STATUS AND THREAT OF THE INDIAN FLYING FOX (*Pteropus giganteus* Brünnich, 1782) IN LOWLANDS OF EASTERN NEPAL

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NEPAL

APRIL 2015

DECLARATION

I hereby declare that the work presented in this thesis has been done by myself and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

Date April 10, 2015 …….

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RECOMMENDATION

It is my pleasure to mention that the thesis entitled **Status and threat of the Indian Flying Fox (*Pteropus giganteus* Brünnich, 1782) in lowlands of eastern Nepal** has been carried out by **Mr. Kaustuv Raj Neupane** for the partial fulfillment of the requirements for the Degree of Master of Science in Zoology with special paper Ecology and Environment. This is his original work which has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions. I recommend that the thesis be accepted for the Degree of Master of Science in Zoology - **Ecology and Environment.**

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LETTER OF APPROVAL

On the recommendation of supervisor **Prof. Dr. Khadga Basnet** this thesis submitted by **Mr. Kaustuv Raj Neupane** entitled **Status and threat of the Indian Flying Fox (*Pteropus giganteus* Brünnich, 1782) in lowlands of eastern Nepal** is approved for examination and submitted to Tribhuvan University in partial fulfillment of the requirements for the Degree of Master of Science in Zoology with special paper **Ecology and Environment.**

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EVALUATION COMMITTEE

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ABSTRACT

The Indian Flying Fox (*Pteropus giganteus)* is a large, social, colonial and known fruit bat species of Nepal. Population estimation of the species was carried out in spring, summer and autumn season in Sunsari, Morang and Jhapa districts of eastern Nepal in 2012. I used exact count method for small population (< 300), branch estimation for larger population (< 300), and identification of trees of roosting. Threats to the animal were identified with discussion with the local people near the area. Altogether, five colonies of the Indian Flying Fox were reported, one in Sunsari (Army Camp Eastern Division, Ithari) and one in Jhapa (Kerkha), and three in Morang (Dangra-4, CDO office and Golchha house in Biratnagar). The highest number of the Indian Flying Fox was observed in Army Camp area and the least in CDO office. There was significant difference (χ^2-116, df=104, P<0.01, α=0.05) in populations of the Indian Flying Fox in different lowlands sites of eastern Nepal. However, seasonal variation was insignificant (χ^2-30, df=28, P>0.3, α=0.05). The mean tree height was moderately correlated (r = 0.59) with the mean number of roosting bats of the area. Eleven species of trees (10 in Kerkha, eight in Army Camp Eastern Division, nine in Dangra, six in Golchha hosue and two in CDO office) were used for roosts, where Sisoo (*Dalbergia sisso*), Simal (*Bombax ceiba*), Teak (*Tectona grandis*), Peepal (*Ficus religiosa*), Mango (*Mangifiera indica*) and Jamun (*Eugenia formosa*) were common in all areas. Habitat destruction and human disturbances were the major threats to the Indian Flying Fox. Besides pesticides, electrocution, hunting for meat and medicine were the serious threats to the survival of the Indian Flying Fox. Detail and comprehensive study is needed to explore the current status of the Indian Flying Fox from different parts of Nepal.

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1 INTRODUCTION

1.1 Background

Many of the less known taxa such as bats are receiving less protection and attention to scientific community. They are facing considerable threats and leading to higher probability of endangerment. Bat species make up 53 out of 208 species almost quarter of all mammal species found in Nepal (Thapa 2010, Janwali et al. 2011). Among them 10 percent of bat species are considered threatened with a further six percent considered as near threatened. Forty percent is considered data deficient. It is difficult to assess whether a species requires any conservation measures without reliable population estimates. That is, unless one cannot show that a population is declining or under threat of decline, one cannot create a plan to conserve it. The Indian Flying Fox (*Pteropus giganteus*) is an ideal first candidate to study population trends because it is

i. the only large pteropodid on the subcontinent and is easily identified
ii. visible during day
iii. large and easy to count
iv. often roosts near humans
v. often easy to acquire historical information about roost from locals (like age of roost, behavior of the animals and population trends)

Initiation for the population estimation is the most essential of the bats. According to the IUCN the population of the Indian Flying Fox is declining. This species is assumed to be locally threatened by cutting down of roosting trees because of road expansion or other purposes. They are hunted for meat and medicine in different places (Molur et al. 2008, Ali 2010).

1.2 Indian Flying Fox

The Indian Flying Fox is a large fruit bat and well known bat species from Nepal (Jnawali et al. 2011). It has a chestnut brown color and has large black ears, with tan or orange belly and blackish brown hairs on the back (Baral and Shah 2008). The hairs on the belly are most

Taxonomy

Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Chiroptera
Family	Pteropodidae
Genus	*Pteropus*
Species	*giganteus*

variable in colour, apparently independent of sex, age or season, ranging from pale tan to a deep orange-red or chestnut brown. On the nape of the neck and mantle, it varies from light yellowish tan to a deep chestnut brown which is sparsely paler than the belly. It is relatively darker around the eyes and mouth. The snout is long and hairy throughout with two well developed nostrils. The first digit (thumb) has a large claw: the claw of the second digit is small. The feet are large and have very robust claws. There is a clear line of demarcation on the shoulders between chest nut hairs of the head, neck and mantle and the dark hairs of the dorsum. The patagium develops from sides of dorsum and back of second toe and has no external tail (Gaikwad et al. 2012). The proximal ends are closed to each other and are slightly curved dorsally forming a notch on the base (Agrawal and Sinha 1973). The baculum is large and semicircular, enclosing a heart shaped space and give birth to young one in between April to early June (Bates and Harrison 1997).

The Indian Flying Fox has a wide spread distribution, found in Pakistan, Nepal, India, China, Maldives, Sri Lanka, Bhutan, Myanmar (Molur et al. 2008, Jnawali et al. 2011; Vendan and Kaleeswaran 2011). It is widely distributed in most of Nepal, including different patches of Kathmandu valley, Kerkha in Jhapa, Saptari and Prakashpur in Sunsari and Biratnagar in eastern lowlands, Kaski, Dang, Taulihawa (Kapilvastu district) and Palpa district (Jnawali et al. 2011). They are usually distributed from 65m to 1500m asl (Baral and Shah 2008).

The Indian Flying Fox is a colonial species (Vendan and Kaleeswaran 2011). They roost in large colonies of hundreds or even thousands of individuals, both in rural and urban gradients of well established trees prior to ponds, agricultural land, roads and forests (Jnawali et al. 2011). To defecate, individuals hang upside down using the claw on each. They prefer Red Cotton Tree (*Bombax ceiba*), Shisoo (*Dalbergia siisoo*), Bar (*Ficus bengalensis*), Mango (*Mangifera indica)* and Tamarind (*Tamarindus indica*) (Sinha 1980, Vendan and Kaleeswaran 2011).

The Indian Flying Fox is the least concern both in national and global scenario (Jnawali et al. 2011, IUCN 2012). However, their populations are rapidly decreasing and are being localized but major threats are still unknown. It has not been studied.

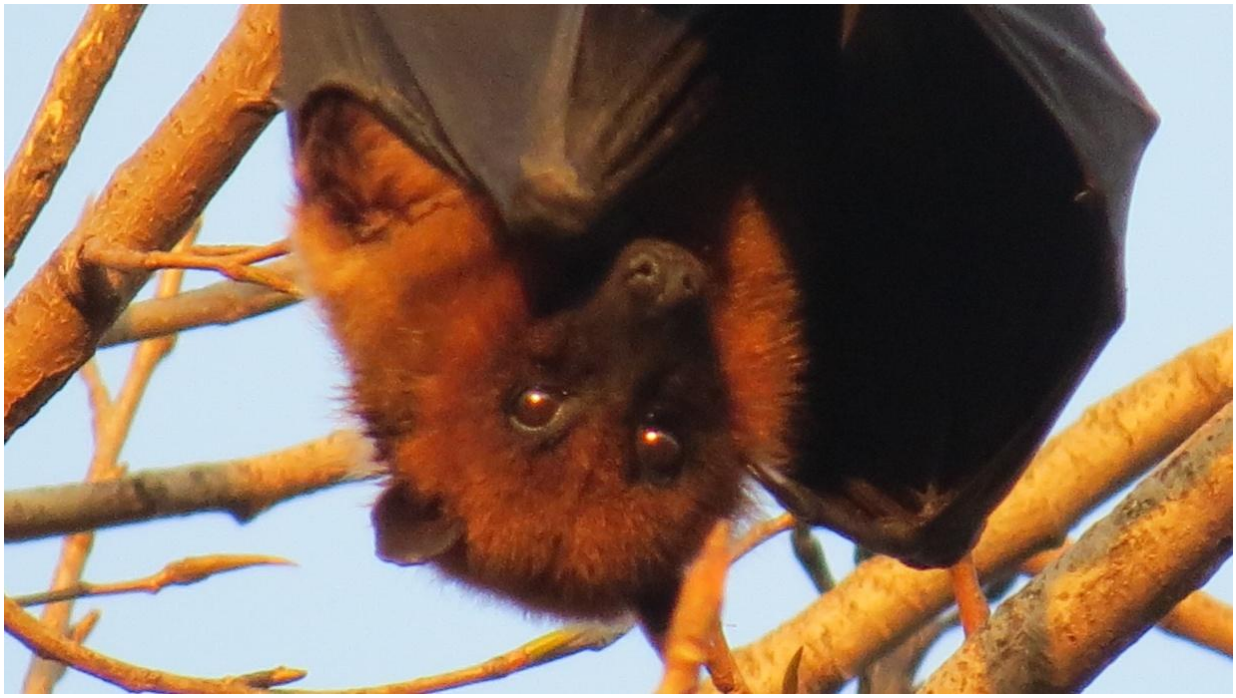

Photo 1 Indian Flying Fox

Photo 2 Dorsal view of the Indian Flying Fox

1.3 Objective of the study

The main objective of this research was to investigate the present distribution and population status of the Indian Flying Fox in lowlands of eastern Nepal. The specific objectives were to examine:

- The roost size and major roosting trees of the Indian Flying Fox
- Seasonal variation in number of individuals of the Indian Flying Fox
- Major threats to the Indian Flying Fox

1.4 Justifications and Limitations

The main habitat for this species ranges in south Asia and this species is enlisted in the CITES Appendix II. The main aim of estimation of population of the Indian Flying Fox is to review status of population, to understand current trends, and to identify critical gaps in knowledge concerning its population trends. Direct mortality of both young and adult bats through exposure to persistent pesticides in the food chain has been well documented in the U.S. including endangered species (Geluso et al. 1976, Clark et al. 1978, Clark 2001, O'Shea and Clark 2002). Similarly, using of pesticides in the fruit trees like banana (*Musa paradisiaca*), litchi (*Litchi chinensis*), mango, and Guava (*Psidium guajava*) is found in the study area and it has not been investigated. The Indian Flying Fox roosts in the tree like Mulberry Tree (*Bombyx mori),* Shisoo and these trees are being cut down with the rapid urbanization causing a threat to its population. In addition to this, using for medicinal purpose and food by indigenous people are the other threats. The awareness in indigenous group may enhance their knowledge regarding the importance of the Indian Flying Fox, which may help to reduce threats. Thus, this research work was carried out to study the population status and threats pertaining to the Indian Flying Fox in eastern lowlands of Nepal.

The present study only includes the status and distribution of the Indian Flying Fox from lowlands of eastern Nepal in only three seasons during the year 2012.

2 LITERATURE REVIEW

Till date, 1117 species of bats have been recognized worldwide: Almost a quarter of all known mammalian species but South Asia harbors only 119 species (Srinivasulu et al. 2010). Usually these bats are grouped into two suborders- the Megachiroptera (frugivore bats) consisting 186 species in one family Pteropodidae and the Microchiroptera (insectivore bats) consisting 931 species in 17 families (Mickleburgh et al. 2002, Srinivasulu et al. 2010). The Indian Flying Fox is the largest and well known species of bats in Nepal (Baral and Shah 2008).

2.1 Roosting size and distribution of the Indian Flying Fox

The Indian Flying Fox was abundantly distributed in most part of Nepal in the past. A colony of around 5000 individuals was recorded from Kerkha, Jhapa district (Jnawali et al. 2011). But at present, their population is gradually decreasing from last five years from most of the area (Janwali et al. 2011). The Indian Flying Fox is dramatically declining from the Kathmandu valley, Pokhara valley, Tansen municipality and extirpated from Argalli VDC of Palpa district. Now, they are localized in Jhapa (Kerkha and Taaghundubba), Saptari, Sunsari (Ithari and Prakashpur) in eastern development region, Kathmandu and Bhaktapur in central development region and Kaski, Dang, Kapilvastu (Taulihawa) and Palpa in western development region of Nepal. Two permanent tree roosts of the Indian Flying Fox were found in Madanpokhara Valley and Tansen Municipality (Adhikari 2011). Timalsina and Ghimire (2011) estimated 983 individuals of the Indian Flying Fox in 62 tress in Jamal Kathmandu section. Thapa (2008) reported 400 individuals in Prakashpur VDC and 500 individuals in Tanmuna VDC, Sunsari and also 200 in Pathari VDC, 300 in Rajdevi temple, Rajbiraj, 400 in Gadiyadhuri village, of Saptari mostly from Red Cotton Tree. He also reported considerable number of colonies from Kerkha Jhapa, Golchha house, Biratnagar.

Most species of Flying Fox are highly social which form colonies of hundreds to cover million individuals (Eby 1991, Parry-Jones and Augee 1992)**.** Kryštufek (2009) reported 24480 individuals of bat in 20 hectares in September 2002 in Peradeniya Botanical Gardens, Sri Lanka. For the first time, Gaikward et al. (2012) recorded 16 colonies of the Indian Flying Fox with 100-500 individuals from Maharastra sate. Similarly, Ali (2010) reported 47% loss (547 to 287) in number of the Indian Flying Fox in a decade in western Assam.

Ali (2010) reported roosting tree species of the site were Yellow Flame Tree (*Caesalpinia inermis)*, Bar, Peepal, Cluster Fig Tree (*F. glomerata)*, Indian Blackberry (*Eugenia jambolana*), Sational (*Alstonia scholaris),* Eucalyptus (*Eucalyptus globossus)*, Indian Fir Tree (*Polyalthiya longifolia)*, Mango and Jack Fruit (*Artocarpus heterophyllus)*. But the major roosting tree species used by the Indian Flying Fox individuals were Yellow Flame Tree, Bar, Peepal and Indian Blackberry. Gaikward et al. (2012) also observed Figs (*Ficus* spp.), Mango and Tamarind as major roosting tress. However, Vendan and Kaleeswaran (2011) found major dominating tress like Asian Palmyra Palm **(***Borassus flabellifer)*, Cashew *(Anacardium occidentale)*, Indian Oleander *(Nerium indicum)*, Date Palm *(Phoenix dactylifera)*, Mesquite *(Prosopis juliflora)* and Butter Tree *(Madhuca indica)* in Madurai region in India. This signifies that roosting trees largely vary from place to place which depends on availability of trees.

2.2 Seasonal variation in number of Individuals of the Indian Flying Fox

The Indian Flying Fox is a seasonal migrant. The species is frugivore (Baral and Shah 2008) and seasonal variation largely depends on the availability of fruiting tress (Khan 2001). Gaikward et al. (2012) observed migration of the Indian Flying Fox to several kilometers for foraging from their roosting sites, simultaneously helps in the seed dispersal and pollination (Shilton et al. 1999, Ali 2010, Vendan and Kaleeswaran 2011).

2. 3 Threats to the Indian Flying Fox

The Indian Flying Fox is highly economical and ecologically important fruit bat species (Ali 2010). However, in recent years, deforestation, electrocution and hunting have massively reduced the population of the Indian Flying Fox (Ali 2010). It is more influenced by rapid urbanizations, which are narrowing their roosting habitat. The road expansion for larger highways and construction of new buildings are also threatening its roosting habitat (Srinivasulu and Srinivasulu 2004, Molur et al. 2008). The renovation of old house caves and temples were also threatening the survival of the Indian Flying Fox (Gaikward et al. 2012). They are hunted for meat as people think it as a cure of asthmatic diseases (Ali 2010). Extreme use of pesticides, insecticides and other poisonous substances in agricultural field causes loss of species and population of bats (Eidels 2010).

3 MATERIALS AND METHODS

3.1 Study Area

The study area included three districts (Sunsari, Morang and Jhapa) of lowlands of eastern Nepal. The area has dense human settlements. Sunsari lies in Koshi zone and with an area of 1,257 km² with Inaruwa as district headquarters. Similarly, Morang lies in Koshi zone with an area of 1,855 km² and Biratnagar is its district headquarters. However, Jhapa lies in Mechi zone with an area of 1,606 km²,Bhadrapur being its district headquarters. The specific study sites are

a. Army Camp Eastern Division (Sunsari) : This study site lies in Ithari Municipality along the Dharan Road. Houses are close to highway and backyard area is dominated by agricultural land.
b. CDO office and Golchha House: These sites lie in built up area of Biratnagar Municipality. Easy access to these sites is restricted.
c. Dangra, Morang: This study site lies in Jamandir Tole of Dangra VDC. Bats reside in the tree planted at the edeges of Pond. Tharu community is resides in this area.
d. Kerkha, Jhapa: This lies in Topgachhi VDC along East west Highway in the premises of Ratuwamai A-forestation Project Office.

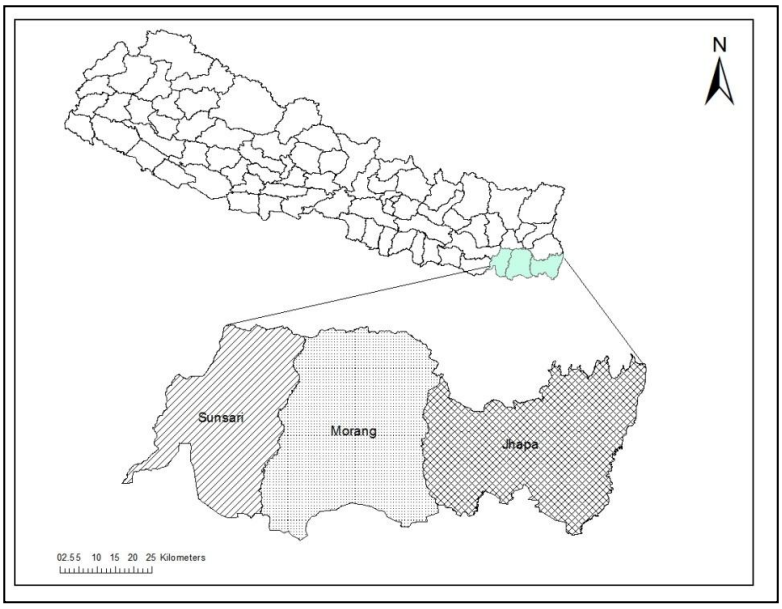

Figure 3.1 Study area (districts) in eastern Nepal

3.2 Climate

The climate of study area is tropical monsoon. Annual average temperature, rainfall and relative humidity of Sunsari district are 27.3^0C (max.), 20.44^0C (min.), 225.875 ml, and 75% respectively whereas annual average temperature, rainfall and relative humidity of Morang district are 30.61^0C (max.), 19.85^0C (min.) and 108.22 ml, 73 % respectively (DHM 2010).

3.3 Fauna and Flora

The eastern lowlands of the terai are getting sub urbanized and urbanized at rapid rate. Animals like Small Indian Mongoose (*Herpestes auropunctatus),* Indian Grey Mongoose (*Herpestes edwardsi),* Golden Jackal (*Canis aureus),* Rhesus Macaque (*Macaca mulata),* Tarai Grey Langur (*Semnopithecus hector),* House Rat (*Rattus rattus),* Porcupine (*Hystrix* spp.) and Small Indian Civet (*Viverriculata indica)* etc are frequent. Similarly, common birds are House Sparrow (*Passer domesticus),* House Crow (*Corvus splendens),* Red Vented Bulbul (*Pycnonotus cafer*), Dove (*Streptopelia* spp.), Cattle Egret (*Bubulcus ibis),* Parakeets (*Psittaculata* spp.), Black Drongo (*Dicrurus macrocercus),* Common Myna (*Acridotheres tristis)* etc. The common herpeto fauna are Cobra (*Naja naja),* Rat Snake (*Ptyas mucosus),* Banded Krait (*Bungarus fasciatus),* Frogs *(Rana* spp.*),* Lizard (*Hemidactylus* spp.).

- Different species of fruiting and other plants can be found in the area. Banana (*Musa paradisiacal),* Coconut (*Cocos nucifera*), Mango, Litchi (*Litchi chinensis*), Palm tree (*Borassaus flabellifer*), Paddy (*Oryza sativa*), Maize (*Zea mays*), Mustard (*Barassica rapa*), Garden pea (*Pisum sativum*), Papaya (*Carica papaya*), Sugarcane (*Saccharum officinarum*) and Wheat (*Triticum aestivum*) are the major crops, whereas Shisoo, Sal Tree (*Sorea robusta*), Red Cotton Tree , Bar Tree, Wild Cinchona (*Anthocephalus chinensis*), Peepal, Teak (*Tectona grandis*), Ashok (*Saraca Asoca*), Custard Apple (*Annona squamosa*), Eucalyptus (*Eucalyptus citriodra*) and Rudrakshya (*Elaeocarpus sphaericus*), Mango, Jack Fruit, Indian Blackberry,etc. are major trees.

3.4 Survey methods

3.4.1 Reconnaissance survey

Reconnaissance survey was done to find the colonies of the Indian Flying Fox based on the literature and discussion with the local people in the three districts of eastern Nepal. Survey was done in March 2012. Colony sites mentioned in various literatures were visited. In addition, people at major settlement, were asked to find out if they have observed Colonies of the bat.

3.4.2 Field design

Five major roosting areas were identified in the lowlands of eastern Nepal. The areas included one each from Sunsari (Army Camp Eastern Division (Ithari)) and Jhapa (Kerkha) and three sites from the Morang district (Dangra-4, Golchha house Biratnagar and CDO office at Biratnagar). The Indian Flying Fox was monitored in day time in three different seasons, spring (April), summer (June) and autumn (September) in 2012.

3.4.2.1 Population estimation

Bats are more active and change their location during dusk and dawn, so day roost count is important to minimize the chance of missing or multiple counts. The population estimation was done by following methods based on the visual count of the roosting bats protocol designed by South Asian Bat Monitoring Programme: The Indian Flying Fox Population Monitoring Project (**http://www.pterocount.org/**) (Annex II):

- **Exact method:** Small roosts (300 or less individuals) were counted with this method where number of bats on individual branches were counted and summed to know the exact number of bats across all the trees.

- **Estimation method:** For larger roosts (more than 300 individuals), I used estimation method (branch estimation) to count each and every bat individuals roosting in each major branch of the tree. Here, a branch with an average number of bats was picked up and counted multiplied by total number of branches occupied by bats.

3.4.2.2 Threats assessments

Threats pertaining to the Indian Flying Fox were assessed by following methods:

- **Observation:** Observation method was followed in the colony site to assess the threat. In this method the observation of electric transmission line, human disturbance activities, development activities as road construction (if any) in close affinity of the roosting site was observed.
- **Schedule method:** A schedule was prepared to assess the threats and the perception of people toward the Indian Flying Fox. All together 45 respondents residing nearby roosting sites were interviewed using the same questionnaire (Annex III).
- **Key informant survey:** Informal interviews were conducted with the key informants who included local leaders, indigenous people, school teachers, agriculturist, NGOs working in the indigenous community, forest user group members, farmers and local people.

3.5 Data analysis

The total number of individuals of the Indian Flying Fox counted in one area was considered as a population of the area (Ali 2010). Chi- square tests were performed to examine the population and seasonal variation of the Indian Flying Fox in all the area during the study period. Pearson correlation was calculated between mean tree height of the area and mean total number of the Indian Flying Fox estimated during the study period. R Console version 2.15.2 (R Development Core Team 2012) was used for performing all the analysis and producing the box plots and excel was used to produce the bar plot. Threats data were analayzed quantitatively and were presented in bar graphs with calculated of percentages.

4 RESULTS

4.1 Roosting size and distribution of the Indian Flying Fox

Five colonies of the Indian Flying Fox were located in the study area. Three colonies in the Morang district and a single colony each on Sunsari and Jhapa districts (Figure 4.1). In Morang district colonies were located at Chief District Office premises, Golchha House and Jamindar Tole, Dangra Village Development Committee. Similarly, colonies were located at Army Camp Eastern Division and Kerkha of Sunsari and Jhapa districts.

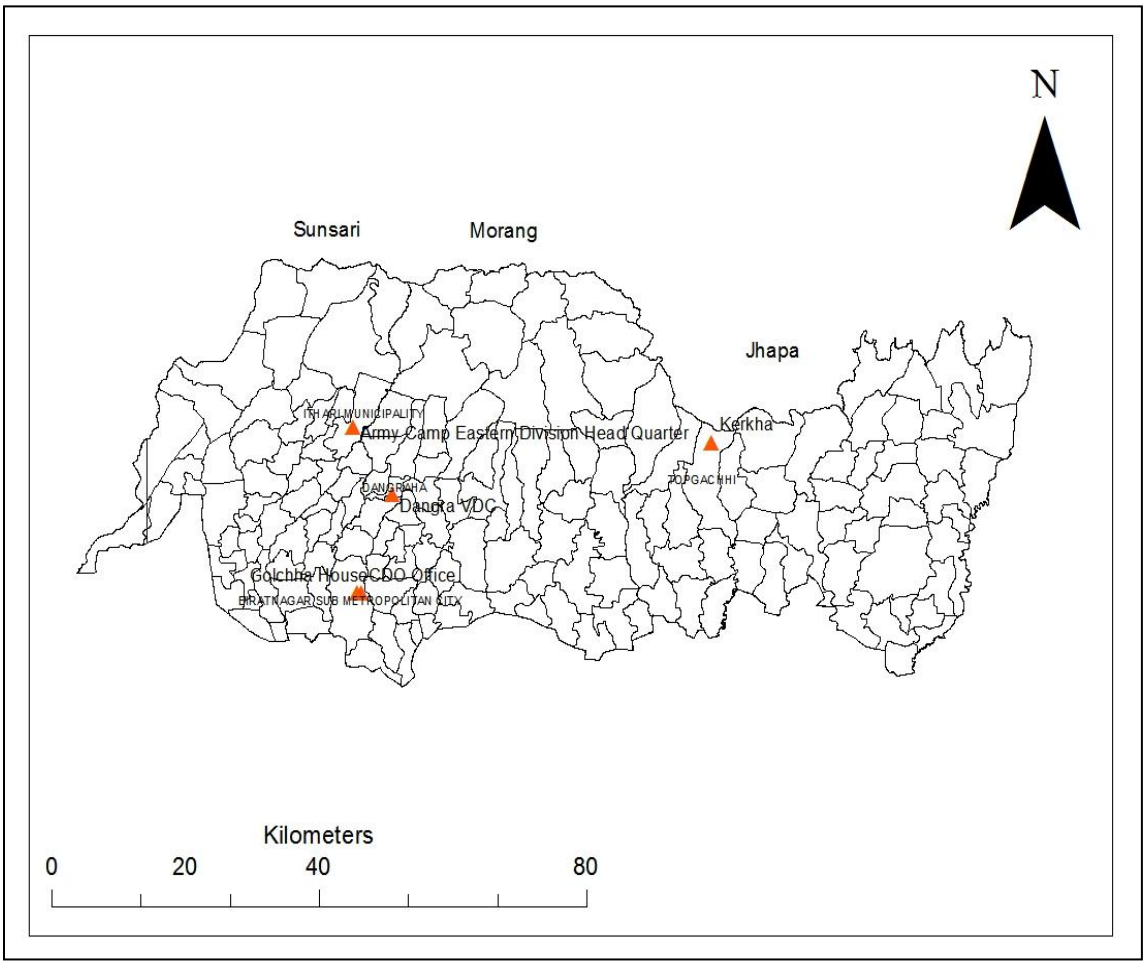

Figure 4.1 Map of Roosting Sites of the Indian Flying Fox.

The roosting size of the Indian Flying Fox varied within the study area. On an average of total 30 visits (6 visit in each roosting site), altogether 4722 individuals of the Indian Flying Fox were observed in the study area. The population was the highest in Army Camp Eastern Division with

1902 individuals and the least in CDO office with 71 individuals (Annex I). However, there was a significant difference in population of the Indian Flying Fox in different study area of eastern Nepal (χ^2-116, df=104, P<0.0.1, α=0.05) (Figure 4.2).

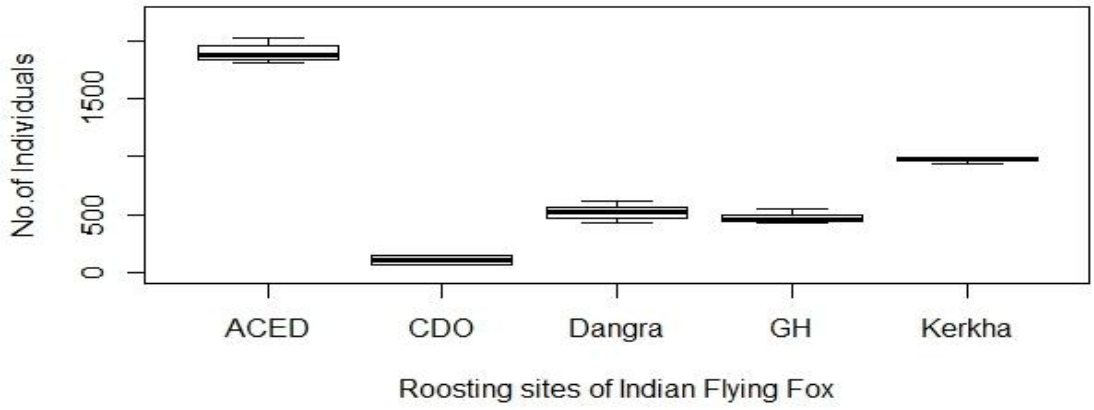

Figure 4.2 Roosting sizes of the Indian Flying Fox in lowlands of eastern Nepal (ACED-Army Camp Eastern Division, Ithari, CDO-Chief District Office, Biratnagar, GH-Golchha House and Morang)

4.1.1 Tree preferences

The roosting sites varied and largely depended on the tress associated within the area. Altogether, 11 species of trees were used for roosting, 10 in Kerkha, eight in Army Camp Eastern Division, nine in Dangra, six in Golchha house and two in CDO office (Figure 4.3). The trees preferred by the Indian Flying Fox for roosting in different areas were:

- Army Camp Eastern Division Head quarter: Shisoo, Red Cotton Tree, Teak, Indian Blackberry, Peepal, Litchi, Jack Fruit and Mango.
- Dangra-4, Morang: Shisoo, Red Cotton Tree, Teak, Indian Blackberry, Peepal, Litchi, Jack Fruit, Mango and Bar Tree.
- Golchha House, Biratnagar: Ashok, Coconut, Litchi, Custard Apple, Peepal and Red Cotton Tree.
- Kerkha, Jhapa: Shisoo, Red Cotton Tree, Teak, Indian Blackberry, Peepal, Litchi, Jack Fruit, Mango, Eucalyptus and Rudrakshya.
- CDO Office: Peepal and Teak.

Moderate correlation (r = 0.59) was observed between the mean height of the roosting trees with the mean individuals of the Indian Flying Fox in the study area.(Annex I).

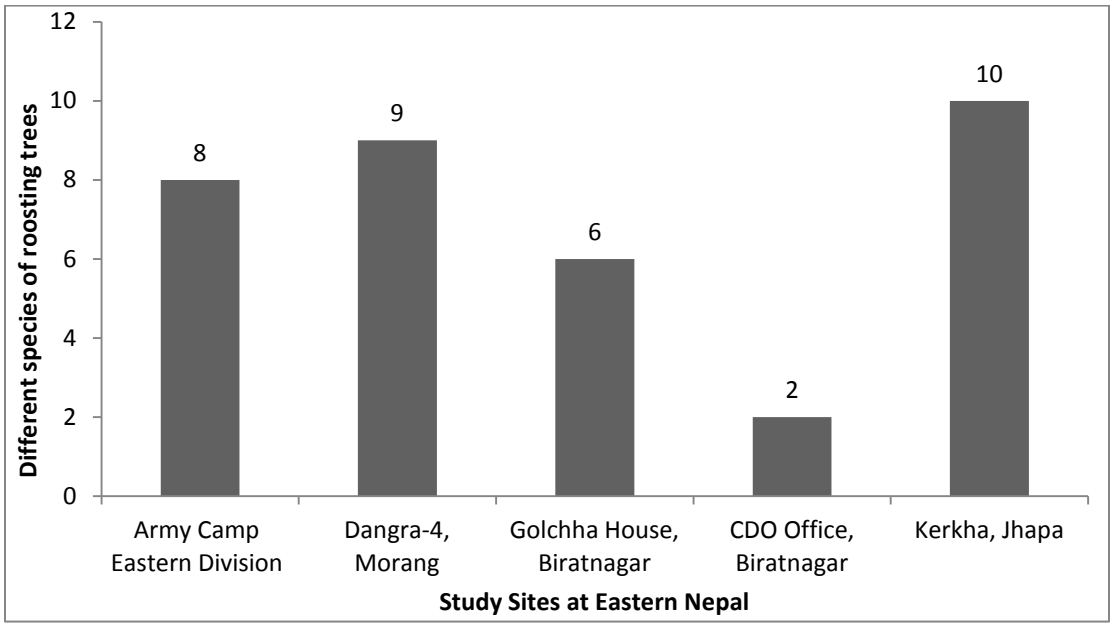

Figure 4.3 Number of different trees species occupied for roosting by the Indian Flying Fox in the area.

4.2 **Seasonal variation in number of the Indian Flying Fox**

Most of the Indian Flying Fox were residential in the area. The number of individuals remained almost the same in different seasons in the year 2012. Higher number of the Indian Flying Fox was observed in autumn (average 847.2 individuals) while the least in spring season (average 756.6 individuals) (Figure 4.4). However, no Indian Flying Fox was observed in CDO office in spring. There was an insignificant variation in individuals of the Indian Flying Fox in three different seasons (χ^2 =30, df=28, P>0.3, α=0.05).

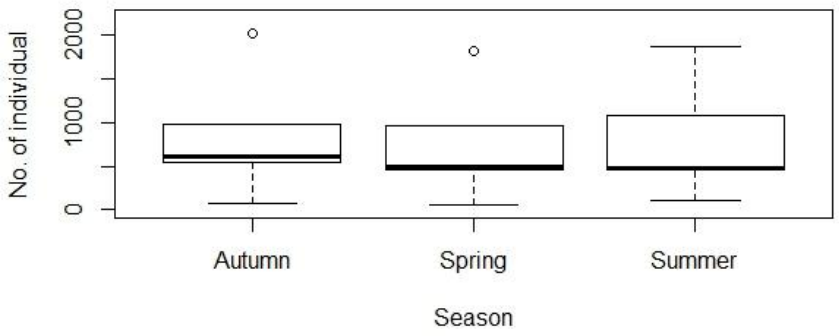

Figure 4.4 Roosting sizes of the Indian Flying Fox in different seasons

4.3 Threat Assessments

4.3.1. Ranking of the anthropogenic threats

Majority of the respondents (60%) ranked habitat loss as the major threats. However, respondents did not think significant difference between human disturbance (27%) and electrocution (18 %) as threats. Fruit poisoning was not considered as threat (Figure 4.5). In Prakashpur of Sunsari Colony of the Indian Flying Fox had disappeared after cutting down of the rooting tree.

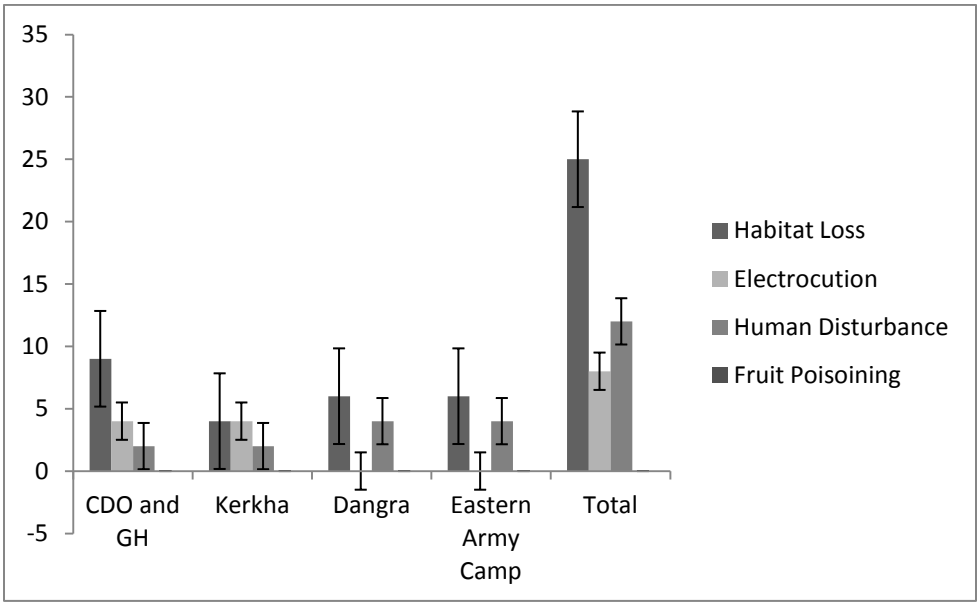

Fig 4.5 Ranking of anthropogenic threats by the respondents

4.3.2. Hunting and selling of the Indian Flying Fox

Almost 96 % of respondents did not notice selling of the Indian Flying Fox in the market but almost 89% observed killing of them (Table 4.1)

Table 4.1 Status of Hunting and Selling of the Indian Flying Fox

Roosting sites	Selling of bats In market		Observation of killing Bats	
	Yes	No	Yes	No
CDO and GH	2	13	12	3
Kerkha	0	10	10	0
Dangra	0	10	10	0
Army Camp Eastern Division	0	10	8	2
Total	2	43	40	5

4.3.3. Reasons for hunting of the Indian Flying Fox

Several reasons were identified for hunting of the Indian Flying Fox. They included medicinal value, food value and entertainment. About 50% respondents considered medicinal value as the main cause of hunting and 20% considered hunting was for meat. However, large section (28%) respondents of the community did not know why the Indian Flying Fox were hunted. More than two percent of respondents thought entertainment was the cause of hunting of bats (Figure 4.6).

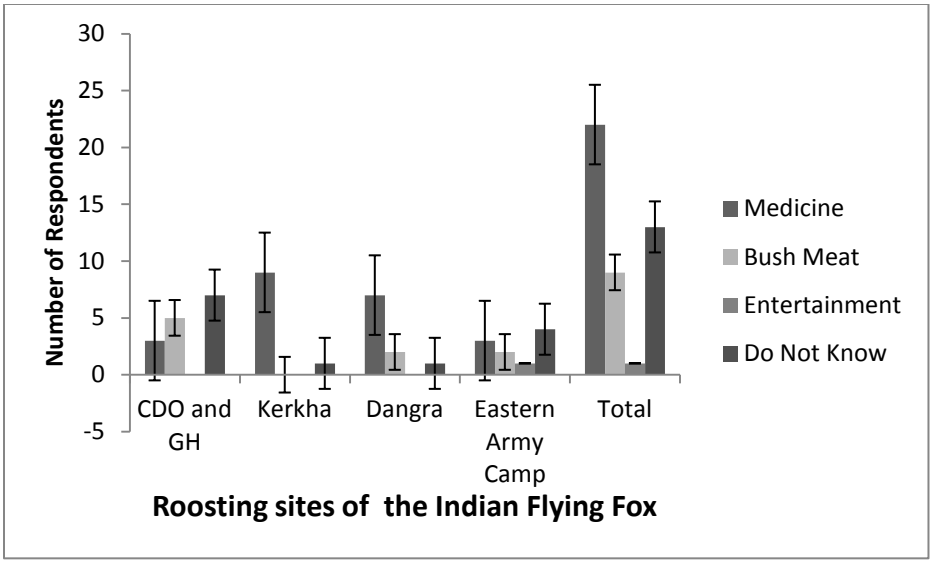

Figure 4.6 Reasons for killing the Indian Flying Fox

4.3.4. People perception about population status, importance and attitude towards Conservation of the Indian Flying Fox

There was a mix opinion about the population status of the Indian Flying Fox. More than 42% of the respondents thought that the population of the Indian Flying Fox was increasing in contrast 47% of the respondents claimed population was decreasing. Five respondents (11 %) said they did not notice the population status. Every respondent said that they have observed the colonies of the Indian Flying Fox. A minor group of respondent's i.e 11% reveled they have not noticed about population status of the species.

More than 40 % respondents did not know the importance of the Indian Flying Fox however 38% people thought they are ecologically important, and 16% respondents thought they have medical importance. 4% respondents considered the Indian Flying Fox of religious importance (Figure 4.7).

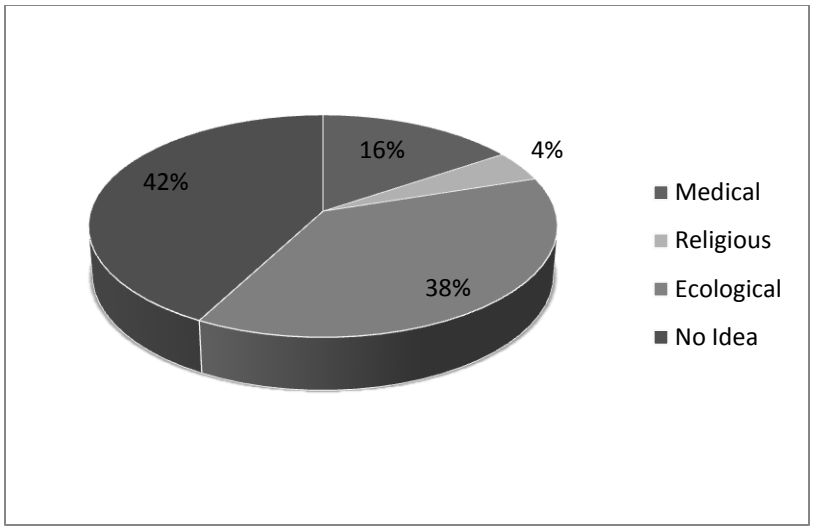

Figure 4.7 Perceptions of respondents about importance of the Indian Flying Fox.

Significant portion of the respondent showed positive attitude towards need for conservation of the Indian Flying Fox. More than 73% respondents were positive towards the need of conservation of the Indian Flying Fox in contrast only 16 % respondent was against need for conservation of the species. 11% of respondents were neither in favors nor disfavor to question regarding need for conservation of the Indian Flying Fox.

5. DISCUSSION

5.1 Roosting size and distribution of the Indian Flying Fox

The Indian Flying Fox are large colonial species with few hundred to thousand individuals (Rainey and Pierson 1992). Highest number of bats (1902 individuals in 50 trees in average) was recorded in Army Camp Eastern Division Headquarters, Ithari, Sunsari and the least in CDO office (71 individuals in 3 trees in average), Biratnagar, Morang. The Army Camp Eastern Division has large forest and was less disturbed one than other areas. However, only eight different fruiting and annual trees were used for roosting that supported larger number of bats. But in case of CDO office, Biratnagar, maximum five trees of two species were chosen for roosting. Indeed, strong and stable population of the Indian Flying Fox was also observed in Kerkha, Jhapa. In average, 968 individuals of the Indian Flying Fox were recorded in 26 trees of 10 different species. The Indian Flying Fox were observed higher in the site where people's movement was less and distance between the trees. Thapa (2008) had also recorded two colonies of the Indian Flying Fox from Golchha house and three colonies from CDO office. Similarly, considerable population of the Indian Flying Fox was also recorded from Dangra-4, (521 individuals in eight tees in average) and Golchha house (475 individuals in 6 trees in average), Biratangar, Morang. A colony of the Indian Flying Fox was not observed in Prakashpur, Sunsari, during this study period though it was observed in 2007 (Thapa 2008). The size of the colony varies with seasons and places. Gaikward et al. (2012) observed 16 colonies with 100-500 individuals. But in my study, I observed five colonies where the number of individuals varied sharply from 65-2200 whereas Kryštufek (2009) reported 10-1200 the Indian Flying Fox with 50 per tree in 20 ha at Peradeniya Botanical Gardens near Kandy, Sri Lanka. Ali (2010) reported 47.53% reduction in the size of the Indian Flying Fox within the decade from 2001-2010 in Assam, India. The mean height of the roosting trees was moderately correlated($r = 0.59$) with the mean number of roosting bats. The taller trees were safe to roost against different predators like cats.

Eleven different species of trees were utilized by the bats, ten in Kerkha, Jhapa, eight in Army Camp Eastern Division, nine in Dangra, Morang, six in Golchha house and two in CDO office. The most common trees preferred for roosting were Shisoo, Red Cotton Tree, Teak, Peepal, Litchi,

Mango and Indian Black Berry. However, Vendan and Kaleeswaran (2011) reported 21 species of plants used for roosting during day camp where Asian Palmyra Palm, Cashew, Indian Oleander, Date Palm, Mesquite and Butter Tree were dominant one. Thapa (2008) reported Red Cotton Tree, Shisoo, and Mango as the major roosting trees. Similarly, Ali (2010) reported Yellow Flame Tree, Bar Tree, Peepal and Indian Black Berry as major roosting trees.

5.2 Seasonal variation in number of individuals of the Indian Flying Fox

The population of the Indian Flying Fox largely depends upon the fruiting trees and uses it year after year (Khan 2001). However, in my study, I observed significant variation in individuals of the Indian Flying Fox in different seasons. The population was almost similar throughout spring, summer and autumn. No Indian Flying Fox was recorded in spring in CDO office but a small population successively occupied in two trees species in summer and autumn seasons. The absence of species from the specific sites during one season and presence in another predicts seasonal short distance migration (Thapa et al. 2012).

5.3 Threats to the Indian Flying Fox

The population of the Indian Flying Fox is being affected by different anthropogenic factors and their population is changing through time. With increase in urbanization, the natural habitat of the animal is being disturbed threatening thin habitats. Road expansion and industrialization in the area were major threats to the Indian Flying Fox (Gaikwad et al. 2012). More than half of the respondents also thought the habitat loss as major factor of population. In addition to this a colony of Prakashpur Sunsari was lost due to cutting of roosting tree. Habitat sharing with Egrets and strokes are also forcing the migration of the Indian Flying Fox from the area. Similarly, the pesticides used in ripening the fruit like banana, mango etc and in agriculture were imposing serious threats to the whole colony of bats (O'Sheas and Clark 2002, Weller et al. 2009). In my study area habitat loss or felling of tall tress was the major threat as people perception and felling of trees in Prakashpur Sunsari.

Ethnic communities usually hunt the Indian Flying Fox are believed to have high medicinal value (Acharya 2008b, Thapa 2008). People use it for the treatment of asthma, knee pain and even in the paralysis. Simultaneously, people hunt it for meat and sell at the rate of Rs 500 per individual and majority thought hunting of the Indian Flying Fox is for medicine.

Ali (2010) reported that deforestations, electrocution and hunting were major threats to the Indian Flying Fox. About 80 % of roosting trees were lost in three decades in Bangladesh due to deforestation (Khan 2001). Lack of awareness was another major threat that includes loud noise or noise pollution in every dawn and dusk and excretion near the human settlements (Acharya 2008a). More than 42 % people did not know the importance of the Indian Flying Fox and their ecological importance in pollination. Similarly roosting sites are disturbed by vehicles and their pressure horns which run close to roosting sites.

6. CONCLUSIONS AND RECOMMENDATIONS

The survey of roosting sites to estimate roosting size of the Indian Flying Fox was conducted in three districts (Sunsari, Morang and Jhapa) of low lands of eastern Nepal using exact count and branch estimation method in different seasons in 2012. The study showed: i) roosting site with highest number of individuals (1902) of the Indian Flying was found in Army Camp Eastern Division, Ithari, than CDO office Morang, Golchha house Morang, Kerkha Jhapa, ii) The mean tree height was moderately correlated with the mean number of roosting bats; species of trees that were extensively used for roosting were Shisoo, Red Cotton Tree, Teak, Peepal, Litchi, Mango and Indian Black Berry iii) Population remained almost similar throughout the seasons, iv) Habitat destruction, human disturbance, electrocution were imposing serious threats to the existing colonies of the Indian Flying Fox. Further, they were hunted by some indigenous people for meat and medicine. More comprehensive survey is necessary to understand the current status of the Indian Flying Fox from different parts of Nepal.

Based on my study, following recommendations are made:

- Cutting of tall trees inhabited by the Indian Flying Fox should be controlled as uses tall and strong trees for roosting
- Habitat of the Indian Flying Fox should be considered before planning the industry and highway construction as tall trees nearby highways are colony site
- Electric wire passing nearby bat colonies should be insulated
- Awareness program should be conducted to aware the indigenous people about the importance of bats in restoring the forest ecosystem

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