

NATURAL HISTORY NOTE

Indian flying fox *Pteropus giganteus* is declining in lowland Nepal: Need of conservation actions

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ABSTRACT

The population of the largest fruit bat Indian flying fox is declining throughout its range. We identified tree felling and hunting as current threats to 11 newly recorded colonies across eight districts of lowland Nepal and that six previously known roosts have collapsed. Importantly, we identified that local people were unaware of the ecological benefits and importance of the Indian flying fox. We propose a number of immediate conservation actions required to protect the remnant populations of the species in human-dominated landscapes across Nepal.

The Indian flying fox *Pteropus giganteus* (Brünnich, 1782) is the largest fruit bat in Nepal and forms large roosting colonies often close to human settlements in urban and rural areas (Acharya et al. 2010, Jnawali et al. 2011). Its diet consists of varieties of wild and cultivated fruits and flowers (Mahmood-ul-Hassan et al. 2010, Javid et al. 2017). It helps in seed dispersal and pollinates many flowering plants (Mahmood-ul-Hassan et al. 2010, Gulraiz et al. 2016). It is distributed across nine countries of South and South-East Asia, including India, Nepal, Pakistan, Bangladesh, Bhutan, Maldives, Sri Lanka, China and Myanmar (Molur et al. 2008). Although it is classified as Least Concern in the IUCN Red List of Threatened Species (<https://www.iucnredlist.org/species/18725/8511108>), its population is declining both at global and national scale. This is predominately due to habitat loss and degradation, loss of large trees, reduction in food availability, introduction of power lines, hunting, etc. (Molur et al. 2008, Jnawali et al. 2011, Acharya 2015, Manandhar et al. 2017, Sharma et al. 2018).

In Nepal, the Indian flying fox was once abundant and a large population was previously distributed from Terai (lowland) to Mid-Hills (65-1500 m). However, due to multiple threats such as urbanization, hunting, habitat destruction, and lack of food (Acharya et al. 2010, Neupane et al. 2016), roosting colonies in several districts have shown dramatic population declines within the last decade. These include roosts from the Kathmandu valley, Kaski, Palpa, Sunsari, Morang, Jhapa, Saptari and Dang (Jnawali et al.

2011, Neupane et al. 2016). Known colonies of the Indian flying fox are not monitored and little is known about their current distribution within the country (Jnawali et al. 2011, Acharya 2015). Based on extensive fieldwork, we update the distribution status of the Indian flying fox in lowland Nepal and suggest conservation actions/measures aimed at reverting the on-going decline of the species.

We contacted key informants and local people to locate new roosting sites of the Indian flying fox across lowland districts of Nepal (elevation 60-125 m). We used binoculars to estimate the number of individuals and also informally interviewed local people/landowners (n=50) to discover historic population trends for each roost and to identify existing threats impacting the colonies. During the survey, visiting once (August 2018-January 2019), we found 11 new colonies of the Indian flying fox across eight districts (Kapilvastu, Rupendehi, Parsa, Bara, Sarlahi, Dhanusa, Siraha and Sunsari) (Fig. 1, Table 1). Most of the interviewees reported tree felling and hunting as the causes for roost collapse in the six previously known localities: Taulihawa in Kapilvastu, Sekhauna and Dhangada in Sarlahi, Dhanusadham in Dhanusa, Itari in Siraha and Prakashpur in Sunsari (Fig. 1A). The estimated number of Indian flying foxes varied from 50-1800 individuals in the surveyed roosts (Fig. 1B-C, Table 1). Masala (*Eucalyptus* spp.), Sissoo (*Dalbergia sissoo*), Pipal (*Ficus religiosa*), Mango (*Mangifera indica*), and Simal (*Bombax ceiba*) were predominantly used roosting trees (Table 1), as reported in other studies (Acharya et al.

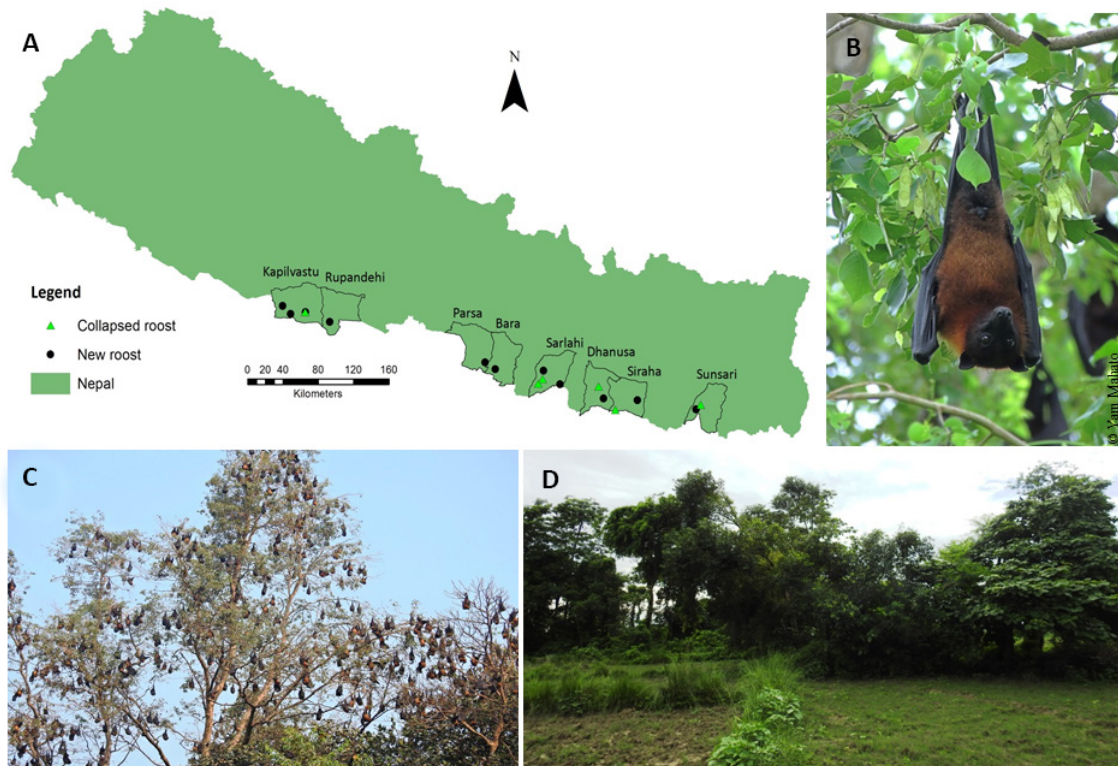


Fig. 1 - Roosting colonies of the Indian flying fox in lowland Nepal; **A**) map depicting the distribution of the colonies in different districts, **B**) adult Indian flying fox, **C**) colony of the Indian flying fox in Murtiya (Sarlahi) and **D**) roosting habitat in Dagdauwa (Kapilvastu).

2010, Jnawali et al. 2011, Neupane et al. 2016, Javid et al. 2017). Local names for the Indian flying fox included *Baadur*, *Gaadur*, *Chamgudri* and *Banchat*. Interviewees reported the destruction of the mango and other fruits by the Indian flying fox; however, they still demonstrated a positive attitude towards it. Locals reported the felling of roosting trees, and hunting by certain poor and marginalized people and semi-nomadic communities for example *Nat/Karori*, *Chidimar*, *Satar*, *Kapadiya* for bushmeats and that the belief of the Indian flying fox meat has medicinal properties, as the major cause for the declining populations (D.N. Mandal per.comm., D.R. Dahal per.comm., S. Khadka per.comm., S. Kushwaha per.comm., Table 1). Although bushmeat hunting for bats is currently uncommon in these areas, it is still known to occur in some places (Table 1). Fortunately, people in Narayanpur (Sarlahi) and Sahalesh Fulbari (Siraha) reported that religious beliefs safeguard colonies whose roosts are located within temple grounds and the sacred forest respectively.

Although most of the colonies of the Indian flying fox were recorded within locally-owned agricultural lands (Fig. 1D), close to settlements and roads, local people do not have knowledge on the ecological benefits and importance of the species. Locals continue to remove mature trees from their lands, largely because of their commercial value to furniture markets and construction works. These large trees are important roosting habitats for the Indian flying fox. As such tree felling is likely a main driver for the declining number of roosting bats observed in some colonies, reflecting reports made elsewhere in Nepal (Pokhara city; Sharma et al. 2018).

We have demonstrated that the Indian flying fox population is declining across the region (Table 1); supporting evidence of wider national population declines (Jnawali et al. 2011). Therefore, we strongly recommend the local governments and other relevant authorities to implement

urgent conservation actions. Recommended conservation actions include: raising awareness among students and local people about the importance of the Indian flying fox in agro-ecosystems (e.g. erecting information boards to spread knowledge of the species), providing alternative livelihood options for low-income, marginalised and semi-nomadic communities to discourage hunting, establishing land-owner and fruit growers conservation incentives and appreciation, granting legal protection for potential roosting trees, enforcement of anti-hunting regulations, seasonal monitoring to capture temporal fluctuations in population size and distribution, and efforts to simultaneously reduce disturbance and habitat degradation in the wider landscape. These measures will help to ensure the coexistence of the Indian flying fox and people across the landscape. We also recommend a nationwide study of roosting colonies, in order to map vulnerable sites in need of priority conservation activities.

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Table 1 - Information on 11 newly recorded colonies of the Indian flying fox from eight districts of lowland Nepal (August 2018-January 2019)-

District	Colony	Locality	Estimated Population	Roosting Trees	Colony Existence	Existing Threats	Population Trend	Interviewees
Kapilvastu	Colony 1	Kapilvastu Municipality-3, Diwan Gadiya	1200-1500	Masala (<i>Eucalyptus</i> spp.), Sissoo (<i>Dalbergia sissoo</i>), Mango (<i>Mangifera indica</i>)	~4 years	Tree felling, hunting	Decreasing	J. Musalman, M. Musalman
	Colony 2	Maharajgunj Municipality-7, Langada	800-1000	Pipal (<i>Ficus religiosa</i>), Simal (<i>Bombax ceiba</i>), Masala (<i>Eucalyptus</i> spp.)	~40 years	Tree felling, hunting	Decreasing	S. Hasan, A. Hasan
	Colony 3	Bijaynagar Rural Municipality-4, Dagdauwa	1000-1200	Sissoo (<i>Dalbergia sissoo</i>), Simal (<i>Bombax ceiba</i>), Mango (<i>Mangifera indica</i>)	~10 years	Tree felling, hunting	Decreasing	A. Khan, S. Khan
Rupandehi	Colony 1	Lumbini Sanskritik Municipality-10, Laxmipur	50-100	Mango (<i>Mangifera indica</i>)	~20 years	Tree felling	Decreasing	Y. Mahato, A. Kurmi
Parsa	Colony 1	Jagarnathpur Rural Municipality-9, Jagarnathpur	1000-1200	Mango (<i>Mangifera indica</i>)	~6 years	Tree felling, hunting	Decreasing	S. Kushwaha, Z. Ansari
Bara	Colony 1	Kalaia Sub-Metropolitan City-11, Khapartata	100-200	Pipal (<i>Ficus religiosa</i>)	~5 years	Tree felling, hunting	Decreasing	S. Kushwaha, J. Kushwaha
Sarlahi	Colony 1	Barahathwa Municipality-9, Murtiya	1000-1200	Sissoo (<i>Dalbergia sissoo</i>), Masala (<i>Eucalyptus</i> spp.), Katahar (<i>Artocarpus heterophyllus</i>)	~15 years	Tree felling	Decreasing	R.J. Mahato
	Colony 2	Parsa Rural Municipality-6, Narayanpur	1500-1800	Pipal (<i>Ficus religiosa</i>), (<i>Eucalyptus</i> spp.)	~20 years	Not reported	Increasing	G. Sah, B. Thakur
Dhanusa	Colony 1	Sahidnagar Municipality-1, Yadukoha	300-500	Sissoo (<i>Dalbergia sissoo</i>), Masala (<i>Eucalyptus</i> spp.)	~12 years	Tree felling, hunting	Decreasing	D.N. Mandal
Siraha	Colony 1	Lahan Municipality-12, Botiyatol Sahalesh Fulbari	1000-1200	Kaijal (<i>Bischofia javanica</i>)	~25 years	Not reported	Increasing	S.S. Yadav, L. Chaudhary
Sunsari	Colony 1	Koshi Rural Municipality-2, Paschim Kusaha	800-1000	Simal (<i>Bombax ceiba</i>), Sissoo (<i>Dalbergia sissoo</i>), Bamboo (<i>Dendroclamus</i> spp.)	~3 years	Tree felling, hunting	Stable	A. Timsina, D.R. Dahal

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