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The Eastern Hoolock Gibbon (*Hoolock leuconedys*) in Eastern Arunachal Pradesh, India

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Abstract: Lowland tropical forest in the Lower Dibang Valley district in the state of Arunachal Pradesh is the prime habitat in India of the eastern hoolock gibbon (*Hoolock leuconedys*). The present study was conducted to assess the threats to the population of *H. leuconedys* in the unprotected forest fragments of the Lower Dibang Valley district, Arunachal Pradesh. Besides field observations, we employed a structured questionnaire survey method to interview villagers, including the *Gaon Burha* (village head) and local hunters. Based on our observations and the interviewees' responses, we recorded that gibbons were occasionally hunted for bushmeat, and that dogs, the Mountain Hawk Eagle (*Nisaetus nipalensis*), and monitor lizards (*Varanus*) were evidently predators of, particularly young, gibbons in the fragmented forest patches. Indirect threats included habitat destruction and fragmentation, deforestation, extraction of non-timber forest products, livestock grazing, road construction, selective (illegal) logging, shifting cultivation, commercial cash-crops, and permanent human settlement. A conservation action plan is urgently needed to protect and conserve the eastern hoolock gibbon from extinction in the region.

Key Words: Anthropogenic threats, forest fragmentation, Lower Dibang Valley, population, hunting, predation.

Introduction

Hoolock gibbons are the only apes found in India. There are two species: the western hoolock gibbon (*Hoolock hoolock*) and the eastern hoolock gibbon (*Hoolock leuconedys*) (Mootnick and Groves 2005; Das *et al.* 2006). They are confined to the rain forests of Southeast Asia, Northeast India, and Bangladesh (Preuschoft *et al.* 1984; Leighton 1987). *Hoolock leuconedys* was earlier believed to be restricted to the east of the Chindwin River to the Salween River in Myanmar and south-western Yunnan Province in China at elevations of 1067 m to 1219 m (Groves 1971). It was reported from the state of Arunachal Pradesh, India, by Das *et al*. in 2006, between the Lohit River in the north and the high mountains of Dafa bum in the south. Further, it was also reported in the Sadiya Division, the easternmost part of the state of Assam, on the south bank of the Dibang-Brahmaputra River system (Chetry and Chetry 2010).

Lowland tropical forest of the Lower Dibang Valley district in Arunachal Pradesh is the prime habitat of *H. leuconedys*. Surprisingly, only a few population surveys have been carried out in India (Das *et al.* 2006; Chetry *et al*. 2008, 2010; Sarma *et al*. in press). The species has otherwise been surveyed in China (Lan 1994; Tian *et al.*1996; Zhang 1998; Zhang *et al.* 2002; Fan *et al.* 2011) and Myanmar (Geissmann 2007), and just recently in Arunachal Pradesh, covering a significant portion of the species' population and highlighting the anthropogenic threat faced by the species in matrix habitats in India (Sarma *et al.* in press).

Forests in the foothill areas of the Lower Dibang Valley district are being heavily exploited, destroying and fragmenting the gibbon's habitats (Sarma *et al.* 2011, 2013). The forest fragments are subjected to logging, fuelwood collection, grazing, and poaching (Umapathy and Kumar 2000). In this paper we report on threats to the long-term survival of *H. leuconedys* in the agricultural matrices (unclassified state forests) in Arunachal Pradesh, India.

Methods

Study area

The study was conducted in protected and unprotected forest fragments in the Lower Dibang Valley district in the state of Arunachal Pradesh, India. The only protected area

there is the Mehao Wildlife Sanctuary, which is surrounded by numerous unprotected forest patches forming a matrix of habitats. The Mehao Wildlife Sanctuary lies roughly between 93°30' and 95°45'E and 28°05' and 28°15'N. The terrain is entirely hilly, ranging in altitude from 400 m to 3568 m above sea level. The forest types of the study area vary with altitude, and consist of tropical evergreen forest (up to 900 m), subtropical and temperate forest (above 900 m to 1800 m), temperate broadleaf forest (1800 m to 2800 m), and temperate conifer forest (2800 m to 3500 m) (Rawat *et al*. 2009). There are a number of perennial streams and lakes draining the sanctuary. The biological importance of the sanctuary is due to the fact that the area has a combination of Palaearctic, Indo-Chinese and Indo-Malayan floral and faunal elements (Rawat *et. al*. 2009). The climate is cool throughout the year, with 2680 mm average annual rainfall. The richness and diversity of the flora provides for a highly diversified fauna.

The main tribes inhabiting the area are the *Idu-Mishimis* and *Adis*. They cultivate mainly rice, maize, and millet; their staple foods apart from bushmeat. They also eat wild vegetables, roots, tubers, and fruit. Agriculture is the mainstay of the economy, and traditional shifting cultivation '*Jhum*' is the most common farming practice.

Survey techniques

A field survey was conducted from November 2010 to October 2012. Using a questionnaire, we interviewed the *Gaon Burha* (village heads), hunters, and other local people to assess the present threats to the gibbons in unclassified state forests (USF) near the Mehao Wildlife Sanctuary. We selected four of the 14 villages in and around the sanctuary—Horupahar, Koronu, Injuno and Delo—based on the extent to which the people depended on natural resources, their proximity to the forest patches, and the occurrence of the eastern hoolock gibbon (Fig. 1). We selected 20 interviewees from each village using a stratified random sampling technique. The primary data were collected through structured and open-ended questionnaires; secondary data were collected from published and unpublished reports, research papers and articles, as well as through interviews of forest department officials. We also interviewed 20 hunters.

Results

Human demography

There are 14 villages in and around the Mehao Wildlife Sanctuary (Table 1). A total of 937 households were reported in the 14 villages, comprising a population of *c.*4238 people. The largest village was Koronu (population 793) and the smallest was Simari (population 12); both located on the southern boundary of the sanctuary. These people are extending their agricultural activities into the unclassified forest areas, where they also extract non-timber forest products to meet their day-to-day needs. This intrusion affects the gibbon population by reducing the extent of pristine forest cover.

Livelihood options: emergence of anthropogenic threats

Agriculture was the primary occupation for 85% of the hunters interviewed (n = 20). Cultivation, listed as the highest source of income by nearly 80% of interviewed villagers (n = 80), was followed by non-timber forest products (13%), and hunting (7%) (Fig. 2). Seventy per cent of the respondents listed subsistence use, 19% indicated trade and 11% listed human-wildlife conflict as the main reason for hunting.

Anthropogenic threats

A number of threats were recorded in the study area, based on field observations, questionnaires, personal interviews and discussions with village heads, hunters and local people. These threats were grouped into two categories—direct and indirect—based on their impact on the population of *H. leuconedys* and their habitats (Fig. 3).

Direct threats: hunting and predation

Hunting was found to be the major activity posing a direct threat to the gibbons. Although the local tribe *Idu Mishmi* do not hunt gibbons due to a cultural taboo, the *Adi* hunt the species for bushmeat. Another alarming direct threat recorded was predation by dogs reared by local villagers to protect them from wild animals. About 20–25 gibbons were reported killed by dogs in the last seven years. Other predators recorded were the Mountain Hawk Eagle (*Nisaetus nipalensis*) and monitor lizards (*Varanus*), which target mainly infant gibbons. Ten attacks by Mountain Hawk Eagles and monitor lizards on immature gibbons were recorded during the period of the study.

Indirect threats: habitat destruction and fragmentation

Indirect threats were subdivided into habitat destruction and fragmentation. Fragmentation is due to selective logging and road construction, whereas habitat destruction was driven by a number of activities, such as extension of agricultural land, encroachment, tree felling for commercial purposes, and

Table 1. Villages in and around Mehao Wildlife Sanctuary and their population status. (Source: Department of Statistics, Arunachal Pradesh).

	Name of village	No. of households	Population
1	Bhismaknagar	34	128
2	Koronu	175	793
3	Dello	59	240
4	Injunu	137	707
5	Abango	115	506
6	Simari	3	12
7	Balek	93	442
8	Cheta I & II	74	300
9	Rayang	64	358
10	6 Kilo	57	193
11	Kebali	34	98
12	Horu Pahar	37	265
13	Chidu	38	129
14	Tewari Goan	17	67
	Total	**937**	**4238**

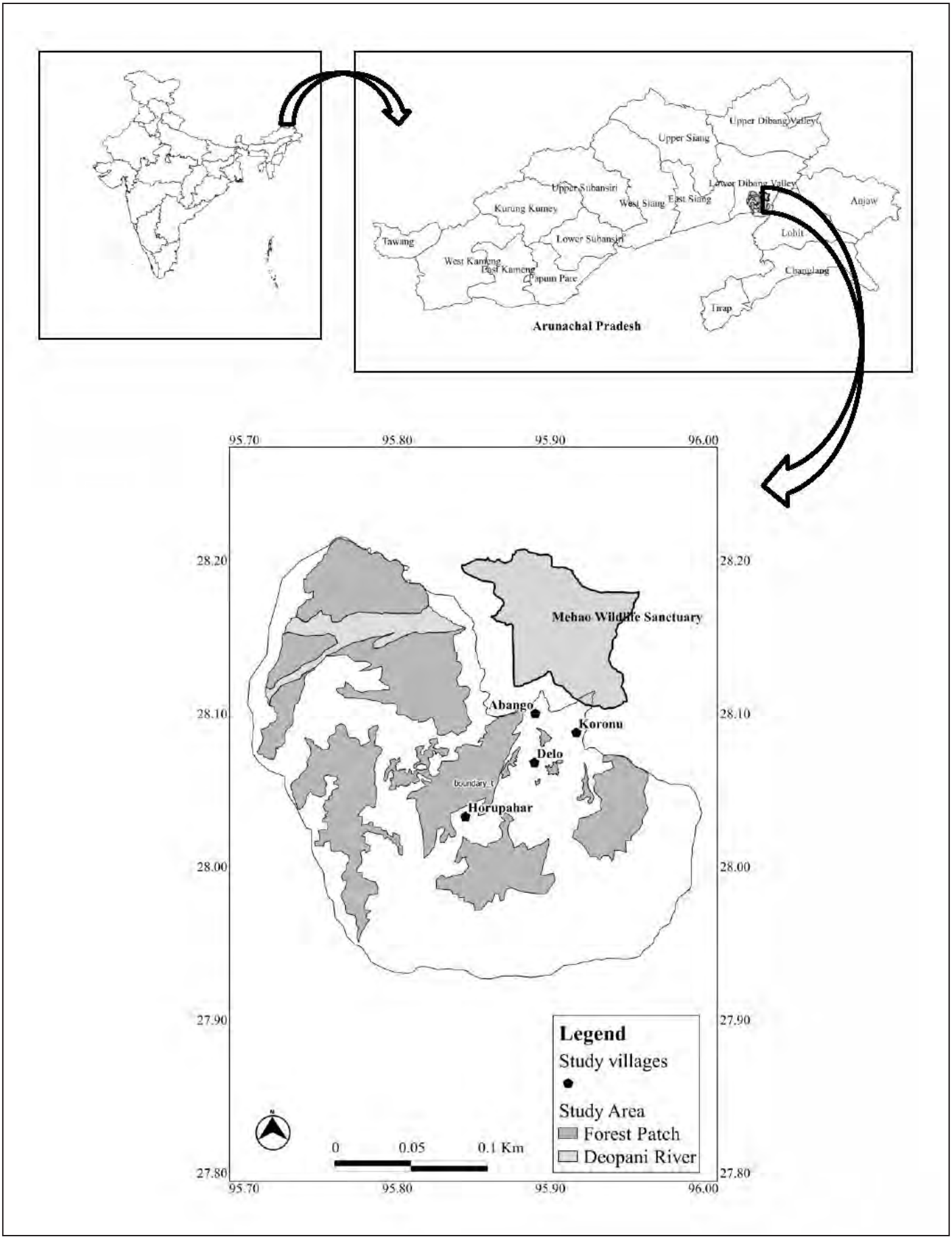

Figure 1. The study area showing the locations of the study villages and existing forest patches in the Lower Dibang Valley district, Arunachal Pradesh, India.

shifting cultivation. We recorded 33 plant species selectively logged for fuelwood, timber, and housing materials during the study period. Twenty-two of them were used by gibbons for food (Table 2). Other indirect threats damaging the habitat of the gibbons include livestock grazing, over extraction and over exploitation of non-timber forest products (including wild vegetables, leaves of many medicinal plants, fuelwood and small poles and boles for building houses).

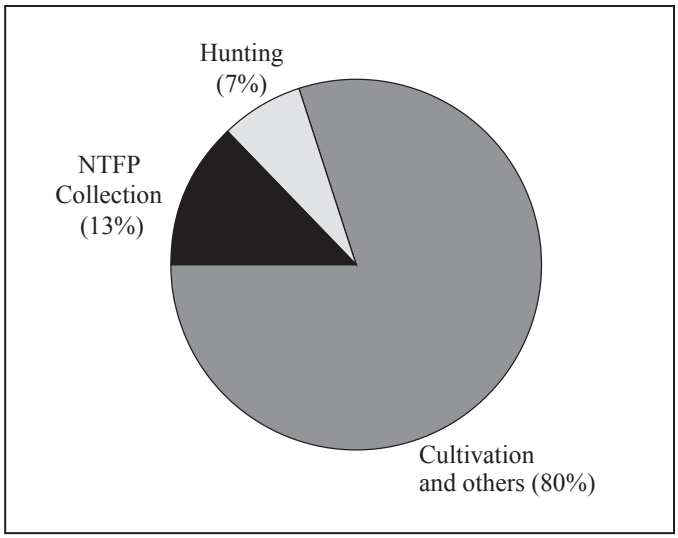

Figure 2. Percentage livelihood options of the villagers in the study area.

Discussion

Lowland tropical rain forests in Northeast India, particularly Arunachal Pradesh, are the most species rich terrestrial ecosystems harboring gibbons in India. Substantial degradation of these rain forests in and outside of protected areas has led to fragmentation and conflict, affecting the populations of both the western hoolock (*Hoolock hoolock*) and eastern hoolock (*Hoolock leuconedys*) gibbons. Populations in the wild have declined by more than 90% over the past three decades due to numerous anthropogenic threats (Walker *et al.* 2007). The western hoolock gibbon is the species most studied for anthropogenic threats in its range (Choudhury 1990, 1991; Mukherjee *et al.* 1992; Srivastava 1999; Ahmed 2001; Srivastava *et al.* 2001a, 2001b; Malone *et al.* 2002; Das and Bhattacherjee 2002; Das *et al.* 2004; Solanki and Chuita 2004; Das *et al.* 2006; Walker *et al.* 2007), and most of the threats apply also to the eastern hoolock gibbon in Arunachal Pradesh. These threats have affected the conservation status of the gibbons (Alfred and Sati 1990, 1994; Choudhury 1991; Islam and Feeroz 1992; Kakati 1997). However, for a species such as the eastern hoolock gibbon, the range of which has yet to ascertained, this compilation might still be incomplete. Habitat loss and fragmentation have been reported as major anthropogenic threats for the eastern hoolock gibbon throughout its known range (Table 3).

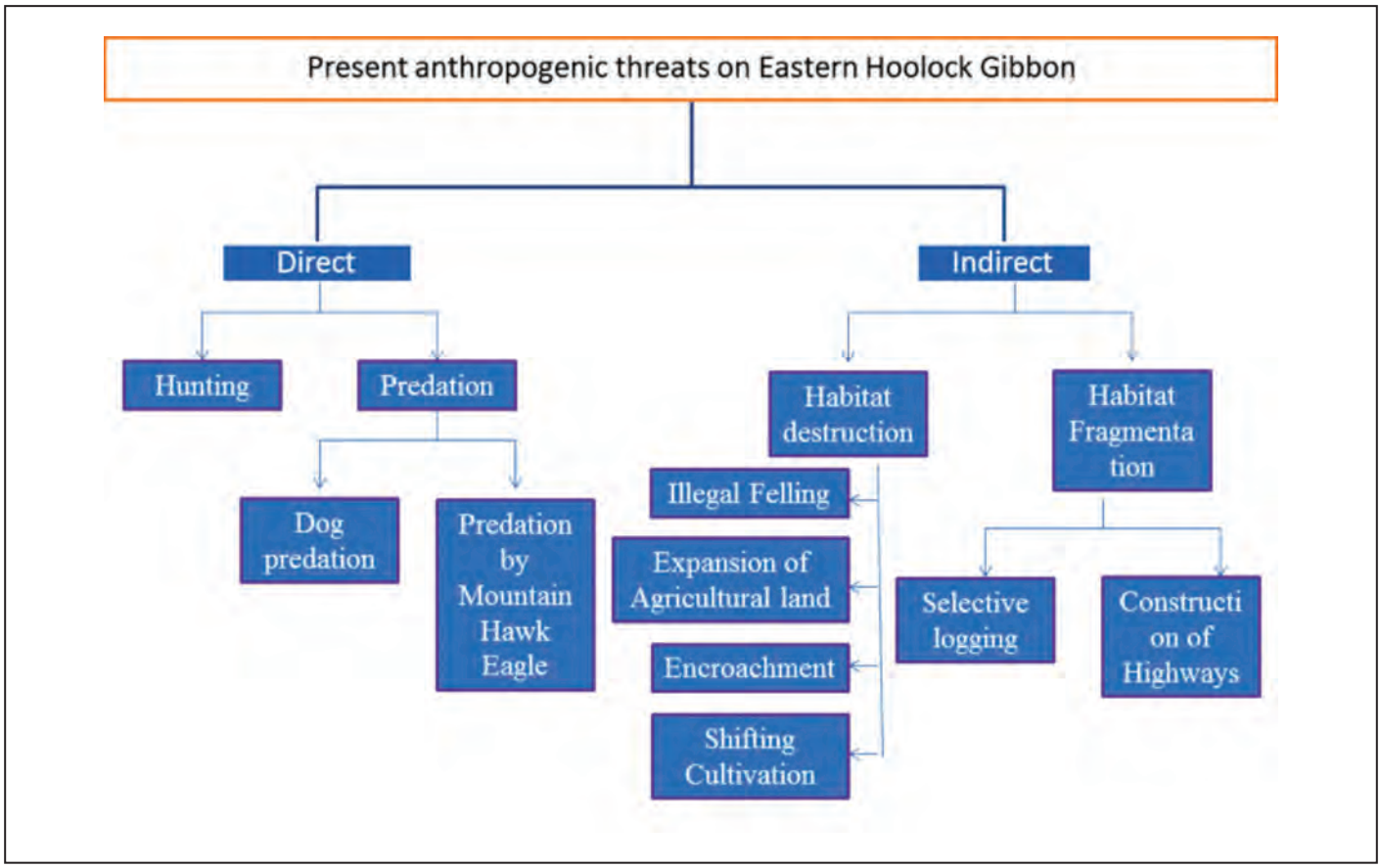

Figure 3. Flow chart of anthropogenic threats recorded for the eastern hoolock gibbon (*Hoolock leuconedys*) in the study area.

Table 2. Plant species selectively logged from the forest areas and their purposes.

	Species name (local name)	Family	Purposes	Food plant*
1	*Duabanga grandiflora* (Khokon)	Myrtaceae	Construction	X
2	*Morus laeviegata* (Bola)	Moraceae	Construction	X
3	*Terminalia myriocarpa* (Hollock)	Dipterocarpaceae	Construction	X
4	*Bambusa tulda* (Jati Bans)	Poaceae	Construction	X
5	*Bambusa hemiltonii* (Kako Bans)	Poaceae	Fuelwood	
6	*Bischofia javanica* (Uriam)	Euphorbiaceae	Construction/ Fuelwood	X
7	*Sterculia* spp. (Udal)	Malvaceae	Fuelwood	X
8	*Sterculia villosa* (Dewachali)	Malvaceae	Fuelwood	X
9	*Albizia procera* (Koroi)	Caesalpiniaceae	Fuelwood	X
10	*Delinia indica* (Otenga)	Dilleniaceae	Fuelwood	
11	*Bauhinia* spp. (Kanchan)	Verbenaceae	Fuelwood	
12	*Cinnamomum glaucescens* (Gonkorai)	Lauraceae	Construction	X
13	*Bombax ceiba* (Semal)	Bombacaceae	Construction / light work	X
14	*Alstonia scholaris* (Satiana)	Apocynaceae	Fuelwood	
15	*Pterospermum acerifolium* (Hatipoila)	Malvaceae	Fuelwood	
16	*Ailanthus integrifolia* (Borpat)	Simaroubaceae	Fuelwood	X
17	*Calamus* spp.	Arecaceae	Construction	
18	*Lannea coromandelica* (Jiapoma)	Anacardiaceae	Construction/Fuelwood	X
19	*Gmelina arborea* (Gomari)	Lamiaceae	Construction	X
20	*Chukarasia tabularis* (Bogipoma)	Meliaceae	Construction/ Fuelwood	X
21	*Calamus erectus* (Jeng patta)	Arecaceae	Construction	
22	*Michelia champaca* (Teeta Sopa)	Magnoliaceae	Construction	
23	*Melia azederach (*Gorat Neem)	Meliaceae	Fuelwood	
24	*Kydia glabrascence* (Pichola)	Malvaceae	Fuelwood	X
25	*Erythrina stricta* (Mader)	Fabaceae	Fuelwood	X
26	*Mesua ferra* (Nahar)	Meliaceae	Construction	
27	*Stereospermum chelonoides* (Paroli)	Bignoniaceae	Construction/ Fuelwood	X
28	*Shorea assamica* (Mekai)	Dipterocarpaceae	Construction	X
29	*Spondias pinnata* (Amora)	Anacardiaceae	Fuelwood	X
30	*Toona cilata* (Jatipoma)	Meliaceae	Construction/ Fuelwood	X
31	*Terminalia citrina* (Hilika)	Combretaceae	Construction	X
32	*Calamus tenuis* (jati bet)	Arecaceae	Construction	
33	*Neolamarckia cadamba* (Kadam)	Rubiaceae	Fuelwood	X

*Food plant data of Das *et al.* (2004) and Kakati *et al.* (2004).

In Arunachal Pradesh, human settlements and livestock grazing have resulted in a new threat in the form of attacks by free ranging dogs, associated also with roundworm (*Toxocara canis*) infestations. Firewood collection and extraction of non-timber forest products damage the forest canopy, forcing the gibbons to go to the ground (Sarma *et al.* 2013), making them vulnerable to dog predation, which will surely affect the survival rates of young gibbons, especially in the long run. An episode of dog predation was recorded by Panor (2011); a young female was rescued from the mouth of a dog.

The land use pattern is gradually changing; more and more local farmers are switching to short-duration, cash-crop cultivation for quick returns. The rate and extent of forest encroachment, disturbance and depletion are determined by many factors, including the legal status and land ownership of each forest area (Baranga *et al.* 2009). Local people have no clear understanding of the existence of the Mehao Wildlife Sanctuary due to the lack of a well-marked boundary, and still think that the land belongs to their forefathers. As such they believe they have the right to hunt and to carry out their day-to-day activities there (Chetry *et al.* 2010). Occasional hunting and illegal selective logging and collection of timber are widespread in the area. There are many wood-based industries within a radius of 5 km from the boundaries of the sanctuary under the Mehao Forest Division. The forest inside the

Figure 4. Major threats to *H. leuconedys* in and around Mehao Wildlife Sanctuary: (a) and (b) male and female gibbons in a fragmented landscape; (c) pasture; (d) and (e) tea plantations; (f) and (g) selective logging (h) timber mill in the study area; and (i) skulls of hunted gibbons.

Table 3. Threats recorded for the eastern hoolock gibbon (*Hoolock leuconedys*) throughout its range.

Country	Forest status	Threats	Sources
Myanmar	Protected and non-protected habitat of Myanmar	– Habitat loss and degradation caused by shifting cultivation and timber extraction. – Hunting for trade and subsistence was also recorded as a serious threat – Poaching by villagers.	Lwin *et al.* (2011)
China	Protected and non-protected habitat of China	– Commercial logging both historical and current leading to habitat destruction – Hunting was also recorded as threat. – Agricultural encroachment and population fragmentation	Fan *et al.* (2011)
India	Namsai Reserve Forest	– Habitat destruction and fragmentation. – Change in land use pattern. – Shifting cultivation. – Conversion of forest area to tea garden. – Expansion of road network. – High tension electric wires.	Das *et al.* (2006)
	Mehao Wildlife Sanctuary and Koronu circle	– Forest loss and fragmentation due to expansion of agriculture. – The conversion of forest for the commercial cultivation of orange, ginger and cardamom – Construction of high-tension electric power line – Encroachment of the forest for human settlements and for small-scale agriculture.	Chetry *et al.* (2008, 2010)
	Reserve forests of Assam	– Forest loss and fragmentation due to the expansion of agricultural activities, encroachment by human settlements, selective illegal felling – Collection of firewood and grazing.	Chetry & Chetry (2010)

sanctuary is still dense, but timber mafias are now targeting felling for commercial purposes inside the sanctuary.

The forests in the foothills are suffering from considerable exploitation, which leads to the destruction and fragmentation of the habitat, adversely affecting the survival of the gibbons. Besides the protected areas, the unclassified state forests, particularly in the southwestern vicinity of the sanctuary that hold a significant portion of the total gibbon population in the state, are facing serious threats in terms of encroachment for agricultural and horticultural practices and logging (Panor 2011; Sarma *et al.* in press). This is evidenced by the number of stumps in the study area. An average of 1.85 stumps per kilometer was reported from the four villages around the Mehao Wildlife Sanctuary (Krishna *et al.* 2012). As the tree densities of all the four study sites are very low, the gibbons are facing difficulties in dispersing. These threats are common in Assam and Arunachal Pradesh.

Based on these anthropogenic threats, the gibbon population is believed to be declining rapidly. Immediate interventions are needed to conserve this vulnerable species; through a captive breeding program for restocking of the wild population and reintroducing the species into protected areas. Two major conservation actions have already been undertaken in Arunachal Pradesh. The Wildlife Trust of India (WTI) in collaboration with the Forest Department has translocated a few isolated groups to the Mehao Wildlife Sanctuary, although they have not been monitored. Moreover, the Biological Park, Itanagar, under the guidance of the Central Zoo Authority (CZA), has taken up the initiative for a conservation breeding program with the ultimate goal of releasing captive-bred individuals into the wild. However, habitat improvement through multipurpose tree plantations and the construction of canopy bridges to connect the remnant forest patches for future survival of the species in the wild is the prime necessity in its fragmented habitats. Local awareness and involvement of the native communities are also needed for the conservation of this species.

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