reference to their habitat, distribution, population, feeding and breeding behaviour. Twelve roosting sites have been recognised during January 2010 to December 2011. Major threats which have been observed in the study area are electrocution, loss of their habitats and hunting for commercial purposes such as oil, leather and specimens for biological institutes. This work will establish the study area as an important habitat for the conservation of megachiropteran species. Hence, several recommendations have also been made for the required conservation of this species.

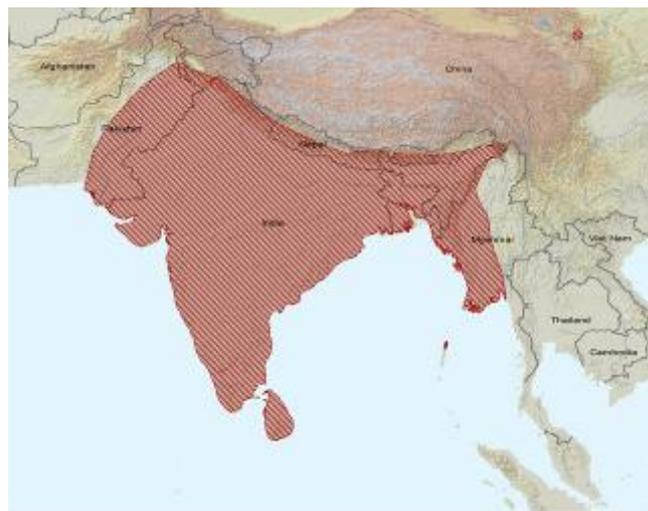
### 1) INTRODUCTION

Of the rich diversity of vertebrate fauna, bats are unique in being the only group of mammals that, like aves, have sustained flight. One of the 26 mammalian orders, the Chiroptera includes 1117 species of bats world over in rather two unequal suborders, the Megachiroptera (consisting 186 species of Old World fruit bats in only one family) and the Microchiroptera (consisting 931 species in 17 families) [1, 2, 3, 4, 5]. Bats are widely distributed and have been recorded throughout the world excepting the Antarctic and a few Oceanic Islands [5].

*Pteropus giganteus* (Fruit-bat) is commonly known as Indian flying fox due to its similarity to a fox. It is one of the largest bat of the world, belongs to family **pteropodidae** of order megachiroptera. Family pteropodidae consists of 43 Genera and about 165 species which are distributed throughout the world. There are about 14 species fruit bats, belonging to 8 genera, found in Indian subcontinent [6] (**Fig.1**).

Bats play several major ecological roles in many ecosystems. They are important mobile links as pollinators and also serve in seed dispersal [7, 8]. Bats could be good indicators of the integrity of biological systems because of their combination of size, mobility, and longevity as well as the variety of trophic roles [9, 10]. They also cause extensive damage to fruit orchards, and are therefore considered pests in many regions.

The Indian government also listed fruit bats as 'Vermin' in 1972 in the Indian Wildlife (Protection) Act.



**Fig.1:** Distribution of *Pteropus giganteus* in Indian subcontinent

\* Corresponding Author: Mr. Jitendra Kumar

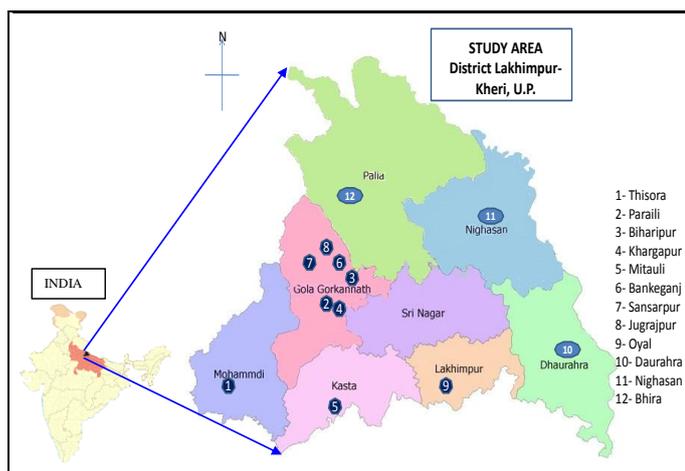
Email address: [jkumar4683@gmail.com](mailto:jkumar4683@gmail.com)

Like many other species of wildlife, Fruit-bats have also been subjected to the pressure of human population growth and development. Old World fruit bats are of considerable conservation concern [1]. Seven out of 64 *Pteropus* species are believed to have become extinct and further 17 species are considered endangered [1, 11]. The Indian flying fox, however, seems to be safe which is widespread on mainland of India. Documented and suspected population declines for numerous species of bats have been attributed to loss of habitats, and persecution by human and some species of bats have either become extinct or are considered threatened, endangered, or vulnerable [5].

Thus a study has been planned to find out distribution and population status of *Pteropus giganteus* in district Lakhimpur-Kheri of Uttar Pradesh with special reference to their habitat, behaviour, distribution and population. The study reflects the status of this bat species in 12 roosting sites, mostly located on the right side area of Sarda River. The work will also establish the study area as an important habitat for the conservation of this megachiropteran species.

## 2) MATERIAL AND METHODS

**Study area:** On the basis of present state of knowledge, it is evident that so far no systematic study has been done on fruit bats (*Pteropus giganteus*) in district Lakhimpur-Kheri which could give a clear picture about their status in this region. Lakhimpur Kheri is the largest district in Uttar Pradesh, India and divided into seven tehsils. Its administrative capital is the city of Lakhimpur. Lakhimpur-Kheri district is a part of Lucknow division, with a total area of 7,680 square kilometres (2,970 sq miles). It is situated between 27.60 and 28.6° north latitude and 80.34° and 81.30° east longitudes. It is roughly triangular in shape, the flattened apex pointing north. It is bounded on the north by the river Mohan, separating it from Nepal; on the east by the Kauriala River, separating it from Bahraich; on the south by Sitapur and Hardoi; and on the west by Pilibhit and Shahjahanpur (Fig. 2).



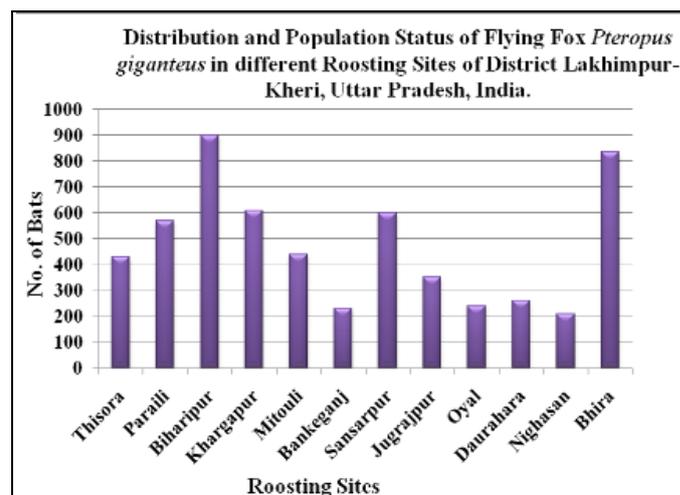
**Fig.2:** Map of study area (Lakhimpur-Kheri) showing location of Roosting Sites

The bat census was undertaken from twelve roosting sites-Thisora, Paraili, Biharipur, Khargapur, Mitouli, Bankeganj, Sansarpur, Jugrajpur, Oyal, Daurahara, Nighasan and Bhira in study area during January 2010 to December 2011. In every roosting sites, each tree with bats was plotted on to a map of the Orchard and an attempt was made to record all the trees

that provided roosts. The number of bats was either counted or estimated as accurately as possible by exact method and Estimation method during daytime. Exact method was used for small roosts (300 or less), located on road sides where individuals can be easily distinguished and counted. Counts should be conducted by enumerating the number of bats on individual branches to create a tree total and then summing bats across all trees. Tree Estimation method was used in private orchard where the roost is spread out across many trees. Count the number of bats on a tree and then multiply by the number of trees. The observations were made using binocular and Camera. Direct counts were frequently impossible because either the animals formed too large aggregations, or part of the group was hidden in the canopy or the tree was not visible from all sides. However, counting was done as accurately as possible. The bats emerging from the colony were also counted from one of the margin of the Orchard. A corridor was selected from where they leave the roosting site and recorded all flying bats every five minute, starting from their first departure. The observation site remained constant each evening, enabling direct comparison between daily counts. Besides direct observations, data was also collected through surveys and interaction with the local people particularly the orchard owners.

## 3) RESULTS AND DISCUSSION

District Lakhimpur-Kheri has dense forest area including the forests under the Forest Department and a number of private orchards. Various types of tree species such as Mango (*Mangifera indica*), Teak (*Tectona grandis*), Sal (*Shorea robusta*), Semal (*Bombax ceiba*), Gular (*Ficus glomerata*), Pepal (*Ficus religiosa*), Banana (*Musa paradisiacal*), Guava (*Psidium guajava*), Jambolana (*Syzygium cumini*), Banyan (*Ficus bengalensis*) etc. are found in the forests as well as orchards. These trees mainly provide food source for the fruit bats. The mango crop during summer season and guava & banana crops during winter are the main source of their food throughout the year.



**Fig. 3** Bar diagram showing distribution of *Pteropus giganteus*

In District Lakhimpur-Kheri, a total of about 5673 bats on 113 trees from 12 roosting sites were counted (Fig. 3). Most of the roosting sites were situated at the right side of Sarda river (i.e. south-west area of district Lakhimpur-Kheri) (Fig. 2). These roosting sites were located mostly in small private mango dominated mix orchards as well as on road side. The Private

orchards are small in area, ranging 60-150 m<sup>2</sup> and the number of the total trees ranges between 8 and 22. Private orchards were of old age (40-60 years old) and in degenerative state. The number of bats per tree varied between 5 and 150. The median value was low (80 bats per tree) and one half of trees showed no bats. Only eighteen trees with 150 or more bats were counted from all sites. Most flying foxes (genus *Pteropus*) that have been studied are moderately or strongly colonial [12]. Fairly small colonies are reported for India: 500 [1], 800-1000 [13]. Khan [14] claims that the largest colony he saw in Bangladesh contained 2500 bats. Five out of the total twelve roosting sites sheltered 500 or more bats. The lowest concentration of bats was found in Nighasan due to presence of degenerated trees and human interferences and the largest number (900 bats) of bats were counted in Biharipur where roosting site was comparatively a healthy mango orchard. So there were 400-550 bats, on average per roosting sites. It clearly showed that their colony size is gradually decreasing. Most of these roosting sites existed near a village with at least one pond located nearby that served as a source of drinking water for them. It was also proved by the observation in Paraili village where *P. giganteus* utilised two roosting sites, one is located very close to the village and other is half kilometre away from the village. There are ponds near both roosting sites. During summer, when the pond near the later site dried up, they start to use the roosting site near the village. It showed that water is essential for this species. The most of roosting sites were recorded in the area of Tehsil Gola Gokarannath (6) due to presence a variety of fruit plants- Mango sp., Guava, Banana, Gular, Banayan, Pepal that regularly provide food source for fruit bat throughout the year (Table 1). This area has many old private orchards, containing 15-75m long plants that are suitable for making roosts. Other regions of the study area are mostly covered with Government forests that contain largely non-fruit plant varieties.

**Table 1: Distribution of roosting sites in different Tehsils of district Lakhimpur- Kheri**

S.N.	Name of Tehsil	No. of Roosting Site	Location of Roosting Site	No. of Bats
1.	Gola Gokarannath	6	Paraili	3260
			Biharipur	
			Khargapur	
			Bankeganj	
			Sansarpur	
			Jugrajpur	
2.	Mohammadi	1	Thisora	430
3.	Mitauli	1	Mitauli	440
4.	Lakhimpur	1	Oyal	240
5.	Palia Kalan	1	Bhira	835
6.	Nighasan	1	Nighasan	208
7.	Dhaurahra	1	Daurahara	260

Various activities of *P. giganteus* were also recorded during visit to the study area. During day time, most of bats were found in sleeping stage, covering their body with large wings and they left their roosting sites during dusk and foraged to the feeding sites (Fig 4-A, B, C & D). Some trees particularly the gular (*Ficus glomerata*) at the roosting sites provide food to the sub-adults which are unable to take long flights. It was

observed that mature individuals generally do not feed on the fruits of the roosting sites except in some cases. General maintenance behaviours such as wing fanning, wing stretching, grooming, locomotion, sleeping, urination, defecation and vocal display were also observed.



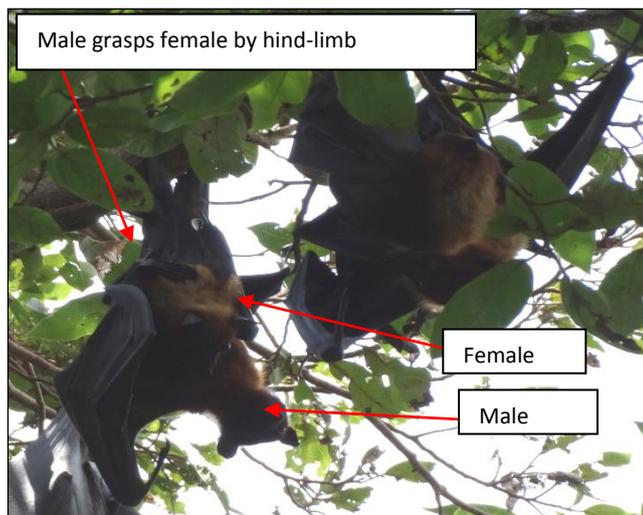
**Fig. 4(A):** A roosting site on mango tree



**Fig. 4(B)** Bats hanging from Bamboo



**Fig. 4(C)** A camp of *Pteropus giganteus*, leaving roosting site during dusk



**Fig. 4(D)** Copulation between male & female bats

A peculiar way of water drinking by this species was observed. Bats drank water only before leaving their roosting site during dusk. They flew over the water body and made 3-5 rounds over the water surface until they dipped their head into the water. During such an action, they took a little amount of water in mouth. Later they took water from the wet body fur by their tongue.

Earlier studies reported that the Indian flying fox, *P. giganteus*, copulates from July to October and gives birth to one or two young from February to March, with 140 to 150 days of gestation [15, 16]. Other studies suggest that *P. giganteus* gives birth to a single young during January–March [13].

The current study shows that breeding season extended from the month of July to March. Mass copulations were observed during month of July to September and give birth during February to March. The adult male bat was generally larger than the adult female. The male frequently approached its selected mate, stretched and fanned the wing towards the female and sniffed her. The female always attempted to repel from the male by screaming and leaving the branch of the tree. However, the male followed her persistently for about 35–75 minutes till he copulated successfully. Copulation lasted for about 70–90 s. The number of copulations between 2.30-5.30 PM was more compared to the rest of the day. The number of copulations under cloudy, dim sunlight was significantly more when compared to copulation under bright sunlight (more in rainy season). Oral sex was also observed among the individuals of this bat species. Parental care was observed in female individuals. Infant bats were seen, attached with abdomen of females, during March to July.

These roosting sites have been existed since long before (60-65 years) and then, the huge population of this species were found (personal communication with Local old persons) but, as time passed, their population declined gradually due to clearance of private orchards and hunting. There was negative attitude towards bats among the local people and they lacked proper information regarding this bat species. It was also seen that the Forest Department easily provided the permission for the clearance of these private orchards. This adversely affects the bat population because they have to migrate to other places because of habitat destruction. Further they search for new roosting sites with good supply of food sources i.e. healthy

fruit trees. These results in more economic loss to human beings (orchard owners) because fruit plants are damaged due to continue roosting of large colony of bats. Thus, the existing and occupied roosting sites should be protected with least human interferences. The orchard owners used various methods, such as crackers, creating loud noise to get rid of these bats during the season of crop only. However, hunting of this species by the tribes for food and other purposes had been reported from some sites. According to local people, maximum capturing and hunting of this bat species was occurred during 2000-06 for the purposes such as oil, leather and specimens for biological institutes. Oil is used in curing paralysis.

During survey, 6 bat carcasses (four from Paraili and two from Thisora) were seen on the ground during visit to the roosting sites. Crows and dogs were seen scavenging on dead bats. All carcasses were of old age and in various stage of decomposition. The electric lines can evidently be a deadly obstacle to flying foxes on their route between their roost and main feeding area. One carcass of fruit bat was found hanging from the electric line that passes over Lakhimpur to Gola Gokaran Nath road near Kasba Fardhan and other near the village Khargapur (Fig. 5A&B).



**Fig 5 (A)** Cases of electrocution of *Pteropus giganteus* from different sites of Study area



**Fig 5(B)** Cases of electrocution of *Pteropus giganteus* from different sites of Study area

**Table-2. Detailed Account on the Roosting Sites of Indian Flying Fox *Pteropus giganteus* Brünnich, 1782 in District Lakhimpur-Kheri, U.P.**

S.N.	Location of the Roost	GPS coordinates	Type of the Roost	Roost Tree Species	No. of Roost Trees	Method Used to Count Bats	Approximate Roost Size	Protection Information
1.	Thisora	N 27°76'120" E 080°38'056"	Private Orchard	Mango sp. Jambolana ( <i>Syzygium cumini</i> )	5 3	Tree Estimation	430	Not Protected
2.	Paraili	N 28°05'713" E 080°50'283"	Private Orchard	Mango sp. Gular ( <i>Ficus glomerata</i> ) Jambolana ( <i>Syzygium cumini</i> )	8 2 3	Tree Estimation	570	Protected by Local Community
3.	Biharipur	N 28°07'265" E 080°58'085"	Private Orchard	Mango sp. Gular ( <i>Ficus glomerata</i> ) Jambolana ( <i>Syzygium cumini</i> ) Bamboo sp. Guava ( <i>Psidium guajava</i> )	13 2 2 4 1	Tree Estimation	900	Protected by Local Community
4.	Khargapur	N 28°04'063" E 080°56'674"	Private Orchard	Mango sp. Gular ( <i>Ficus glomerata</i> ) Neem ( <i>Azadirachta indica</i> )	10 1 2	Tree Estimation	610	Not Protected, Hunting was reported
5.	Mitouli	N 27°72'253" E 080°49'186"	Private Orchard	Mango sp. Jambolana ( <i>Syzygium cumini</i> )	8 2	Tree Estimation	440	Not Protected
6.	Bankeganj	N 28°08'056" E 080°54'783"	Roadside	Mango sp. Gular ( <i>Ficus glomerata</i> )	2 1	Exact Count	230	Not Protected
7.	Sansarpur	N 28°08'533" E 080°54'912"	Private Orchard	Mango sp. Jambolana ( <i>Syzygium cumini</i> )	9 4	Tree Estimation	600	Not Protected
8.	Jugrajpur	N 28°09'118" E 080°52'583"	Private Orchard	Mango sp. Jambolana ( <i>Syzygium cumini</i> )	6 2	Tree Estimation	350	Not Protected, Hunting was reported
9.	Oyal	N 27°74'402" E 081°06'203"	Roadside	Mango sp. Pepal ( <i>Ficus religiosa</i> )	2 1	Exact Count	240	Not Protected
10.	Daurahara	N 28°01'203" E 081°16'213"	Roadside	Banyan ( <i>Ficus bengalensis</i> )	1	Exact Count	260	Not Protected
11.	Nighasan	N 28°16'255" E 081°10'153"	Roadside	Mango sp. Pepal ( <i>Ficus religiosa</i> )	1 1	Exact Count	208	Not Protected
12.	Bhira	N 28°20'305" E 080°57'588"	Private Orchard	Mango sp. Jambolana ( <i>Syzygium cumini</i> ) Gular ( <i>Ficus glomerata</i> )	12 3 2	Tree Estimation	835	Not Protected, Hunting was reported

#### 4) CONCLUSION

District Lakhimpur-Kheri is rich in biodiversity of flora and fauna. There were a huge population of fruit bats found in this region during past years, but the population of this species is decreasing day by day mostly due to clearance of their habitats, hunting and human interferences. Because of large size of their wingspan, electrocution accidents were higher for this bat species. Most of electrocution accidents were observed on the close electric power lines passes near the fruit bearing trees. When wingspan length is more than the distance between power lines, it results into a good conductor in case they touch these wires. It causes serious injuries which lead to death.

A more comprehensive study is needed to explore all the bat species and to estimate exact population number of *P. giganteus*. The study strongly recommends reviewing the legal status in provincial wildlife legislation in order to provide appropriate protection to this species. Ecological studies should be strongly recommended for better understanding of the status and economic value of species as conservation status of bats. Habitat management includes not only conserving roosting areas such as private orchards but also in conserving its sources of food (fruit trees). Study and documentation of pollination and seed dispersal by bats in different ecosystems, would help to improve the image of this bat species among the local people. Measures for preventing deforestation should be taken to protect the major source of their food.

Lastly, the study area provides a suitable habitat for the conservation of this species and such regions should be declared as 'Bat Zones' or 'Bat Hubs'.

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