

# A Note on the Population Status, Ecology and Conservation of Hoolock Gibbon (*Bunopithecus hoolock*, Harlen) in Gumti Wildlife Sanctuary, Tripura, Northeast India

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## 1. Introduction

The hoolock gibbon (*Hylobates hoolock*, Harlen 1834; Hylobatidae: Hylobates) is the only ape species among nine lesser apes in the world and among 15 non-human primate species in India. In India its distribution is confined to all the northeastern states, from south of Brahmaputra River in Assam to Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya. Elsewhere, it is reported from Bangladesh, Myanmar, and Southern China (Mukherjee 1982). Although, it is categorized as endangered by IUCN and listed in Schedule I of the Indian Wildlife (Protection) Act, 1972, yet it is one of the least studied primate species in India for its behavioural ecology and conservation. The only studies on its ecology and behaviour are by Tilson (1979), Siddiqi (1986), and Alfred and Sati (1986, 1990). Other studies by Mukherjee (1982, 1986, 1988) and Choudhury (1990, 1991), Gupta (1994), and Kakati (1997) are mostly on population status of gibbons in the northeastern states of India. Ahsan (1994) has conducted a detailed study on its ecology and behaviour in Bangladesh.

Most of the studies on gibbon conclude that gibbons are specialized in many ways: monogamous, frugivorous, highly territorial and brachiators. Disturbance and fragmentation results in reduced availability of fruit thus adversely affecting frugivorous gibbons. In addition, their highly territorial nature or 'spatial inflexibility' prevents them from exploiting food resources in adjoining areas that are occupied by other groups (Mackinnon and Mackinnon,

1984). Further, the strictly arboreal habit and brachiatry of gibbons affect their movement and make them vulnerable due to loss of continuous canopy serving as corridors. Laurance (1991) rates this inability of a species to exploit matrix habitats as the best indicator of very high extinction risk for that species. Although gibbons are long lived, they are monogamous, live in small family groups, and their reproductive output is low, which means that population sizes cannot exceed beyond a small maximum even if environmental conditions improve. All these characteristics make gibbons highly susceptible to habitat fragmentation and disturbance.

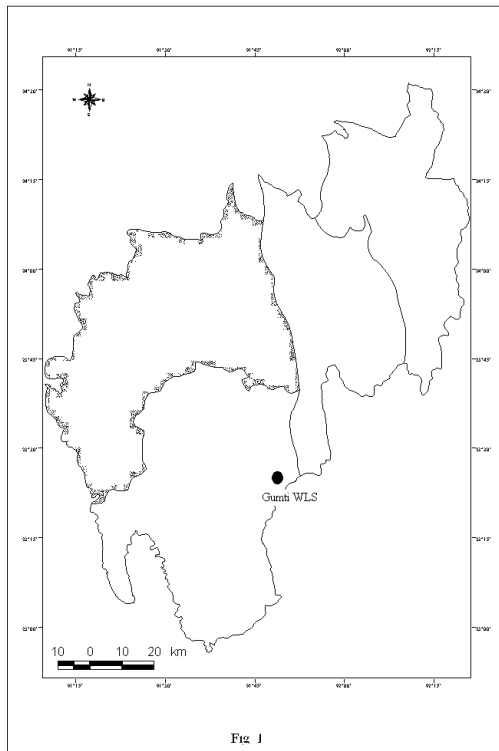
The data presented here are from a preliminary study of one group of gibbons, which formed a part of long-term project on "Population Status, Ecology and Conservation of Non-human Primates in Tripura, with special reference to Shifting cultivation

## 2. Methods

### 2.1 Study area

The study was conducted in Gumti Wildlife Sanctuary (GWLS, 23° 21' – 23° 40'N to 91° 57' to 91° 20'E), located in south district of Tripura, India (Fig. 1). The Sanctuary (389 km<sup>2</sup>) is spread over the foothills of Atharamura-Kalajhari hill ranges on the eastern side and constitutes the catchments and watershed area for Khowai, Sorma, Raima and Gumti rivers and their tributaries. The terrain is rugged with ridges, narrow valleys, deep gorges and seasonal

**Fig. 1:** Map of Tripura showing the location of the study area (GWLS)



and many perennial streams. The general altitude varies from 150 m to 380 m. The area experiences three distinct seasons – summer (March to June); monsoon (July to October) and winter (November to February). The mean daily maximum and minimum temperature varies from 36°C (May) to 8°C (January). The mean annual rainfall is 1625 mm. July and August are two main rainy months.

The vegetation consists of widely scattered small patches of Cachar tropical evergreen forests, large tracts of moist-mixed deciduous forests and old man-made forests (plantations). Low alluvial savannah woodlands and dry and secondary moist bamboo brakes are also common in areas with severe biotic influence (see Gupta and Kumar, 1994 for further details). The area has large tribal population engaged in jhum for many years.

## 2.2 Study group

A total of 7 groups of gibbon were located in Gumti WLS. Of these, one group consisting of one adult male, one adult female and one juvenile located at Mukhcherri was selected as the study group. Other primate species in the area were Phayre's langur (*Trachypithecus phayrei*), capped langur (*T. pileatus*), rhesus macaque (*Macaca mulatta*), pig-tailed macaque (*M. nemestrina*), stump tailed macaque (*M. arctoides*) and slow loris (*Nycticebus coucang*).

## 2.3 Data on behavioural and feeding ecology

A period of about two months was initially spent on habituation of the study group and preparation and mapping of the study area. Because of the time constraints, the group was followed for one day each month (same day in the first week) from dawn to dusk (total 144 contact hours; range 11-14 hours, mean = 12 hours per day) and time spent on different activities was estimated from group scan (Altmann, 1974). A 'scan' refers to a single recording of the behaviour of an individual within 15 minutes intervals, which provided data on different activities, broadly classified into feeding, resting, ranging and other activities. Ranging patterns were studied by recording the group position on each observation (every 15 minutes) inside 50mx50m quadrats and day range length was calculated as cumulative distance traveled by the gibbon group in single line travel between consecutive roosting trees. Percent time spent feeding was estimated from:  $T = (n_f \times 100)/N$ , where  $T$  = % daytime spent feeding,  $n_f$  = number of records that included feeding, and  $N$  = total number of records for the day. Time spent feeding on different plant species and parts, as well as animal diets, was also estimated using the above equation (Gupta and Kumar 1994). Frequency and direction (from where call was

heard) of calls was recorded as and when songs were heard. All the food plant species and parts were identified with the help of local botanist. I also calculated preference indices (PI) for each food species in relation to their abundance in the study area: one divides percentage time spent feeding on a given species by its relative abundance, calculated as the percentage of total basal area (Kumar 1987).

Raemaekers and Chivers (1980) have suggested that in a variable and complex forest environment, continual monitoring and frequent sampling of primate groups from dawn to dusk on at least 5, preferably 8-10, consecutive days, is important for assessing the behavioural and ecological repertoire of any study primate group. By that standard a one day follow might be too short to provide comparable data on gibbons. The data collected from dawn to dusk for one day coupled with *ad libitum* notes (during surveys, vegetation samplings, phenological studies) while studying Phayre's langur group at the same site (Gupta and Kumar, 1994), however, provided first-ever systematic data on the behavioural ecology of gibbons covering changes in the vegetation and other environmental parameters over an annual cycle. One day sampling data in this study, though, may not be comparable with other studies on gibbons, yet these could be suggestive of the ecology and conservation status of the gibbon in this area. Curtin (1980), in almost a similar situation, used alternating periods of 2-3-days dawn-to-dusk follows each month for studying the ecology and behaviour of two sympatric species (*Presbytis melalophos* and *Trachypithecus obscurus*).

### 3. Results

#### 3.1 Group size and composition

The author identified twenty-seven groups of gibbons in the then three districts (now four) of Tripura (Gupta, 1994) including 7 in GWLS with average group size of 2.14 ind/group

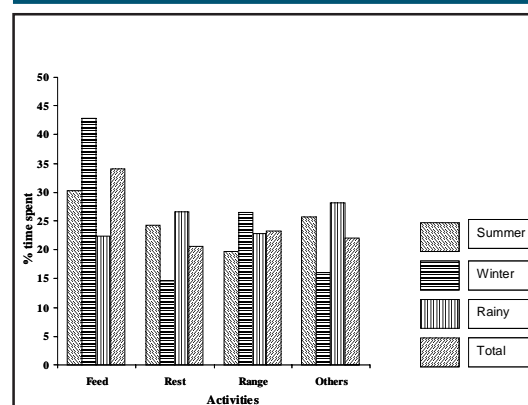
(Table 1). Four of these 7 groups were monogamous with an adult pair, sub-adults and juveniles. Three solitary individuals (2 Adult male and one adult female) were present as one-animal group. Tilson (1979) also identified solitary individuals in Assam and described them as a floating population who travel through 2-3 established territories, do not sing and avoid other groups. I also did not notice them singing.

#### 3.2 Activity pattern

Group scan yielded 1313 records (at times all three individuals were not visible) in this study. Feeding accounted for 34.1% of the total activity time, followed by ranging (23.2%) and resting (20.6%). Other activities (playing, grooming, singing etc.) accounted for 22.1% (Fig. 2).

Time spent on different activities varied seasonally and during different hours of the day. Daily activity period ranged between 11 to 14 hours, of which, about half was spent on feeding alone. The animals were more active in winter compared with the other two seasons. Time spent feeding was highest in winter months. Animal spent most time feeding between 0600 – 0900 hours in any given season. Time spent ranging was also high in the winter months. In summer months more time was spent ranging between 0600 – 0900 hours, while in winter and monsoon months ranging was

**Fig. 2 : % Time spent in different activities in different seasons by hoolock gibbon**



**Table 1: Group size and composition of gibbons in Gumti Wildlife Sanctuary**

Group No.	Adult male	Adult female	Sub-adult	Infant	Total
1	1	1	1	-	3
2	1	1	1	-	3
3	1	-	-	-	1
4	-	1	-	-	1
5	1	-	-	-	1
6	1	1	1	-	3
7	1	1	-	1	3
Total	6	5	3	1	15

Mean Population                      0.86                      0.71                      0.43                      0.14                      2.14

more between 0900-1200 hours. Animals spent more time resting in summer months between 1200-1500 hours in the summer months and from 0900 to 1200 hours and from 1600 to 0900 hours in winter and monsoon months, respectively (**Fig. 3**).

### Use of Plant parts

The diet consisted of leaves, flowers, fruit, seeds and insects. Of the total time spent feeding, 59.1% was spent on fruits, followed by leaves (21.7%). Flowers and seeds accounted for 11.2% and 5.3%, respectively. Feeding on animal matters (insects) was the least (2.7%). Time spent feeding on fruit was consistently higher through all the months than any other plant part (**Table 2**).

### Use of Plant species

The gibbons used 13 food plant species (**Table 3**) for food (10 families; 11 genera). Of these,

69.2% were used for fruit diet, 61.5% for leaves, 38.5% for flowers and only 15.4% for seeds.

Three *Ficus* species alone accounted for about 90% of the total feeding time on fruit. Five species (*Ficus religiosa*, *F. indica*, *Eugenia jambolina*, *Lagerstroemia parviflora* and *F. bengalensis*) accounted for about 70% of the total feeding time. Of these five, *F. religiosa* and *F. indica* were most used (23.5% and 22.8% of the total feeding time, respectively) due to round the year availability of fruit, as compared to the remaining three species. *E. jambolina* was most preferred (preference index (PI) 9.9), followed by *L. parviflora* (PI, 8) and *F. indica* (PI, 1.5).

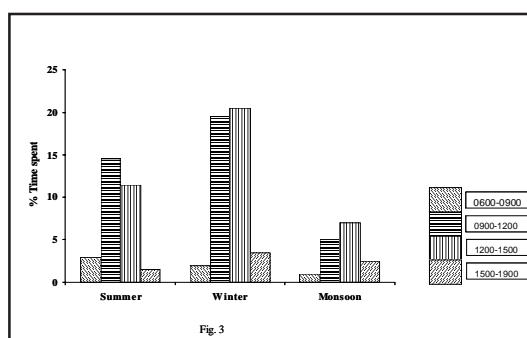
### 3.2 Ranging behaviour

Average day range was 550 meters (range = 200-900m). The animals ranged more in winter months followed by summer and least in monsoon. Ranging was more in the forenoon in summer and in the afternoon during winter months (**Fig. 3**). In most cases adult female initiated ranging, followed by other group members as a cohesive unit. The inter-individual distance ranged between 10-12m.

### Singing

During the course of this study, I encountered 196 singing bouts from the study group and two neighbouring solitary groups (one adult male and female) in response to songs from the study group. In absence of the required

**Fig. 3 : % Time spent in Ranging in different hours of the day in three distinct seasons**



**Table 2: Percentage time spent feeding on various plant parts and % number of food plant species used for corresponding plant part by hoolock gibbon.**

Part	% of plant parts eaten					% of total plant species used		
	Minimum		Maximum		Mean	Min.	Max.	Mean
	%	Month	%	Month				
Leaves	2.1	Nov	24.3	Jan	21.7	11.4	70.2	61.5
Flowers	2.2	May	14.8	Dec	11.2	0.0	44.4	38.5
Fruit	21.3	May	65.2	Dec	59.1	29.4	72.8	69.2
Seeds	0.0	Nov	9.2	Mar	5.3	0.0	20.2	15.4
<b>Number of feeding bouts = 447</b>						<b>Number of food plant species = 13</b>		

**Table 3: List of food plant species and plant parts used by hoolock gibbon**

Species	Family	L	Fr	S	Fl
<i>Salmalia malabarica</i>	Bombaceae	-	+	-	-
<i>Ficus indica</i>	Moraceae	+	+	-	-
<i>Ficus religiosa</i>	Moraceae	+	+	-	-
<i>Ficus bengalensis</i>	Moraceae	+	+	-	-
<i>Macaranga denticulate</i>	Euphorbiaceae	+	-	-	+
<i>Pterospermum alata</i>	Sterculiaceae	-	-	-	+
<i>Lagerstromia parviflora</i>	Lythraceae	+	+	-	+
<i>Artocarpus chaplasha</i>	Moraceae	+	+	+	-
<i>Ziziphus jujuba</i>	Rhamnaceae	-	+	-	-
<i>Terminalia bellerica</i>	Combrataceae	+	+	+	-
<i>Michelia champaca</i>	Magnoliaceae	+	-	-	+
<i>Delonix regia</i>	Leguminoceae	+	+	-	+
<i>Syzygium cumini</i>	Myrtaceae	-	+	+	+

L= Leaves; Fr = Fruit; S = seeds, Fl – Flowers; ‘+’ = eaten, ‘-’ = not eaten

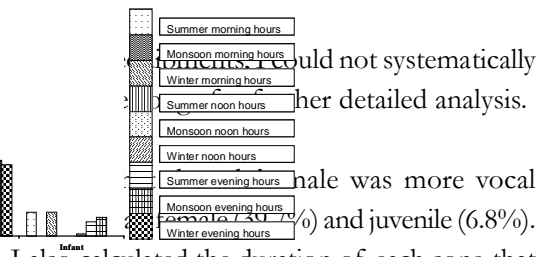


Fig. 4

I also calculated the duration of each song that lasted for about 30-35 seconds, with uniform time gap between two successive songs. I also noted that the juveniles produced more of high-pitched songs of shorter duration than their adult counterparts. Singing was more in the morning (63.2%) than evening (29.1%) and afternoon (7.7%) hours. In fact, morning singing bouts helped me in easily locating the study group. In summer months most morning calls were between 0600-0800 hours, while in winter (>70%) between 0800 to 1000 hours (Fig. 4).

#### 4. Discussion

Gibbons are monogamous, largely arboreal, large bodied, frugivorous primates, who live in

small family group. The activity budget especially time spent feeding on different plant parts including fruit, use of *Ficus* species as main food plants, ranging patterns, and song and singing behaviour by the gibbon in this study is comparable with few major studies by Feeroz and Islam (1992), Alfred and Sati (1994) and Ahsan (1994), Kakati (1997) (Table 4). The group in this study, however, differed in the number of food species and brachiation. In

**Fig. 4: % Sex-wise and season wise time spent singing during different hours of the day**



**Table 4: Comparison of the dietary composition of different species of family Hylobatidae**

Species	% of diet					Source
	Fruit	Fig	Leaves	Flowers	Animals	
<i>H. agilis</i>	58	22	39	3	1	Gittins, 79
<i>H. concolor</i>	21		72	7	0	Lan, 93
<i>H. klossii</i>	72	23	2	0	25	Whitten, 84
<i>H. lar</i>	50	22	29	7	13	Raemaekers, 77
<i>H. moloch</i>	61		38	1	0	Kappeler, 84
<i>H. muelleri</i>	62	24	32	4	2	Leighton, 87
<i>H. pileata</i>	71	26	13	0	15	Srikosamatara, 84
<i>H. syndactylus</i>	41		48	5	6	Chivers, 74
<i>H. hoolock</i>	67		32	0	1	Tilson, 79
<i>H. hoolock</i>	40		50	10	0	Mukherjee, 86
<i>H. hoolock</i>	89	38	5	6	0	Feeroz & Islam, 92
<i>H. hoolock</i>	71	41	14	6	2	Ahsan, 94
<i>H. hoolock</i>	59		22	11	3	This study

this study, gibbons used only 13 food species as compared to 43 (Tilson, 1979) and 40 (Ahsan, 1994). Small number of food species was an indication of both less plant diversity (Gupta and Kumar 1994) and non-availability of existing food resources due to biotic disturbances, especially shifting cultivation, which can further reduce the plant diversity and in the process may even remove most favoured ficus (three) species accounting for about 90% of the total time spent feeding on fruit by gibbon study group. These ficus species may be ranked as keystone species and should be protected. It is worth noting here that because of their small bole size and short tree height the ficus trees are cut and burnt at the time of cleaning the forest patches for shifting cultivation. Secondary forests with drastic reduction in plant species diversity, which now surround the patches of primary forests, fail to support resident groups of frugivorous gibbons requiring year round supply of fruit. Mean group size of gibbon populations in Tripura is lowest compared with other gibbon populations in neighbouring northeastern states and Bangladesh (Table 5), mainly because of the fragmented status of the gibbon habitat coupled with the heavy pressure of shifting cultivation, which is further adding to the fragmentation of the habitat and replacement of the primary forests with secondary forests.

Being highly adapted to brachiation, gibbons cannot move across even short stretches of young secondary forest fragments because of canopy discontinuity. With decreasing fallow periods of shifting cultivation this discontinuity is on the increase resulting into serious adverse repercussions on the gibbon population increase through the formation of new groups.

### ***Ranging***

Availability and distribution of food resources in different seasons determined one of the two distinct types of ranging patterns; short distance ranging within the large food patches, and long distance ranging between scattered food patches. The seasonal variations in the day range movement are generally correlated with feeding activity.

### ***Singing***

Singing is perhaps the most dramatic and energetically costly behaviour (Chivers, 1985). While it is most commonly explained as territorial advertisement and defense, as inter-group communication, there is evidence to show that singing is crucial in the formation, development and maintenance of the pair bond (Brockelman and Srikosamatara, 1984). Candler (1904) and McCann (1933) have both

**Table 5: Group size of hoolock gibbon populations in other studies**

Area	Groups (N)	Mean Group size	Source
Meghalaya and Assam	24	3.2	Tilson, 79
Eastern Bangladesh	6	3.5	Gittins, 82
Bangladesh	5	2.3	Ahsan, 84
Tripura	9	3.0	Mukherjee, 86
Lawachhera RF, Bangladesh	6	4.0	Siddiqi, 86
Arunachal Pradesh	12	3.2	Mukherjee et al., 88
West Garo Hills, Meghalaya	42	3.0	Alfred & Sati, 90
Assam	8	3.1	Choudhury, 90
Assam	14	3.0	Choudhury, 91
Lawachhera & Chunati, Bangladesh	13	2.9	Feeroz & Islam, 92
Tripura	27	2.1	Gupta, 94
Lawachhera & Chunati, Bangladesh	15	2.9	Ahsan, 94
Gumti WLS, Tripura	7	2.1	This study

described that gibbon song is an elaborate duet between the adult pair. The adult male initiates the songs with a single high note given two to three times in succession and repeats the series if the female does not respond. Ahsan (1994) has suggested that songs serve a variety of complex functions: maintenance of pair bond; concentration and reinforcement of social ties within group; mate attraction and pair formation; mate defense; advertisement for a mate; and territorial advertisement, defense and fitness. The reasons for the late start of the morning calls can be related with the observations by Tilson (1979), who described the late start and restricted distribution of winter songs as a function of shorter day light hours and colder temperature associated with extensive basking before starting the day's activity.

### **Conservation**

Deforestation and habitat fragmentation are two major conservation problems for gibbons in Tripura. As compared to other northeastern states where gibbons are distributed, fortunately, hunting is not a major threat for gibbons in Tripura due to effective protection and legal measures across the state. Deforestation and habitat fragmentation,

however, are still continuing, which is associated with the socio-economic and socio-cultural life-style of many tribal groups that form an integral part of PA and depend upon natural resources for most of their life-supporting needs. Shifting cultivation is one such need. Shifting cultivation in its non-traditional form (Gupta and Kumar, 1994) has replaced vast continuous tracts of evergreen forests, especially on gentle hill slopes and low lands, with open canopied, low-plant- diversity deciduous forests; moist and dry low quality bamboo brakes; and open grasslands of *Imperata cylindrica*. Evergreen forests, which are ideal gibbon habitats, are now present only in small isolated fragments on difficult and inaccessible terrains that have escaped the human pressure more due to inaccessibility. Fragmentation causes reduced food supply (Scott, 1998), which is evident in this study where only 13 food species are supporting the gibbon population. Kakati (1997) also reported similar results in Assam where 18 out of more than 207 species present in the home range of gibbon accounted for about 80% to total feeding time. This shortage in fruit may force the frugivorous primates to respond by including alternative food, such as: leaves, insects, seeds, bark, vines, etc. But, gibbons have a very limited ability to digest leaf

material (Vellayan, 1981) and high dependence on leaves may cause nutritional stress to them

The ideal conservation measures may include a moratorium on further conversion of existing primary forest patches into secondary forests either through degradation or outright deforestation through shifting cultivation. This is necessary even in the short term both for the survival of the hoolock gibbon and human population since these primary forest patches function as seed banks in the regeneration of the fallow forest patches created as a result of shifting cultivation.

### ***Shifting Cultivation***

The regenerating secondary forests should be protected from further jhuming to act as viable corridors linking existing primary forest patches. A functional management plan must immediately be drawn up for Gumti WLS to achieve this objective. This can also be achieved by utilising the provisions of conservation and community reserves as per the amended Wildlife (Protection) Act 2003. Artificial regeneration using suitable plant species to supplement natural regeneration is advised. The major objective should be to restore canopy contiguity between primary forest patches to facilitate dispersal of hoolock gibbons across its distribution range within the Sanctuary for out-breeding.

The practice of shifting cultivation within the Sanctuary needs to be examined in greater detail from the perspectives of the socio-cultural aspects of the tribals and ecological aspects of the wild flora and fauna. Shifting cultivation can be examined in terms of time (the fallow period) and space (the actual areas selected for shifting cultivation). Shifting cultivation should be separated in time and space so that: a) adequate areas of secondary forests (15 years or older) are always available next to the proposed jhuming areas, b) attempt should be made to only allow jhuming over fallow areas

of more than 15 years c) sufficiently large areas near existing primary forests need to be totally protected from shifting cultivation. Regeneration in these areas could be assisted through artificial planting of food plant species to enhance survival of gibbons within the Sanctuary.

Since complete ban on shifting cultivation within a short span of time is neither possible nor feasible, the attempts should be made to keep the existing mean fallow period overall uniform, but increase the spatial variation. Shortening of the duration of fallow period and lack of soil conservation measures have been two main reasons responsible for the degradation of shifting cultivation areas into *Imperata cylindrica*, *Mikania scandans* and other weed dominated areas making them unsuitable even for shifting cultivation. Appropriate soil and moisture conservation measures to restore jhumed habitats would constitute a major priority.

Further settlement of people in and around the Sanctuary is strongly discouraged. Incentives to the people to evacuate them from the Sanctuary area must be considered through participatory forest management and ecodevelopment programmes.

The frugivorous diet, high territoriality and adaptations for brachiation easily make the gibbons one of the most threatened species in those areas where habitat loss and fragmentation have been intense, particularly when the short fallow period between shifting cultivation prevents the restoration of species diversity and canopy contiguity in secondary forests.

## **4. Acknowledgement**

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