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Research Article

ROOST CHARACTERISTICS AND HABITAT PREFERENCE OF INDIAN FLYING FOX (*Pteropus giganteus*) IN LAKHIMPUR - KHERI, UTTAR PRADESH, INDIA

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ABSTRACT

Roost characteristics and habitat preference of Indian flying fox, *Pteropus giganteus* were observed at 14 day roost sites of Lakhimpur - Kheri district, Uttar Pradesh, India form January 2010 to December 2015. All roosts harbor 972 trees belonging to 9 families, 11 genera and 14 species, of which 157 trees belonging to 6 families, 7 genera, and 10 species served as roost trees for these bats. Height of the roost trees varied from 8.80 m (*Psidium guajava*)) to 16.18 m (*Bambusa balcooa*) and DBH ranged from 10.73 cm (*Bambusa balcooa*) to 144.71 cm (*Ficus benghalensis*). Maximum average bats (n=336.25) were roosted on *Ficus religiosa*, having height of 9.97 m and DBH of 134.47 cm whereas minimum bats (n=7) were observed on *Psidium guajava*, having height of 8.80 m and DBH of 44.10 cm. The current study revealed that *P. giganteus* preferred to roost in larger trees with sufficient heights and dense canopy, located nearby water bodies and human habitations.

INTRODUCTION

Of the rich diversity of vertebrate fauna, bats are unique in being the only group of mammals that have sustained flight like aves. The mammalian order Chiroptera consists of about 1,232 species which represents a quarter of the total 5,487 mammal species of the world (Schipper *et al*, 2008; Simmons, 2010; Kunz *et al*, 2011). *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 species in the world which belongs to family pteropodidae of order megachiroptera. Family pteropodidae consists of 43 genera and about 165 species which are distributed throughout the world. India has a rich diversity of bat fauna comprising approximately 119 species of bats, out of which 14 species are fruit-eating or megachiropteran (Pteropodidae) belongs to 8 genus and the remaining are insect-eating or microchiropteran bats (Bates and Harrison, 1997). *P. giganteus* is the largest fruit bat and the largest flying mammal in India. In general, *P. giganteus* is widely distributed and commonly seen bat species throughout the whole country (Srinivasulu and Srinivasulu, 2001). The IUCN red list of threatened species 2011 categorized this species as least concern (LC version-3.1). *P. giganteus* is generally a colonial species and roosts in large trees often in area with topographic features that offer protection from strong winds, assist in thermoregulation and provide access to updrafts for easier flight (Cheke and Dahl, 1981; Pierson and Rainey, 1992; Richmond *et al,* 1998). They have good eye sight which helps in finding the food. The colonies are generally located in close association with human habitations and observed in cities and villages. *Ficus* trees are the most favoured roosting trees, however they also known to roost on *Eucalyptus globulus, Mangifera indica* and *Tamarindus indica* (Vendan, 2003). At dusk, flying foxes leave the roost to forage upon flower, nectar and fruit of trees in agro-forest plantation as well as in primary and secondary forests (Pierson *et al*, 1996).

Bats play an important role in ecosystem (Hinman, 2003) and are able to provide billions of dollars in ecosystem services (Boyles *et al*, 2011), including seed dispersal and pollination (IUCN SSC, 2014). These bats are economically important to our society. They play crucial role in the maintenance of forest ecosystems worldwide (Wiles and Fujita, 1992). Loss of their natural habitat by increased human population and human

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activities such as deforestation, use of pesticides, industrial activities as well as deliberate anthropogenic disturbance are the major causes of their population decline throughout the world. Even the minor alterations in the habitat such as the loss of key landscape elements- tree lines, hedgerows, and canals that are used regularly by bats during flight result in the abandonment of their roosts and maternity colonies (Mahmood-ul-Hassan *et al*, 2006).

All animals require food and shelter to survive successfully for which they search the appropriate place to roost and reproduce. A study on habits and habitats of bats is the first step towards their effective conservation. Knowledge of the ecology of bats, their habitats and roosting requirements is therefore needed for the protection of roosts and foraging areas (Nowak, 1994). Bats show diverse roosting behaviours and using different kinds of roosts, according to different requirements for environmental conditions in different seasons (Kunz, 1982; Kurta, 1986). Day roosts are diurnal shelter during day hours and night roosts are temporary resting as well as feeding places of foraging bats during night hours. Hibernation roosts are occupied during long periods of cold environment (Fenton, 1983). They need such roost sites for exhibiting activities like copulation, hibernation, maternal care, social interactions, escape from adverse weather and predators and spend half of their life time inside the roosts (Kunz, 1982; Altringham, 1996; Kunz and Lumsden, 2003). Thus, diurnal roost habitat selection is an important component of bat ecology (Barclay and Kurta, 2007). *P. giganteus* was the largest and the most common amongst all recorded bat species in study area. They have long hairy snout, pointed black ears, strong hind limbs, large wings with black patagium and well developed nostrils.

The average forearm length was 15.80 ± 0.18 cm and wingspan 83.50 ± 3.60 cm. Hence, the present study was made to survey the ditribution of *P. giganteus* in district Lakhimpur-Kheri, Uttar Pradesh. This study documented diversity and characteristics of day roosts as well as habitat preference of *P. giganteus*.

Study Area

Lakhimpur-Kheri is the largest district of the state Uttar Pradesh and divided into seven Tehsils. It is situated between 27.6° and 28.6°N latitude and 80.34° and 81.30°E longitudes. It is bounded by the river Mohan in north, separating it from Nepal; by the river Kauriala in east, separating it from Bahraich; by district Sitapur and Hardoi in south and Pilibhit and Shahjahanpur in west (Fig 1). Being a Terai district, it is rich in natural resources with lush green scenery and many rivers. The principal rivers are Sarda and Ghaghra. Dudhwa National Park, Sonaripur Sanctuary, Kishanpur Sanctuary, Sarda Dam are other major attractions of Lakhimpur-Kheri. The climate is hot throughout the year except the rainy season. In winter, nights are very cold with fog. Winter- October to February, 4°C to 30°C; Summer- March to June, 20°C to 43°C; Rainy Season-July to September, 20°C to 35°C; Rainfall-1085.3 mm (en.wikipedia.org and kheri.nic.in).

MATERIALS AND METHODS

The present study was conducted to locate day roost sites of *P. giganteus* in Lakhimpur - Kheri district of Uttar Pradesh over a period of two years during January 2010 to December 2011. *P. giganteus* day roosts were located based on inquiries from local people.

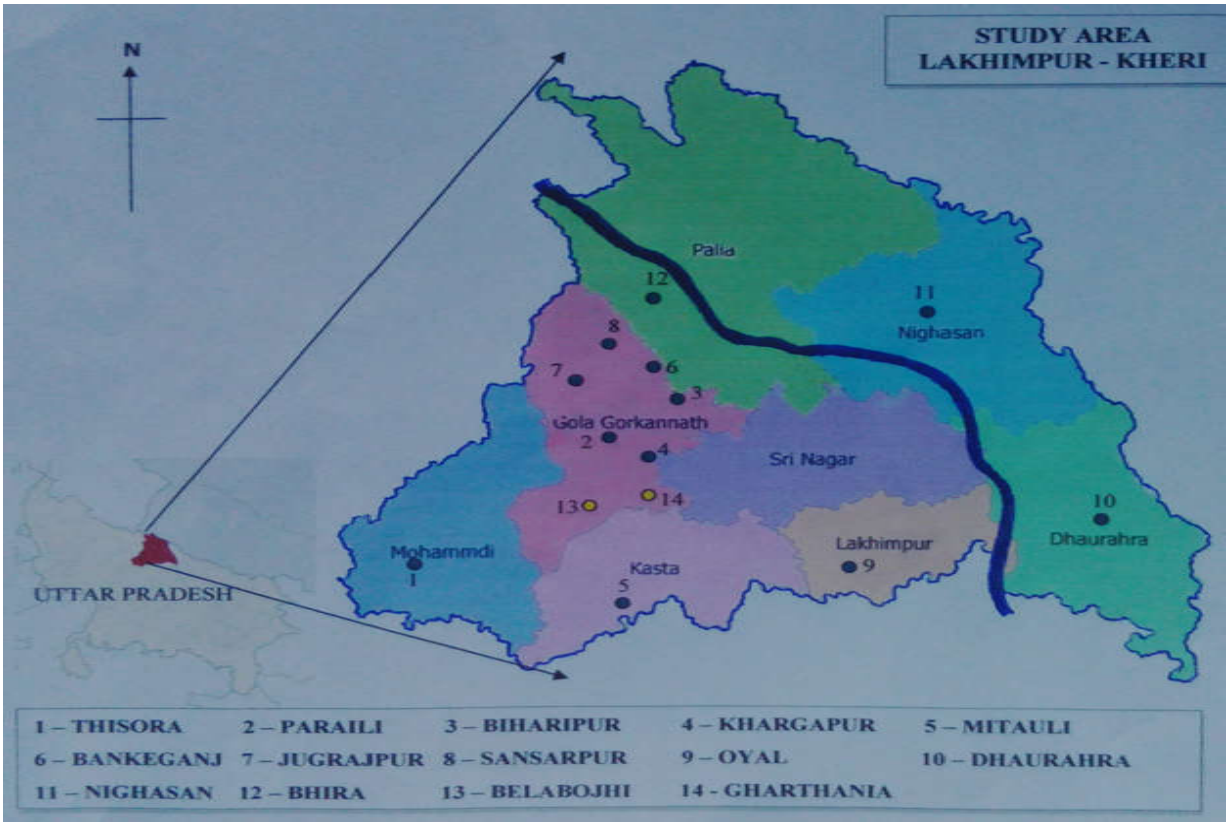


Fig 1 12 day roost sites of the Indian flying fox, *Pteropus giganteus* located at various places (black dots) along with two newly recorded day roosts (yellow dots) of Lakhimpur - Kheri district, U.P.

The survey for day roost investigation was conducted yearly. The following parameters such as species, family, number, height, circumference and DBH (diameter at breast height) of roost trees were taken at each roost site. The roost informations such as location of roost; duration of occupancy; species, family and number of nearby non-roost trees; colony size; water body and association with human habitations were recorded. The measurement of roost tree height was taken using Clinometer. The circumference of the roost tree was taken with the help of a measuring tape and diameter at breast height (DBH) was calculated from circumference. The colony size was assessed by direct roost count of roosting bats during day hours at their roosts, following Kunz *et al*, 1996. Data are presented as mean ± SD.

RESULTS

The first field survey for roost investigation was conducted from January 2010 to December 2011 and located 12 day roost sites, namely Thisora (N27°76 120 E80°38 056), Paraili (N28°05 713 E80°50 283), Biharipur (N28°07 265 E80°58 085), Khargapur (N28°04 063 E80°56 674), Mitauli (N27°72 253 E80°49 186), Bankeganj (N28°08 056 E80°54 783), Sansarpur (N28°08 533 E80°54 912), Jugrajpur (N28°09 118 E80°52 583), Oyal (N27°74 402 E81°06 203), Dhaurahra (N28°01 203 E81°16 213), Nighasan (N28°16 255 E81°10 153) and Bhira (N28°20 305 E80°57 588) with total number of 5673 bats. Two new roost sites, namely Belabojhi (N27°59 251 E80°29 780) and Gharthania (N28°02 313 E80°27 431) with total number of 1115 bats were reported during the last phase of study (June to December 2015). The field surveys were also conducted yearly to find out the distribution and population status of *P. giganteus* in study area.

As being social and colonial species, *P. giganteus* colonies were observed in several diurnal roosts with hundreds of individuals. *P. giganteus* colonies were observed to roost mainly in mango dominated mix orchards (60-65 years old) and road side trees. All day roosts harbor a total of 972 trees belonging to 9 families, 11 genera and 14 species. Out of 972 trees, only 157 trees belonging to 6 families, 7 genera and 10 species were observed as roost trees (Table 1). The colonies of *P. giganteus* were usually roosted in larger and taller trees with dense canopy such as Mango (*Mangifera indica*), Peepal (*Ficus religiosa*), Bargad (*Ficus bengalensis*), Gular (*Ficus glomerata*), Pakad (*Ficus virens*), Jamun (*Syzygium cumini*), Bamboo (*Bambusa balcooa*), Amla (*Phyllanthus emblica*), Neem (*Azadirachta indica*) and Amrud (*Psidium guajava*). The DBH of roost trees ranged from 10.73 cm (*Bambusa balcooa*) to 144.71 cm (*Ficus benghalensis*). Height of the roost trees ranged from 8.80 m (*Psidium guajava*)) to 16.18 m (*Bambusa balcooa*) (Table 2). *P. giganteus* preferred to roost in larger *ficus* tree species and *Mangifera indica* compared to other trees species. The maximum number of bats (n=721) were found to roost in two trees of *Ficus religiosa* located on the margin of Belabhojhi village. There was a positive correlation between colony size and DBH of roost trees (r=0.755, n=44, P> 0.001), however a negative correlation between colony size and height of the roost trees (r=-0.114, n=44, P< 0.05). The DBH of roost trees influence the roosting habit of *P. giganteus* while the height of roost trees did not (Graph 7a & 7b).

A total of 6791 individuals were directly counted in 44 day roost colonies of *P. giganteus*. The colony size ranged from 7 to 486 individuals of *P. giganteus*. The highest population of bats (900 individuals) was recorded in a private orchard at Biharipur village while lowest population (208 individuals) in a road side roost at Nighasan (Graph 1). The most of roost trees were located in the middle of orchard whereas non-roost trees on the periphery of orchard.

Out of 157 roost trees, *Mangifera indica* of anacardiaceae family (n=90) was used predominantly compared to other trees (*Bamboo balcooa*, n=20; *Syzygium cumini*, n=19; *Ficus glomerata*, n=10; *Ficus religiosa*, n=4; *Ficus virens*, n=4; *Phyllanthus emblica*, n=4; *Ficus benghalensis*, n=3; *Azadiracta indica*, n=2 and *Psidium guajava*, n=1) (Graph 3 & 4). Among the 10 roost tree species found in 14 roost sites, *Mangifera indica* was in 13 places. *Syzygium cumini* in 7, *Ficus glomerata* in 6, *Bamboo balcooa* in 5, *Ficus religiosa* in 3, *Ficus benghalensis* in 3, *Ficus virens* in 3 and *Phyllanthus emblica* in 2 roost sites were recorded. Two out of 10 roost tree species were recorded in only one roost site, included *Azadiracta indica* and *Psidium guajava* (Graph 5). Maximum number of roost trees (n=24) were recorded in a private orchard at Bhira while minimum number of roost trees (n=1) along road side at Dhaurahra (Graph 2).

The presence of water bodies close to roost or on foraging pathway were observed to be necessary for bat population because water bodies served as a source of drinking water for them. It was seen in Paraili village where *P. giganteus* utilized two roosts, one was located very close to the village (stable roost) and other was half kilometer away from the village (temporary roost). There were 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. They were obseverd over the water surface and dip their body into the water for drinking. They also licked their body hairs by tongue to get water. Maximum water drinking activity of *P. giganteus* was observed during pre-emergence period after sunset and before leaving their roosts. Ten out of 14 day roosts were found closer to water bodies. Such water bodies were in the form of pond (n=6), water channel (n=3) and river (n=1, Sharda). Roost trees were also located along the road sides (n=3). 11 roost sites were located closest to human habitations, mainly villages (Graph 6).

Various threats to this bat species were also reported from study area. Loss of habitats (old mango orchards and larger *ficus* trees) by continued and uncontrolled tree felling was the major threat to the population of *P. giganteus*. Hunting was reported in a few day roosts located at Khargapur, Jugrajpur and Bhira. It was found on inquiries with local people that *P. giganteus* was still hunted for food and medicine. Its meat and oil (extract from its burned body) were used by some villagers to cure paralysis, asthma / breathing disorders and body pains. The survival of *P. giganteus* was severely threatened due to human interference. During study period, it was observed that 5 out of its 14 day roosts were abandoned by *P. giganteus* due to trees felling, hunting and human interference.

P. giganteus leaves the roost about 20-35 minutes after sunset and returns to its day roost at dawn.

Table 1 Details of day roosts used by *P. giganteus* in Lakhimpur-Kheri district, Uttar Pradesh

S. No.	Location of the Roost	GPS coordinates	Name of Tree	Family	No. of Roost Tree	No. of Non-roost Tree	Total no. of tree
1	Thisora	N 27º76 120 E 080º38 056	Mango (*Mangifera indica*)	Anacardiaceae	05	12	17
			Jamum (*Syzygium cumini*)	Myrtaceae	03	03	06
			Neem (*Azadirachta indica*)	Meliaceae	00	01	01
2	Paraili	N 28º05 713 E 080º50 283	Mango (*Mangifera indica*)	Anacardiaceae	08	77	85
			Gular (*Ficus glomerata*)	Moraceae	02	00	02
			Jamum (*Syzygium cumini*)	Myrtaceae	03	03	06
			Bamboo (*Bambusa Balcooa*)	Poaceae	03	62	65
			Shisham (*Dalbergia sissoo*)	Fabaceae	00	01	01
3	Biharipur	N 28º07 265 E 080º58 085	Mango (*Mangifera indica*)	Anacardiaceae	13	27	40
			Gular (*Ficus glomerata*)	Moraceae	02	00	02
			Jamum (*Syzygium cumini*)	Myrtaceae	02	04	06
			Bamboo (*Bambusa balcooa*)	Poaceae	04	28	32
			Amrud (*Psidium guajava*)	Myrtaceae	01	07	08
			Eucalyptus (*Eucalyptus tereticornis*)	Myrtaceae	00	10	10
4	Khargapur	N 28º04 063 E 080º56 674	Mango (*Mangifera indica*)	Anacardiaceae	10	34	44
			Pakad (*Ficus virens*)	Moraceae	01	00	01
			Gular (*Ficus glomerata*)	Moraceae	01	00	01
			Eucalyptus (*Eucalyptus tereticornis*)	Myrtaceae	00	11	11
			Neem (*Azadirachta indica*)	Meliaceae	02	02	04
			Sagaun (*Tectona grandis*)	Lamiaceae	00	10	10
5	Mitauli	N 27º72 253 E 080º49 186	Mango (*Mangifera indica*)	Anacardiaceae	08	33	41
			Bargad (*Ficus benghalensis*)	Moraceae	01	00	01
			Jamun (*Syzygium cumini*)	Myrtaceae	02	04	06
			Semal (*Bombax ceiba*)	Malvaceae	00	08	08
			Neem (*Azadirachta indica*)	Meliaceae	00	02	02
6	Bankeganj	N 28º08 056 E 080º54 783	Mango (*Mangifera indica*)	Anacardiaceae	02	26	28
			Bargad (*Ficus benghalensis*)	Moraceae	01	00	01
			Gular (*Ficus glomerata*)	Moraceae	01	00	01
			Shisham (*Dalbergia sissoo*)	Fabaceae	00	08	08
			Sagaun (*Tectona grandis*)	Lamiaceae	00	04	04
7	Sansarpur	N 28º08 533 E 080º54 912	Mango (*Mangifera indica*)	Anacardiaceae	09	46	55
			Pakad (*Ficus virens*)	Moraceae	02	00	02
			Jamun (*Syzygium cumini*)	Myrtaceae	04	07	11
			Eucalyptus (*Eucalyptus tereticornis*)	Myrtaceae	00	17	17
			Bamboo (*Bambusa balcooa*)	Poaceae	04	56	60

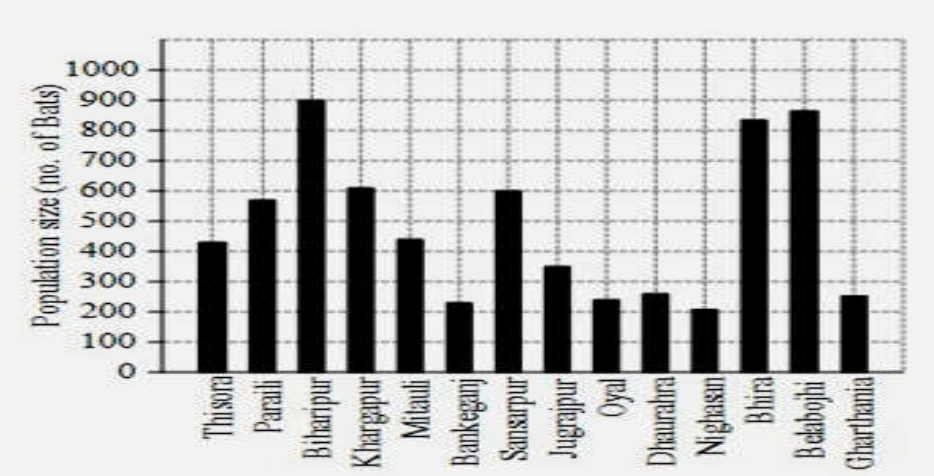
			Shisham (*Dalbergia sissoo*)	Fabaceae	00	05	05
8	Jugrajpur	N 28°09 118 E 080°52 583	Mango (*Mangifera indica*)	Anacardiaceae	06	21	27
			Jamun (*Syzygium cumini*)	Myrtaceae	02	02	04
			Amla (*Phyllanthus emblica*)	Phyllanthaceae	02	00	02
			Sagaun (*Tectona grandis*)	Lamiaceae	00	18	18
			Shisham (*Dalbergia sissoo*)	Fabaceae	00	06	06
9	Oyal	N 27°74 402 E081°06 203	Mango (*Mangifera indica*)	Anacardiaceae	02	00	02
			Peepal (*Ficus religiosa*)	Moraceae	01	00	01
10	Dhaurahra	N 28°01 203 E 081°16 213	Bargad (*Ficus benghalensis*)	Moraceae	01	00	01
11	Nighasan	N 28°16 255 E 081°10 153	Mango (*Mangifera indica*)	Anacardiaceae	01	00	01
			Peepal (*Ficus religiosa*)	Moraceae	01	00	01
12	Bhira	N 28°20 305 E 080°57 588	Mango (*Mangifera indica*)	Anacardiaceae	12	15	27
			Gular (*Ficus glomerata*)	Moraceae	02	00	02
			Pakad (*Ficus virens*)	Moraceae	01	00	01
			Jamun (*Syzygium cumini*)	Myrtaceae	03	08	11
			Bamboo (*Bambusa balcooa*)	Poaceae	06	71	77
			Eucalyptus (*Eucalyptus tereticornis*)	Myrtaceae	00	02	02
13	Belabojhi	N 27°59 251 E 080°29 780	Mango (*Mangifera indica*)	Anacardiaceae	08	17	25
			Peepal (*Ficus religiosa*)	Moraceae	02	00	02
			Gular (*Ficus glomerata*)	Moraceae	00	01	01
			Bamboo (*Bambusa balcooa*)	Poaceae	00	21	21
			Shisham (*Dalbergia sissoo*)	Fabaceae	00	02	02
			Jamun (*Syzygium cumini*)	Myrtaceae	00	01	01
14	Gharthania	N 28°02 313 E 080°27 431	Mango (*Mangifera indica*)	Anacardiaceae	06	60	66
			Gular (*Ficus glomerata*)	Moraceae	02	02	04
			Amla (*Phyllanthus emblica*)	Phyllanthaceae	02	00	02
			Shisham (*Dalbergia sissoo*)	Fabaceae	00	06	06
			Neem (*Azadirachta indica*)	Meliaceae	00	03	03
			Bamboo (*Bambusa balcooa*)	Poaceae	03	45	48
			Peepal (*Ficus religiosa*)	Moraceae	00	02	02
			Jamun (*Syzygium cumini*)	Myrtaceae	00	04	04
					157	815	972

It commonly roosts with its head downward and wrapped wings around its body but during warm hours of the day individuals often cool themselves by fanning their wings. They generally rest and sleep during day hours in roosts, covering whole body with patagium of forearm. During day hours, a few young bats were also found to feed on fruits in their day roosts.

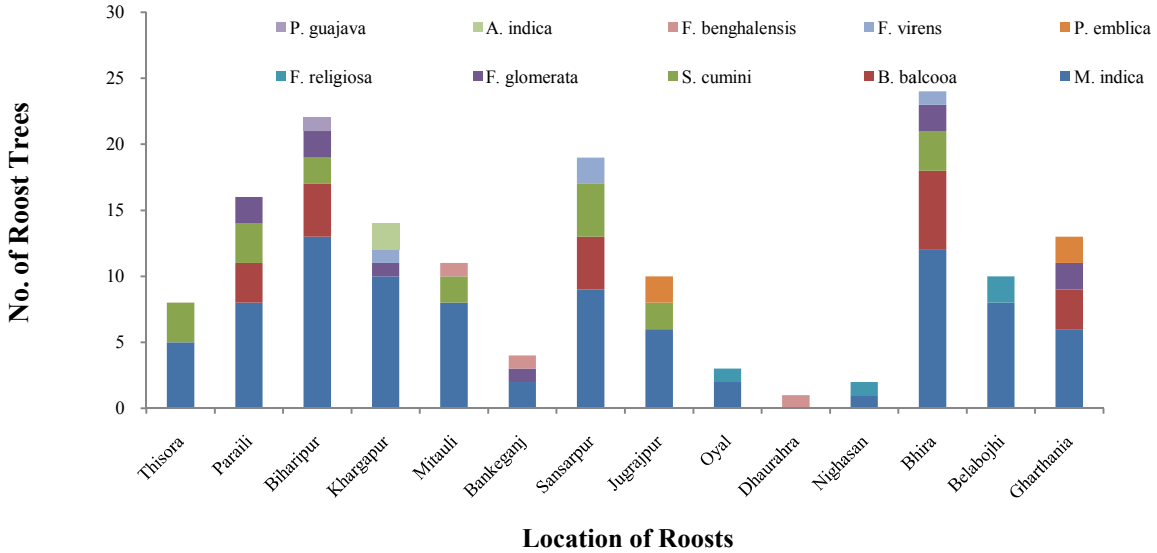
The movement of bat from tree to tree and branches to branches, calling as well as grooming were found to increase during pre- emergence period just after sunset. The wing fanning during summer and basking with stretched wings during winter were commonly observed. During day hours, various activities of *P. giganteus* such as licking body parts, cleaning and scratching with claws, squabbling and fighting for better roost were also observed.

Table 2 Roost trees and roost characteristics of *Pteropus giganteus*

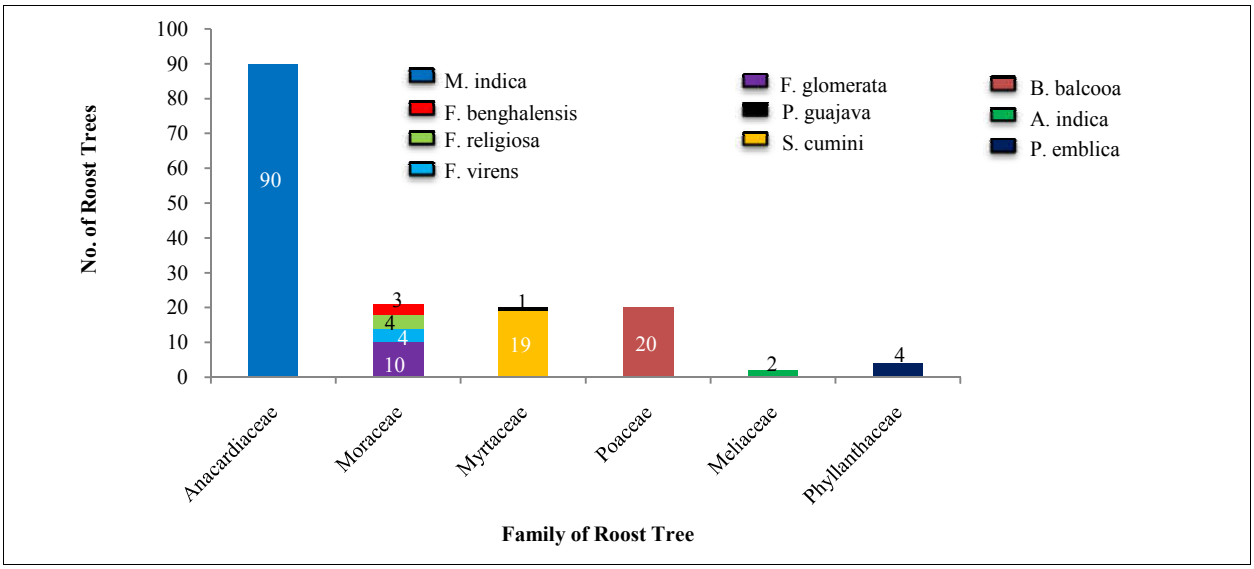
S. No.	Name of Tree	Circumference (cm)	DBH (cm)	Height of Roost Tree (m)	No. of Roost Tree	No. of Bats per Tree	Total No. of Bats
1	Mango (*M. indica*)	192.52 ± 72.60	61.26 ± 23.10	9.38 ± 2.25	90	26.18 ± 24.02	2356
2	Peepal (*F. religiosa*)	422.60 ± 93.73	134.47 ± 29.83	9.97 ± 1.63	04	336.25 ± 61.62	1345
3	Bargad (*F. benghalensis*)	454.80 ± 58.26	144.71 ± 18.54	10.61 ± 1.49	03	175.34 ± 43.18	526
4	Gular (*F. glomerata*)	364.89 ± 78.30	116.10 ± 24.92	12.00 ± 1.25	10	131.70 ± 34.51	1317
5	Pakad (*F. virens*)	397.76 ± 51.24	126.56 ± 16.31	9.28 ± 1.50	04	119.50 ± 0.24	478
6	Jamun (*S. cumini*)	279.04 ± 27.37	88.77 ± 8.71	11.26 ± 1.65	19	17.27 ± 11.35	328
7	Bamboo (*B. balcooa*)	33.71 ± 3.37	10.73 ± 1.07	16.18 ± 1.90	20	16.30 ± 8.85	326
8	Amla (*P. emblica*)	145.50 ± 18.89	46.30 ± 6.02	8.94 ± 2.11	04	13.25 ± 6.74	53
9	Neem (*A. indica*)	295.67 ± 21.10	94.08 ± 6.71	10.65 ± 0.99	02	27.50 ± 8.24	55
10	Amrud (*P. guajava*)	138.58	44.10	8.80	01	7.00	07



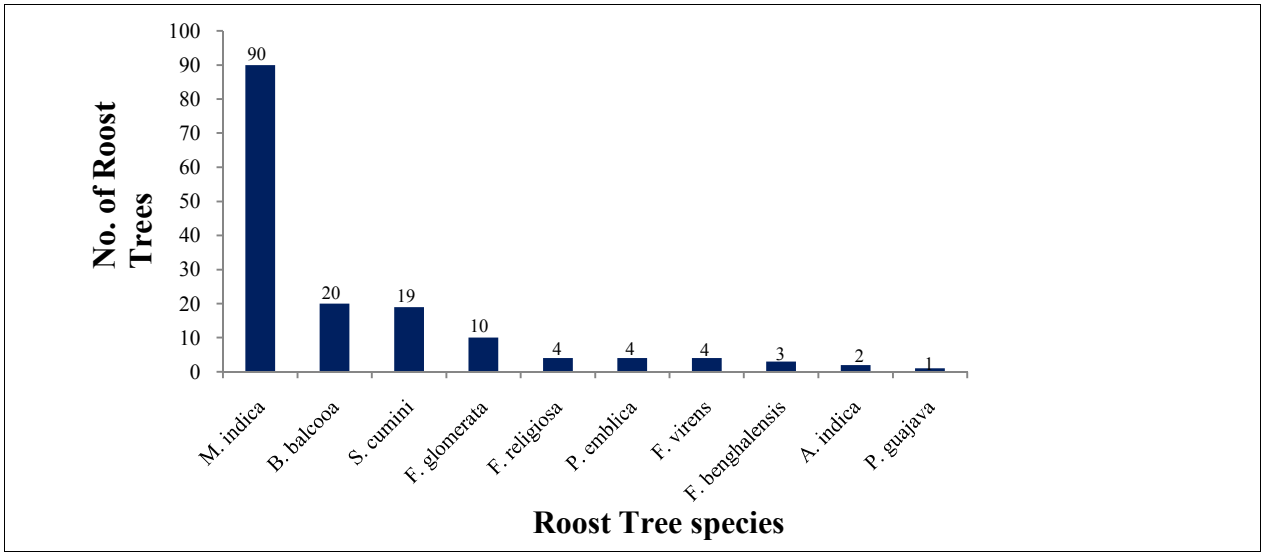
Graph 1 Distribution and population of *P. giganteus* in different day roosts



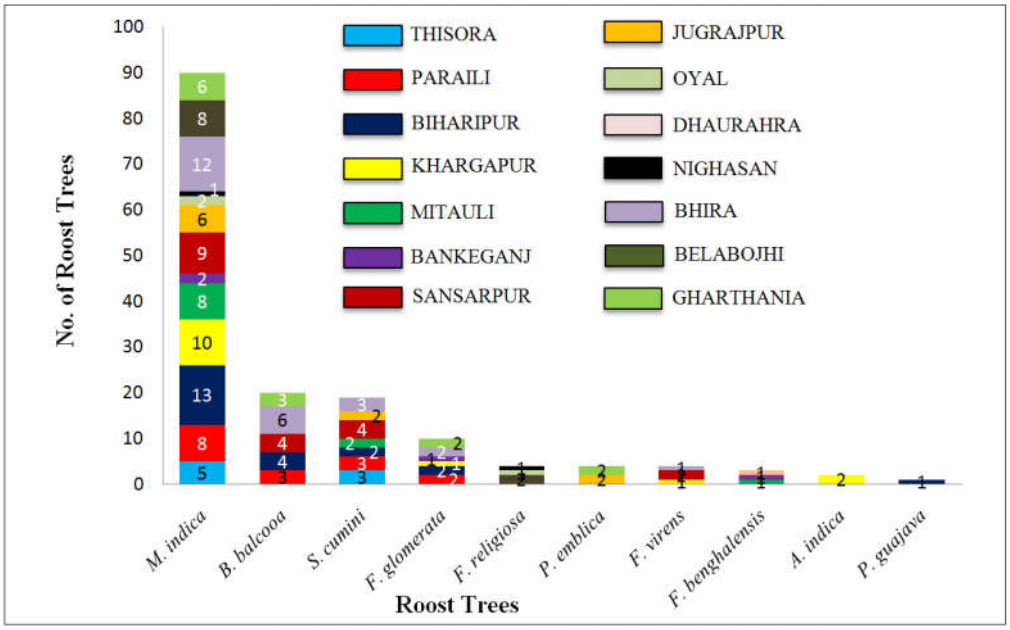
Graph 2 Details of roost diversity in different day roosts



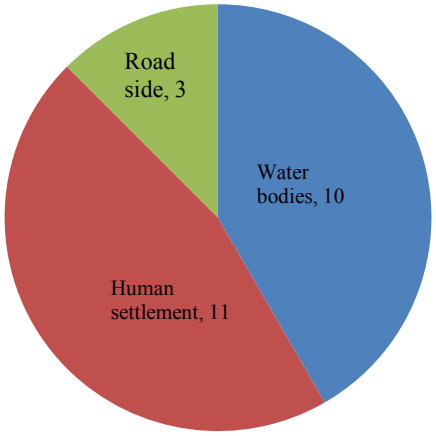
Graph 3 Tree families that were used by *P. giganteus* as roost trees



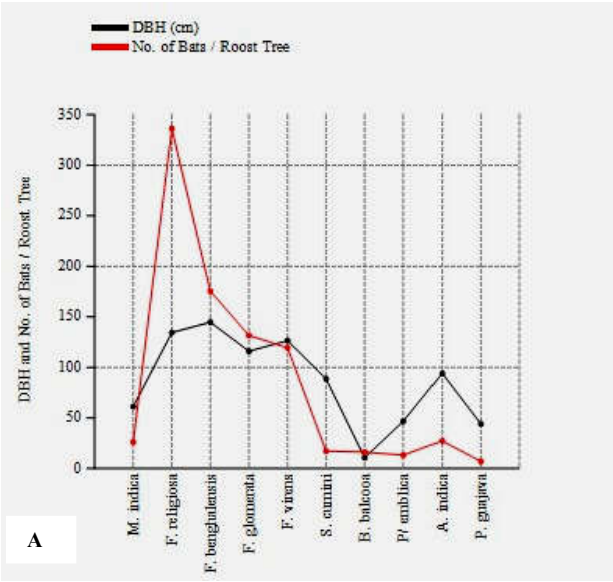
Graph 4 Details of roost trees that were used by *P. giganteus*

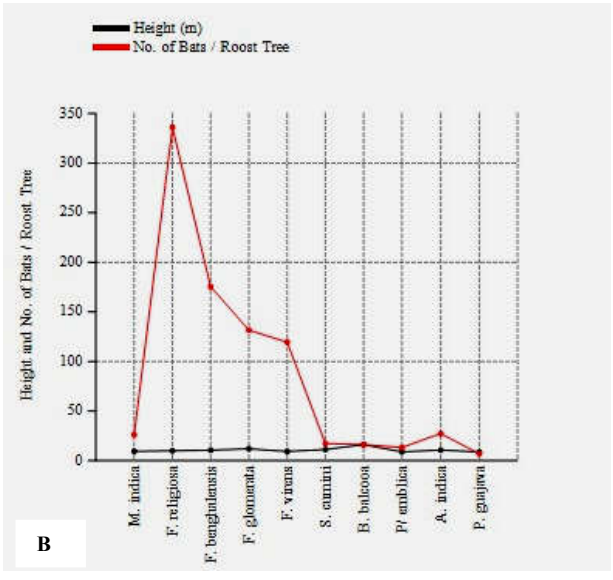


Graph 5 Details of roost tree species based on the different roosting sites. Numbers indicate no. of roost tree



Graph 6 Characteristics of the surrounding areas of *P. giganteus* day roosts in Lakhimpur - Kheri. Numbers indicate the number of day roost sites





Graph 7a & 7b Roost tree preference of *P. giganteus* based on DBH and height of roost trees

Fig 2 Roost trees [A] Mango (*Mangifera indica*), [B] Peepal (*Ficus religiosa*) [C] Bamboo (*Bambusa balcooa*) [D] Amla (*Phyllanthus emblica*) [E] Gular (*Ficus glomerata*) [F] Bargad (*Ficus bengalensis*)

Lakhimpur-Kheri district is rich in diversity of flora and fauna. Various types of tree species such as Mango (*Mangifera indica*), Gular (*Ficus glomerata*), Peepal (*Ficus religiosa*), Bargad (*Ficus bengalensis*), Pakad (*Ficus virens*), Bamboo (*Bamboo balcooa*), Jamun (*Syzygium cumini*), Neem (*Azadirachta indica*), Amla (*Phyllanthus emblica*), Amrud (*Psidium guajava*), Sagaun (*Tectona grandis*), Semal (*Bombax ceiba*), Kela (*Musa paradisiacal)*, Eucalyptus (*Eucalyptus teritocornis*), Shisham (*Dalbergia sissoo*), Chilbil (*Holoptelea integrifolia*), Kaitha (*Limonia acidissima*), Khair (*Acacia catechu*), Babool (*Acacia nilotica*), Reonj (*Acacia leucophloea*), Haldu (*Adina cordifolia*), Bel (*Aegle marmelos*), Aru (*Ailanthus exelsa*), Akol (*Alangium salvifolium*), Kala Siris (*Albizia labbeck*), Dhau (*Anogeissus latifolia*), Dhaura (*Anogeissus pendula*), Hingot (*Balanites aegyptica*), Kachnar (*Bauhinia variegate*), Salai (*Boswellia serrata*), Dhak (*Butea monosperma*), Chilla (*Casearia elliptica*), Amaltas (*Cassia fistula*), Lasoda (*Cordia oblique*), Tendu (*Diospyros melanoxylon*), Kateri (*Flacourtia indica*), Kharpat (*Garuga pinnata*), Anjan (*Hardwickia binata*), Dudhi (*Holarrhena antidysentrica*), Kanju (*Holoptelea integrifolia*), Sidha (*Lagerstroemia parviflora*), Jhingan (*Lannea coromandelica*), Rohini (*Mallotus philippensis*), Mahua (*Madhuca latifolia*), Kadamb (*Mitragyna parviflora*), Sakhu (*Shorea robusta*), Kusum (*Schleichera oleosa*), Arjun (*Terminalia arjuna*), Bahera (*Terminalia bellerica*), Asna (*Terminalia tomentosa*) and Ber (*Zizyphus mauritiana*) are found in the forests and private orchards. The above tree species provide places for roosting and fruits for feeding to *P. giganteus*.

The current study revealed the occurrence of high population of *P. giganteus* in Lakhimpur-Kheri district. The wide distribution and huge population of *P. giganteus* showed that the district Lakhimpur-Kheri has suitable habitat and diversity of flora for its survival and reproduction. The results showed that *P. giganteus* preferred to roost in larger trees having dense canopy such as Mango (*Mangifera indica*), Gular (*Ficus glomerata*), Peepal (*Ficus religiosa*), Bargad *(Ficus bengalensis*), Pakad (*Ficus virens*), Bamboo (*Bamboo balcooa*), Jamun (*Syzygium cumini*), Neem (*Azadirachta indica*), Amla (*Phyllanthus emblica*), Amrud (*Psidium guajava*). Roost tree preference by *P. giganteus* was analyzed and concluded that larger trees (greater DBH, height and dense canopy) facilitate bats to gain good protection from human interference, enable them to take-off and land more easily and also to evade predators rapidly. The larger trees are more stable and long lasting. They provide protection to bats in time of natural disasters such as high velocity wind, torrential rain, hailstorm and high intensity sun rays. The large colony size of *P. giganteus* was found in large roost trees such as *F. religiosa, F. glomerata, F. Benghalensis and F. virens.* Therefore, the larger size of trees is one of the important factors for colony size. Larger the size of trees larger the colony size of bats.

The current study concluded that there were three important factors such as roost trees (orchards/ Road sides), human habitations (Villages/ Cities) and Water bodies (Ponds/ Lakes/ Water channels/ Stream/ Rivers) that influenced the population size of bats in their day roosts. Human habitations and water bodies were of almost constant factors whereas roost trees were variable factors. Therefore, felling of roost trees or destruction of habitat adversely affect the bat population and caused its decline. On the other hand, the colony size of bats in a particular tree species depended upon a combination of two factors out of the three variable factors such DBH, height and

canopy of the roost tree. These bats preferred to roost either on trees with greater DBH and dense canopy or with greater height and DBH or with greater height and dense canopy. Destruction of large and taller roost trees adversely affected the colony size of the bats. Therefore, the current study revealed that the roost tree preference of the bats depends on the height, DBH and canopy of the tree.

During day hours, most of bats were busy in sleeping and some were actively involved in cleaning by tongue and scatching with claws as well as fighting to each other. They left their day roosts after sunset and foraged to the feeding sites. The youngones of *P. giganteus* were found feeding on fruits of their roost trees. The behaviour such as wing fanning during summer and wing wrapping as well as basking during winter is associated with thermoregulation.

The Indian flying fox, *P. giganteus* is known to live in close proximity of humans and was observed roosting in botanical gardens, cities, and villages (Chakravarthy *et al*., 2008; Krystufek, 2009). Similarly, I recorded 11 day roosts of *P. giganteus* closest to villages. Four out of its 14 day roosts were protected by owners of orchards. These bats generally preferred roost in the trees located in the middle of orchards to minimize external disturbance. These day roost sites were existed since long before (60-65 years) and then, the huge population of this species were found (inquiries with local people) but, as time passed, their population declined gradually due to destruction of private orchards and hunting. The stability and availability of roost may influence their survival, reproduction and distribution (Humphrey, 1975; Bell *et al*, 1986). Similarly, fluctuations in the population of *P. giganteus* were observed in all day roosts. Their population was gradually increased in healthy and stable day roosts whereas declined in unstable day roosts. They had to migrate to other safe places in and out of the study area. Hunting was reported in a few day roosts located at Khargapur, Jugrajpur and Bhira. The survival of *P. giganteus* was severely threatened due to human interference. The Indian flying fox, *P. giganteus* was facing a drastic decline in its population. It was found on inquiries with local people that *P. giganteus* was continue hunted for food and medicine in some day roosts. Its meat and oil were used to cure paralysis, asthma / breathing disorders and body pains in some villages.

Bats play several major ecological roles in many ecosystems. They are important mobile links as pollinators and seed dispersers (Kunz *et al*., 1995; McCracken *et al*., 1996). The decline of *P. giganteus* raised serious ecological and economic concerns. Understanding the importance of bats in the ecosystem is a key to conserve this species. In India, fruit bats are listed under Schedule V of the Indian Wildlife Protection Act, 1972 which is the only Schedule that carries no penalty or restriction at all for the killing or capturing of animals. There is an immediate need for the revision in Indian Wildlife Protection Act to remove Fruit bats from schedule V (Vermin category). Protection of roosts has been identified as a priority in conserving species of bats (Pierson, 1998). Legislation should be formulated to protect the key roosting sites of bat species. Action plans are needed to prevent the disturbance to the roosting sites and hunting of bats for food and medicinal use. To ensure the survival of *P. giganteus* population in district Lakhimpur - Kheri, its day roosts as well as feeding sites must be protected. Aware the villagers and orchard owners about their importance in balancing ecosystem, seed dispersal, regeneration of valuable trees, maintaining floral diversity and the benefits of their excrement (as natural biofertilizer) may be a good afford in their conservation. Being a mammal, we should remember that these are the only flying mammal in the world and take necessory steps to save them.

Reference

Altringham, J.D., (1996): Bats: Biology and Behaviour. Oxford University Press, New York, United Kingdom, pp. 262.

Bates, P.J.J. and Harrison, D.L. (1997): Bats of the Indian Subcontinent. Harrison Zoological Museum Publications, Sevenoaks, UK, pp. 258.

Boyles, J.G., Cryan, P.M., McCracken, G.F. and Kunz, T.H. (2011): Economic importance of bats in agriculture. Science, 332: 41-48.

Bell, G.P., Bartholomew, G.A. and Nagy, K.A. (1986): The roles of energetics, water economy, foraging behaviour and geothermal refugia in the distribution of the bat, *Macrotus californicus*. *J. Biochem. Physiol*. B., 156: 441-450.

Barclay, R.M.R. and Kurta, A. (2007): Ecology and behavior of bats roosting in tree cavities and under bark. In: Lacki MJ, Hayes JP, Kurta A (eds.) Bats in Forests, Conservation and Management: John Hopkins University Press, Baltimore, Maryland, USA, pp. 17-59.

Chakravarthy, A.K. and Yeshwanth, H.M. (2008): Status of roost of Indian fruit bat (*Pteropus giganteus*) in Karnataka, South India. CCINSA, 9: 16-18.

Cheke, A.S. and Dahl, J.F. (1981): The status of bats on western Indian Ocean islands, with special reference to *Pteropus*. *Mammalia*, 1: 205-238. en.wikipedia.org and kheri.nic.in

Fenton, M.B. (1983): Roosts used by the African bat, *Scotophilus leucogaster* (Chiroptera: Vespertilionidae). Biotropica, 15: 129-132.

Hinman, K.E. and Snow, T.K., (2003): Arizona Bat Conservation Strategic Plan. Nongame and Endangered Wildlife Program Technical Report 213. Arizona Game and Fish Department, Phoenix, Arizona.

Humphrey, S.R. (1975): Nursery roosts and community diversity of nearctic bats. *J. Mammal.* 56(2): 321-346.

IUCN SSC (2014): IUCN SSC Guidelines for Minimizing the Negative Impact to Bats and Other Cave Organisms from Guano Harvesting. Ver. 1.0. IUCN, Gland.

Krystufek, B. (2009): On the Indian flying fox (*Pteropus Giganteus*) colony in Peradeniya botanical gardens, Srilanka. Mammology, 20: 29-35.

Kunz, T.H. (1982): Roosting ecology of bats. In: Kunz TH (editor) Ecology of bats: Plenum Press, New York, USA, pp. 1-55.

Kunz, T.H., Whitaker, J.O. and Wadanoli, M.D. (1995): Dietary energetics of the Mexican free-tailed bat (*Tadarida brasiliensis*) during pregnancy and lactation. *Oecologia*, 101: 107-115.

Kunz, T.H., Thomas, D.W., Richards, G.C., Tidemann, C.R., Pierson, E.D. and Racey, P.A. (1996): Observational techniques for bats. In: Wilson DE, Cole FR, Nichils JD, Rudran R, Foster MS (eds) Measuring and Monitoring

Biological Diversity, Standard Methods for Mammals: Washington, D.C., USA, Smithsonian Institution Press, pp. 105-114.

Kunz, T.H., Lumsden, L.F. (2003): Ecology of cavity and foliage roosting bats. In: Kunz TH, Fenton MB (eds) Bat ecology: University of Chicago Press, Chicago, IL, pp. 3-89.

Kunz, T.H., Elizabeth, B.T., Dana, B., Lobova, T. and Fleming, T.H. (2011): Ecosystem services provided by bats. Annals of the New York Academy of Sciences, 1223: 1-38.

Kurta, A. (1986): Factors affecting the resting and post-flight body temperature of little brown bats, *Myotis lucifugus*. *Physiol Zool,* 59: 429-438.

Mahmood-ul-Hassan, M. and Nameer, P.O. (2006): Diversity, role and threats to the survival of bats in Pakistan. *J. Anim. Pl. Sci.,* 16: 1-2.

McCracken, G.F., Lee, Y.E., Westbrook, J. and Wole, W.W. (1996): High altitude predation by Mexican free-tailed bats on migratory insect pests. *Bat Res. News*, 37: 140-141.

Nowak, R.M. (1994): Walkers Bat's of The World. Baltimore and London, The Johns Hopkins University Press.

Pierson, E.D. and Rainey W.E. (1992): The biology of flying foxes of the genus Pteropus: a review. In: Wilson DE, Graham GL (Eds) Pacific Island Flying Foxes: Proceedings of an International Conservation Conference held at Washington, D.C.: US Fish and Wildlife Service Biological Report, 90: 1-17.

Pierson, E.D., Elmqw, T., Rainey, W.E. and COX, P.A. (1996): Effects of tropical cyclonic storms on flying fox populations on the South Pacific islands of Samoa. *Conservation Biology*, 10(2): 438-451.

Pierson, E.D. (1998). Tall trees, deep holes and scarred landscapes: conservation biology of North American bats. In: Kunz TH, Racey PA (eds) Bat biology and conservation: Smithsonian Institution press, Washington, D.C, pp. 309-325.

Richmond, J.Q., Banack, S.A. and Grant, G.S. (1998): Comparative analysis of wing morphology, flight behaviour and habitat use in flying foxes (Genus: *Pteropus*). *Australian Journal of Zoology* 46: 283-289.

Schipper, J., Chanson, J.S. and Chiozza, F. (2008): The status of the world's land and marine mammals: diversity, threat, and knowledge. Science, 322: 225-230.

Simmons, N.B. (2010): Personal Communication. American Museum of Natural History. New York.

Srinivasulu, C. and Srinivasulu, B. (2001): Bats of the Indian subcontinent. *Current Science*, 80 (11): 1378-1380.

Vendan, S.E. (2003): Roost and diet selection in the Indian Flying Fox, *Pteropus giganteus* (Megachiroptera). MSc, Madurai Kamaraj University, Madurai, India.

Wiles, G.L. and Fujita, M.S. (1992): Food plants and economic importance of flying foxes on Pacific Islands. In: Wilson DE, Graham GL (eds) Pacific Island flying foxes: Proceedings of an International Conservation Conference held at Washington, D.C: USF&WS Biological Report, 90(23): 24-35.

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