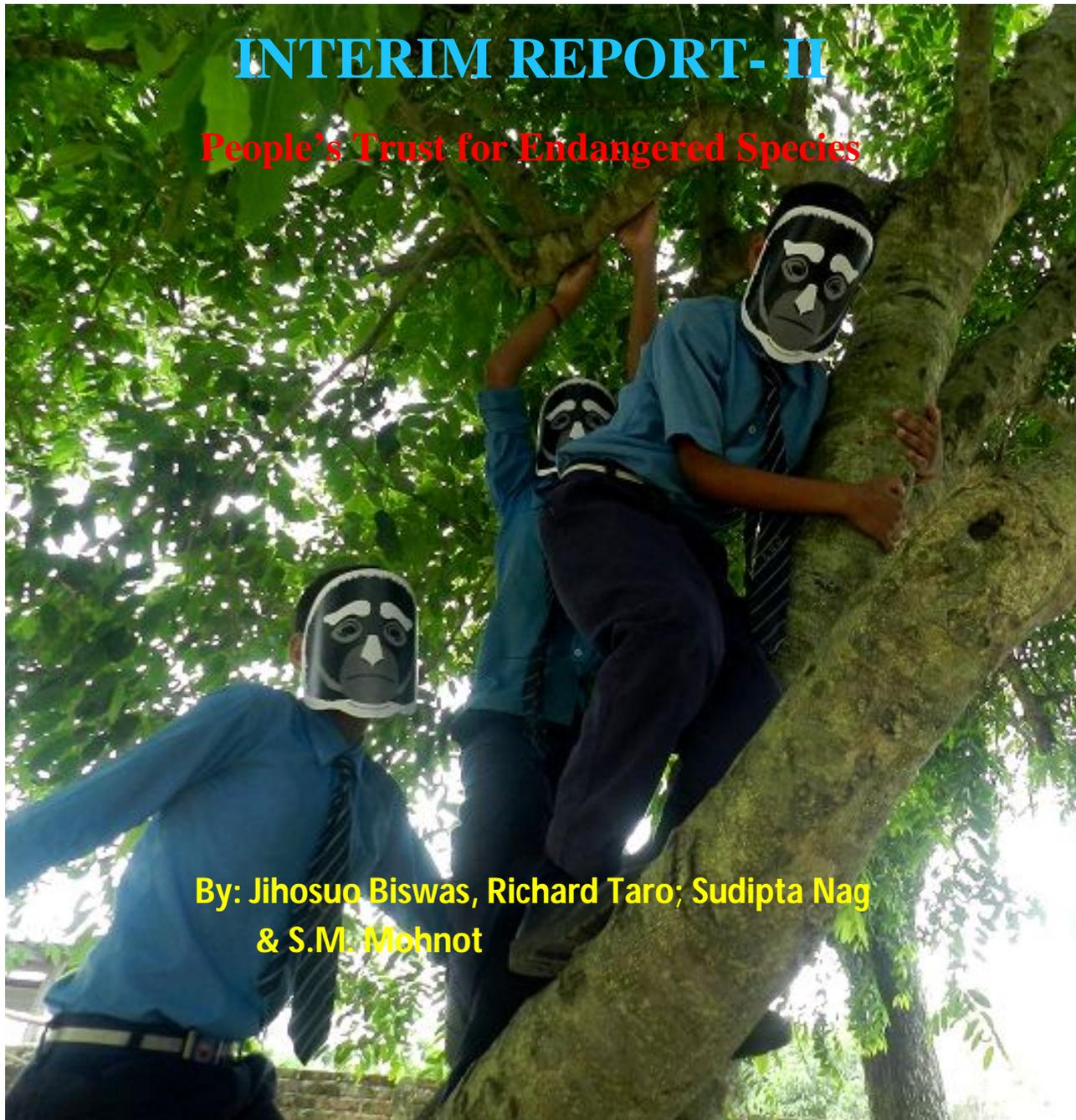


INTERIM REPORT- II

People's Trust for Endangered Species



By: Jihosuo Biswas, Richard Taro; Sudipta Nag
& S.M. Mohnot

Adopting an inclusive approach of research, capacity building, community education and outreach to conserve Western Hoolock Gibbon in Karbi Anglong under Kaziranga-Karbi Anglong landscape, Assam, India



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Interim Report-II

1st October 2014

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HIGHLIGHTS OF THE MAJOR ACCOMPLISHMENT

- Gibbon population estimation by using auditory method was applied in Dhanshiri-Borlangpher and Khuriming – Panimur – Amren priority forest complexes of Assam, India. A total 48 individual in 16 groups were directly observed and a total 95 duet calls from 19 listening posts was recorded during census.
- The estimated population of gibbon in these two forest complex under Karbi Anglong district of Assam is 125 – 155 groups and 370 – 450 individuals.
- The group size is invariably small (2.8 ± 0.6) with lower percentage of juvenile (18.05%) and infants (14.5%) indicated low recruitment rate and infant mortality.
- Mapping of the habitat in these two priority complexes in GIS environment was done. The available habitat left for gibbon in these priority complexes is 374.5 km² of which 75.9 km² is primary habitat and 298.5 km² is secondary habitat.
- Habitat destruction in the form of jhoom cultivation and illegal logging was found to be single largest factor affecting the population in these forest complexes.
- Hunting in Dhanshiri - Borlangfer priority forest complex and Khuriming RF results low population size.
- A total eleven school programs covering 779 students and one three days long intensive nature orientation camp on Hoolock gibbon was organized covering 30 participants.
- Two paper based on this study were presented in international (IPS) seminars.

INTRODUCTION

Western Hoolock gibbon or white-browed gibbon, *Hoolock hoolock* (Harlan, 1834) is one of the 2 species of lesser apes found in India. The species is distributed in the seven northeastern States apart from British Burma now Myanmar (Tickell, 1864), Chittagong Hill Tracts of Bangladesh (Anderson, 1878) and probably in Lao PDR (SSC, Red Data Book, IUCN, 2000). While the population of this gibbon species in Bangladesh remains <500 individuals, Myanmar and the state of Assam holds the major population (> 95%). The species is listed as ‘Endangered’ in the IUCN Red List of Threatened Species (Brockelman *et. al.* 2008) and ‘Appendix-I of CITES. It also enjoys highest legal protection as ‘Schedule-I’ species under ‘The Indian Wildlife (Protection) Act, 1972’ amended in 2002 in India.

Gibbons live as single, territorial family groups, comprising a monogamous pair and up to four offspring. They prefer middle and upper canopy of the tropical and sub-tropical rain forests as well as moist deciduous forest.

Gibbons are mainly frugivorous. Since, fruit is a limited resource in the forest, gibbon protect their territory by producing a high-pitched ‘belching growl’ vocalization call or ‘song’ which can be heard very clearly over a kilometer (Mootnick, *et al.*, 1987). Both the male and female produce loud call together called ‘duet’ to establish their territory by singing to each other. When one family group is singing, the other groups of the neighboring territory respond.





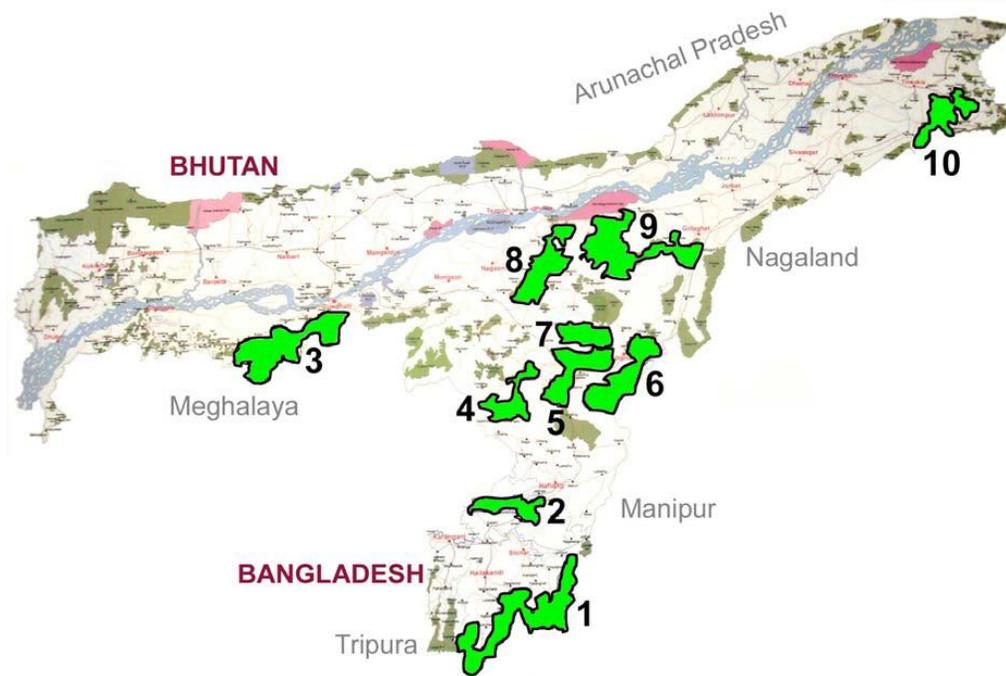
Gibbons are brachiators and to support this suspensory mode of locomotion, they require contiguity of forest canopy. Habitat disturbance in the form of canopy breakage in the forest has restricted their movement and isolated them in smaller patches, even within large forest patch.



Like other gibbon species, western Hoolock gibbons also have experienced a drastic population decline both in Assam and elsewhere in other north-eastern states of India due to rapid habitat loss and fragmentation. During last 3 – 4 decades, the population of western Hoolock gibbons in Assam declined from > 80,000 to < 5,000 individuals - a decline of more than 90% (Chivers, 1977; Das *et. al.*, 2009).

Assam constitutes the highest population of western Hoolock Gibbon in India (> 65%). Ten priority ‘conservation areas’ or ‘forest complexes’ for western Hoolock gibbon have already been identified on the basis biological importance (BI) i.e. high primate diversity and landscape integrity (LI).

Each priority forest complex comprised cluster of wildlife sanctuaries (WLS), reserved forests (RF), District Council Reserved Forest (DCRF), proposed reserved forests (PRF) and unclassified state forest (USF) (table-1) (Das *et. al.*, 2006; Das, *et. al.*, 2009). The spatial relationships between the areas of remaining forest, estimated gibbon population; conservation gaps based on the viability and representation analysis and remaining habitat blocks were used to identify these priority conservation area. These areas or forest complexes have the greatest potential for long term conservation of western Hoolock Gibbon in Assam.



Map -1: Map showing different priority forest complex of Hoolock gibbon in Assam, India

S. No.	Districts	Priority Conservation Landscape	Area Km ²	Gibbon habitat (%)	Primate diversity
1	Cachar, Karimganj	Innerline-Katakhal-Singla Complex	1291	35%	1,2,3,4,5,6,7,8
2	Karbi Anglong, Golaghat	Langlakso-Mikir Hills-Kalyoni Complex	1104.5	55%	1,2,3,4,5,8
3	Dibrugarh, Tinsukia	Joypur-Dirak-Upper Dehing-Dilli-Abhayapuri Complex	580.0	60%	1,2,3,4,5,8
4	NC Hill	Barail-North Cachar Complex	300.0	45%	1,2,3,4,5,7,8
5	Karbi Anglong	Marat Longri-Patradisa-Longnit Complex	802.0	40%	1,2,3,4,5,8
6	Kamrup	Rani-Garhbhanga Complex	281.0	55%	1,2,3,4,8
7	Karbi Anglong	Khurimming-Panimur-Amreng Complex	186.0	28.8%	1,2,3,4,5,8
8	Karbi Anglong	Dhanshiri-Borlangfer Complex	984.0	50%	1,2,3,4,5,8
9	Karbi Anglong, Nawgaon	Martlongri and adjacent areas.	802.0	55%	1,2,3,4,8
10	Nawgaon	Lumding RF	252.9	40%	1,2,3,4,8

(1- Hoolock gibbon, 2-Capped langur, 3- Assamese macaque, 4-Rheussu macaque, 5-pig-tailed macaque, 6-Phayre's leaf monkey, 7-Stump tail macaque, 8-Slow loris)

Table-1: List of priority forest complexes of Assam for Western Hoolock Gibbon showing primate diversity.

STUDY AREA

Of these ten priority forest complexes of Assam, the Karbi Anglong district of central Assam, which is an Autonomous Council (KAC) under the 'VIth Schedule' of Indian Constitution alone, comprises five priority complexes, contributing about 60% gibbon population of the State.

Of these five priority complexes, Dhanshiri-Borlangfer Complex (984 km²) is one of the important forest complex prioritized for conservation of western Hoolock Gibbon in Assam. It comprises Dhansiri RF (770 km²), Borlangfer RF (77 km²) Daldali RF (123.6 km²) and Tamulbari RF (13.4 km²) (fig -1) and important elephant corridor connecting Lamding RF and Itanki NP of Nagaland.

Similarly the Khurimming-Panimur-Amreng forest Forest Complex (186 km²) is another important forest complex having cluster of reserved forest (RF) and proposed reserved forests (PRF) (fig-2). The complex is situated in Hamren sub division of Karbi Anglong and comprises Khurimming RF (67.9 km²), Panimur PRF (55.3 km²) and Amreng RF (62.8 km²).

Both the complexes have huge conservation potential, not only for gibbons, but also for other threatened species like elephant, etc. They could support substantially good population of western Hoolock gibbon. But despite having huge conservation scope, both the forest complexes of Karbi Anglong Autonomous Council (KAC) are facing enormous anthropogenic pressure ranging from severe habitat loss, encroachment, fragmentation and degradation even hunting, making the species extremely vulnerable. Since, forest being Council (KAC) subject having separate legislation, State authority cannot interfere on it. And there is very week capacity of wildlife protection in the council. No separate wildlife wing of the forest department under the Council (KAC) has been established till date to protect wildlife and their habitat in Karbi Anglong. Management of most of these forests and wildlife is either on ad hoc basis or depending on the crisis.

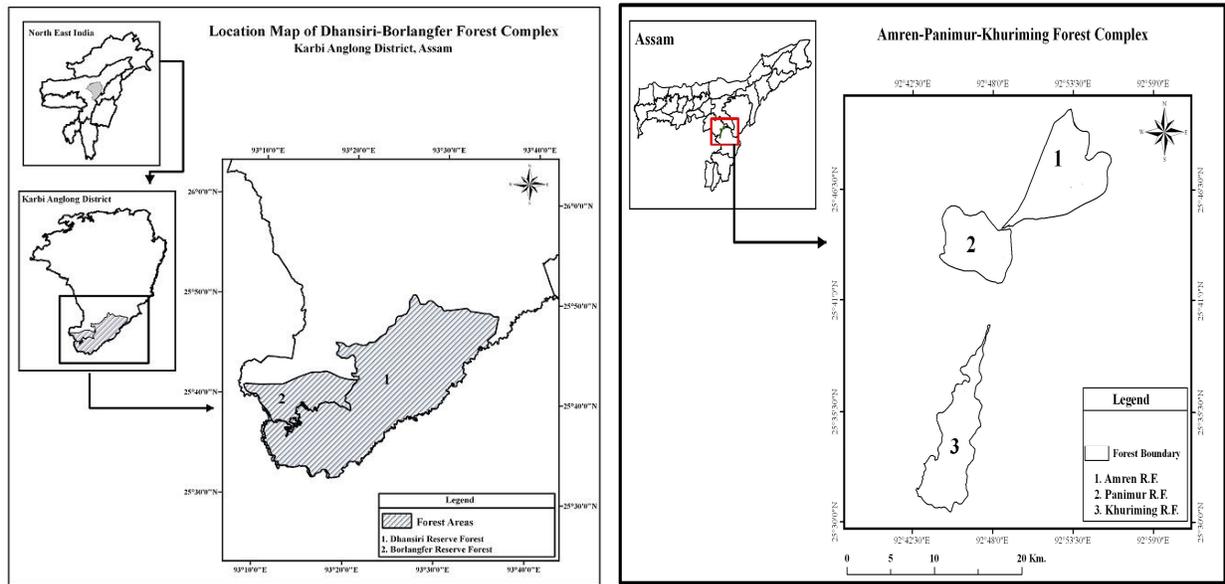


Fig-1: Dhanshiri - Borlangfer forest complex

Fig-2: Khurimming-Panimur-Amreng complex.

Keeping these in view and long term need of the remaining key gibbon habitat protected from further alteration, present project was initiated under the support from People's Trust of Endangered Species for a number of reasons: 1) there is a lack of information of its population and habitat status for strategy planning, 2) it is threatened by habitat loss and hunting, 3) there is weak capacity for protection, 4) and there is no awareness education among communities where it resides. This project is the follow-up action of the previous project supported by PTES and achieved through following activities:

- 1) Gibbon population surveys over a period of one year,
- 2) Socio economic survey of the fringe villager to assess the threat.
- 3) Awareness campaign for promoting conservation and public awareness,
- 4) Organizing strategic planning workshop for western Hoolock gibbon in Karbi Anglong district, Assam.
- 5) Train and facilitate front line forest staffs as a part of capacity building program.

PROJECT GOAL & OBJECTIVES

Goal: Conserving Dhanshiri - Borlangfer and Khuriming - Panimur - Amren forest complexes focusing on Western Hoolock Gibbons as flagship species.

Objectives

- (i) *Research:* To collect baseline information on population density, habitat status and demographic status of gibbons and to identify threats in remaining two complexes e.g. Dhanshiri-Borlangfer and Khurimming-Panimur-Amreng forest complexes, which covers 6 forests under these 2 complexes.
- (ii) *Action Plan:* To develop site specific action plan for Hoolock gibbon in the Karbi Anglong Autonomous Council (KAC).
- (iii) *Capacity building:* To train front line forest staff of Karbi Anglong Autonomous Council (KAC) on different techniques of wildlife monitoring to improve their skills.
- (iv) To boost the morale of the staffs for better performance by facilitating field gears and equipments.
- (v) *Education:* To initiate community outreach program through participatory conservation awareness and education campaign for the species. 20 one day long school education program, 10 one day long community education program, 3 three days long intensive education programs.

GIBBON POPULATION ESTIMATION

While considerable survey work has been carried out on western Hoolock gibbon in other parts of the state as well as in Northeast India and Bangladesh (Gittins, 1984; Gittins & Tilson, 1984; Choudhury, 1990; Das *et. al.*, 2003; 2005; 2009; Molur, *et. al.*, 2005), nothing has been done for Karbi Anglong district of Assam except one report, which was published based on preliminary observations (Choudhury, 2009). Owing to the fact that there is a gap of information of the species status and habitat quality, while having huge conservation potential we have undertaken a survey of these two priority complexes.

Methods

Census methods:

The survey covered all the Reserved Forests, Proposed Reserve Forests and DC RFs under Dhanshiri-Borlangfer and Khurimming-Panimur-Amreng forest complexes to know the population structure, densities and group composition. For this, extensive survey to know the demographic details by direct count method i.e. modified line transects method (Burnham *et al.*, 1980; Mohnot *et. al.*, 1998; NRC, 1981; Srivastava *et. al.*, 1999; Struhsaker, 1975) and intensive survey to know the density by indirect or call count method (Brockelman & Ali, 1987; Brockelman & Srikosomatara, 1993) was used.

Data was taken only in dry season from November, 2013 to March, 2014, since singing bout is limited during rainy season. After collecting the calls, the estimated numbers of gibbon groups for each post was computed.

Results

Altogether 285 km long transect having ~ 4.5 km each was laid in two forest complexes covering all forest and vegetation type for demographic and habitat survey.

A total of 48 individuals in 16 family groups and one lone male individuals of western Hoolock gibbon were observed during the survey. Of these, 34 individuals in 14 family groups was observed in Dhanshiri-Borlangfer forest complex and 14 individuals in 4 family groups and one lone male individuals were observed from Khurimming-Panimur-Amreng forest complex.

The overall average group size of both the forest complexes was 2.8 ± 0.6 per family groups ranging from 2 to 4 individuals (table -2). Both the forest complexes having similar group size (Dhanshiri-Borlangfer forest complex 2.8 ± 0.4 and Khurimming-Panimur-Amreng forest complex 2.8 ± 1.0).

Although, the percentage of age group (adult to juvenile and infant) varies considerably between forest complexes and also from forest to forest even within the same complex. The age sex ratios of the gibbon groups in both the forest complexes are given in the table – 2.



Photo: Data collection by PI & Researchers

Sl. No	Landscape	Name of the Forest	Total Group	Group size	% of age composition		
					Adult	Juvenile	Infant
1	Dhanshiri-Borlangfer Complex	Dhanshiri RF	8	2.9±0.35	69.6%	17.4%	13.0%
2		Barlangfer RF	2	2.5±0.7	80.0%	-	20.0%
3		Tamulbari RF	-	-	-	-	-
4		Daldali RF	2	3.0±0.0	66.6%	33.3%	33.3%
Total / average				2.8±0.4	70.6%	14.7%	14.7%
3	Khuriming -Panimur- Amren Complex	Amren RF	2	2.33±1.1	71.4%	14.3%	14.3%
5		Khuriming RF	2	3.5±0.7	57.1%	28.6%	14.3%
Total / average			16	2.8±1.0	64.3%	21.4%	14.3%

Table -2: Demographic details of Hoolock gibbon groups observed during survey.

Population density:

To estimate the density of gibbons in both the forest complexes, apart from line transect method, we established 19 listing post or sites across the two forest complexes, Dhanshiri-Borlangfer (n = 12) and Khuriming – Panimur - Amren (n = 7). During our study, we have attempted to cover all the RFs and PRFs under each forest complexes but due to some problem related to law and order in the bordering areas of Karbi Anglong, Assam and Nagaland in Daldali RF under Dhanshiri - Borlangfer forest complex, we could not conduct our study.

We recorded 95 duet calls across 19 listening sites in two forest complexes. We did not heard any calls from Tamulbari RF under Dhanshiri - Borlangfer forest complex and Panimur RF under Khuriming -Panimur- Amren forest complex, which are heavily disturbed by human activities. We have confirmed the absence of Hoolock gibbon from these two localities from the villagers, so we discard both the RFs for our calculation. All the 19 listening post or sites (LP) are mapped in figure 3 & 4. We arbitrarily assumed that all groups could be heard within a distance of 1 km from each listening post, and the total area within 1 km radius of any LP was taken as the listening area (LA). All groups that mapped within 1 km radius of an LP are used for

density calculations. But we also assumed that groups that were behind hills from LP may not be audible from 1 km. So to provide a check on the reliability of these assumptions, we performed another density calculation using a listening area radius of 600 m, and all groups within 600m of any LP were also used in density determination apart from 1km radius. Groups behind hills sound more distant and many such groups 600 – 1000m away may have been considered to be farther than 1 km away, and therefore not included in the listening area.

Name of the Forest	Listening Area in respective radius		No. of Groups in respective radius		Density / sq. km in respective radius	
	1 km	600m	1 km	600m	1 km	600m
Dhanshiri RF	4.5	2.17	2.30	1.87	0.51	0.86
Borlangfer RF	3.9	1.9	0.33	0.00	0.08	0.00
Mean	4.2	2.02	1.31	0.93	0.31	0.46
Amren RF	4.47	2.19	0.48	0.33	0.11	0.14
Khuriming RF	4.64	2.22	3.21	1.92	0.69	0.87
Mean	4.55	2.21	1.85	1.13	0.41	0.51

Table - 3: List of census sites with listening areas and gibbon group densities for listening radii of 1 km and 600m from the listening post.

The results of the density estimates, size of the listening area and number of groups heard of 1-km radius area as well as 600m radius area for all the forests under two forest complexes are given in the table – 3. They do not differ greatly, although the estimate using the smaller radius usually gave a slightly higher density. These densities (with standard errors of the mean) ranged from 0.00 to 0.90 groups km^{-2} (mean \pm SE = 0.31 ± 0.23 groups km^{-2}) for the larger 1-km radius listening area, and from 0.00 to 1.03 groups / km^2 (mean \pm SE = 0.46 ± 0.28 groups km^{-2}) for the 600m listening radius in Dhanshiri-Borlangfer forest complex. While the densities of gibbon in Khuriming – Panimur - Amren forest complex ranged from 0.00 to 0.69 groups km^{-2} (mean \pm SE = 0.41 ± 0.19 groups km^{-2}) for the larger 1-km radius listening area, and from 0.00 to 0.95 groups km^{-2} (mean \pm SE = 0.51 ± 0.32 groups km^{-2}) for the 600m listening radius.

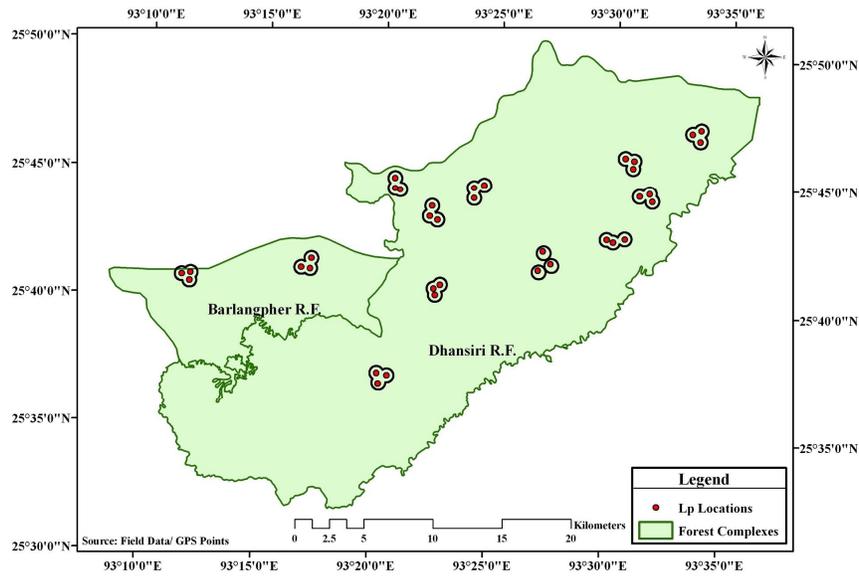


Fig - 4: Map showing census area of different forests under Dhanshiri - Borlangfer forest complex with 1 km radius listening area and LP position.

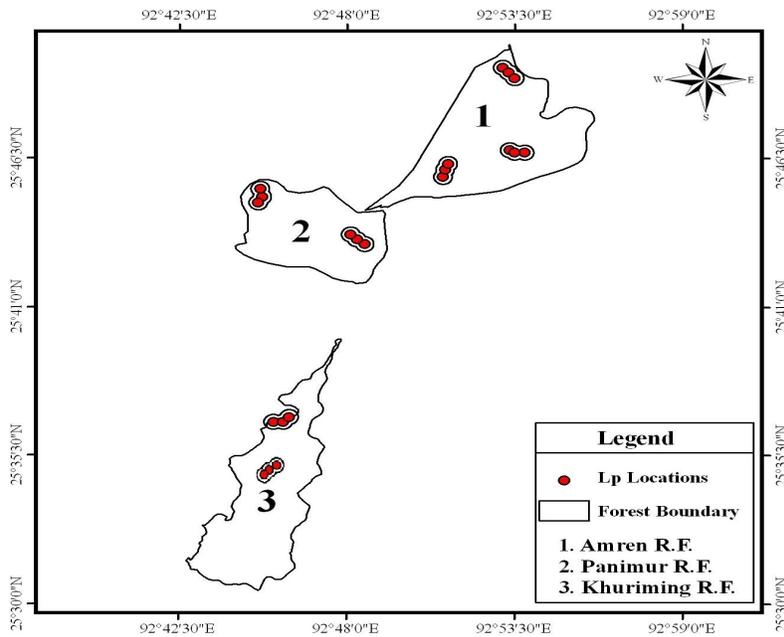


Fig - 5: Map showing census area of different forests under Khuriming - Panimur - Amren forest complex with 1 km radius listening area and LP position.

Gibbon population estimation:

Based on satellite data and GIS analysis (table – 6 & 7), the available habitat of Hoolock gibbon in Dhanshiri - Borlangfer forest complex is about 325.8 km² including primary (60.6 km²) and secondary habitat (285.2 km²). The overall density of gibbon Dhanshiri - Borlangfer forest complex irrespective of habitat type is 0.31 ± 0.23 groups' km⁻² for the larger 1-km listening radius and 0.46 ± 0.28 groups km⁻² for the 600m listening radius excluding Daldali RF. But the densities varies greatly between forests, as in Dhanshiri RF under Dhanshiri-Borlangfer forest complex, the density if gibbon in both the listening radius yielded greater result (0.51 & 0.86 groups/ km²) from that of Borlangfer RF (0.08 & 0.0 groups/ km²) as well as between habitat types i.e. primary forest habitat and secondary forest habitat. On the other hand the average group size of gibbon in this forest complex is 2.8 ± 0.4 individuals per group. Thus, considering these factors, the estimated Hoolock gibbon population in Dhanshiri - Borlangfer forest complex would be between 100 to 125 groups and 300 to 350 individuals with the mean number predicted at approximately 325.

Similarly the available habitat of Hoolock gibbon in Khuriming -Panimur- Amren forest complex is about 48.7 km² including primary (15.3 km²) and secondary habitat (33.44 km²). Overall density of gibbon irrespective of habitat type is 0.41 ± 0.19 groups' km⁻² for the larger 1-km listening radius and 0.51 ± 0.32 groups' km⁻² for the 600m listening radius. Here also, the densities varies greatly between forests, as in Khuriming RF under Khuriming -Panimur- Amren forest complex, the density if gibbon in both the listening radius yielded greater result (0.69 & 0.87 groups/ km²) from that of Amren RF (0.11 & 0.14 groups / km²) as well as between habitat types i.e. primary forest habitat and secondary forest habitat. The average group size of gibbon in this forest complex is 2.8 ± 0.1 individuals per group. From these observations, after considering all these factors, the estimated Hoolock gibbon population in Khuriming - Panimur- Amren forest complex would be between 25 to 30 groups and 70 to 85 individuals with the mean number predicted at approximately 80 individuals.

HABITAT ASSESSMENT AND MAPPING

The habitats of Hoolock gibbon in these two forest complexes of Karbi Anglong district are found to be two major types: sub tropical semi ever green and sub tropical moist deciduous forest. The deciduous forests of Karbi Anglong are intermingled with ever green trees (Choudhury, 2009). There are also patches of semi ever green forests within the deciduous biotope especially along the streams forming a mosaic. The major tree species includes: *Terminalia myriocarpa*, *Mesua ferrea*, *Artocarpus cham*, *Terminalia myriocarpa*, *Altingia excelsa*, *Ficus sp.*, *Dysoxylum gobara*, *D. procerum*, *Duabhangia sonneratoides*, *Tetrameles nudiflora*, *Dilenia scabrela*, *Bombax ceiba*, *Gmelina arborea*, *Shorea robusta* etc.

The habitats of Hoolock gibbon in entire Karbi Anglong district is under severe anthropogenic pressure resulting from traditional *jhum* cultivation, commercial rubber, beetle nut leaf cultivation and settlement. Since Hoolock gibbons' prime habitat lays in the sub-tropical semi-evergreen and moist deciduous forest, which are heavily destroyed for jhoom cultivation and settlement irrespective of their protection or legal status as reserved forests or wildlife sanctuary. The entire semi evergreen and deciduous forest under Borlangfer RF, Tamulbari RF, Daldali RF and Dhanshiri RF under Dhanshiri – Borlangfer complex is affected by human activities. This loss encompasses roughly $\leq 90\%$ of the forest habitat in some part of Dhanshiri – Borlangfer complex like Tamulbari RF.

Altogether 450 vegetation sample plots were taken at each 500m intervals and at the Hoolock gibbon encounter point during survey of 285 km long transect. Data on habitat quality (within the existing forest and not the actual forest boundary) showed that almost 30.6% of the area of Dhanshiri - Borlangfer complex has less than 20% canopy cover, while 45.4% area of Khuriming – Panimur - Amren complex has less than 20% canopy cover (table – 6). Data also indicate that Dhanshiri - Borlangfer complex have 44.4% area with moderate ($\leq 50\%$) canopy cover which constitute the secondary habitat and 25% area with good canopy cover ($\geq 50\%$) or closed canopy cover which constitute the primary habitat of gibbon. While in Khuriming –

Panimur - Amren complex 36.6% area have moderate canopy cover ($\leq 50\%$) and only 18.2% area with good canopy cover (≥ 50) that constitutes the primary habitat of gibbon.

Forest Complex	Forest	Percentage of canopy cover		
		1-20%	20 – 50%	>50 – 90%
Dhanshiri - Borlangfer	Dhanshiri RF	37.8	43.2	18.9
	Borlangfer RF	56.3	31.3	12.5
	Tamulbari WLS	27.1	39.6	33.3
	Daldali RF	8.3	75.0	16.7
Khuriming – Panimur - Amren	Khuriming RF	19.4	38.9	41.7
	Panimur RF	74.0	25.7	0.00
	Amren RF	42.9	45.8	19.0

1 - Sample plots are vegetation sample units taken during survey.

Table - 4: The number of vegetation sample plots, percentage of each canopy cover class in different forests.

For habitat analysis and mapping, we procured recent satellite images of IRS P LISS-III for both Dhanshiri - Borlangfer and Khuriming – Panimur - Amren forest complexes and analyzed it in GIS environment to get the actual picture of vegetation cover in these two complexes. Based on ground truthing survey we classified the six types of landscape elements (LSE) from both the Dhanshiri - Borlangfer and Khuriming – Panimur - Amren forest complex under Karbi Anglong district. The Physical Landscape Elements are (i) Semi ever green forest, (ii) Moist mixed deciduous forest, (iii) Scrub forest (jhood abandoned), (iv) Degraded forest, (v) Agricultural land with shifting (jhood) cultivation within notified forest and (vi) water bodies. All these landscape elements are spatially well distributed all over these parts of Dhanshiri - Borlangfer and Khuriming – Panimur - Amren forest complexes (Fig- 7 & 8).

Most of the semi evergreen forest lies in the Dhanshiri RF under Dhanshiri - Borlangfer forest complex and Khuriming RF under Khuriming – Panimur - Amren forest complex. These patches have substantial value in Hoolock gibbon conservation since it forms the ideal habitat of

Hoolock gibbon and most of the groups were found from these areas. While most of the parts of both the forest complexes are dominated by the mixed-moist deciduous type of forest.

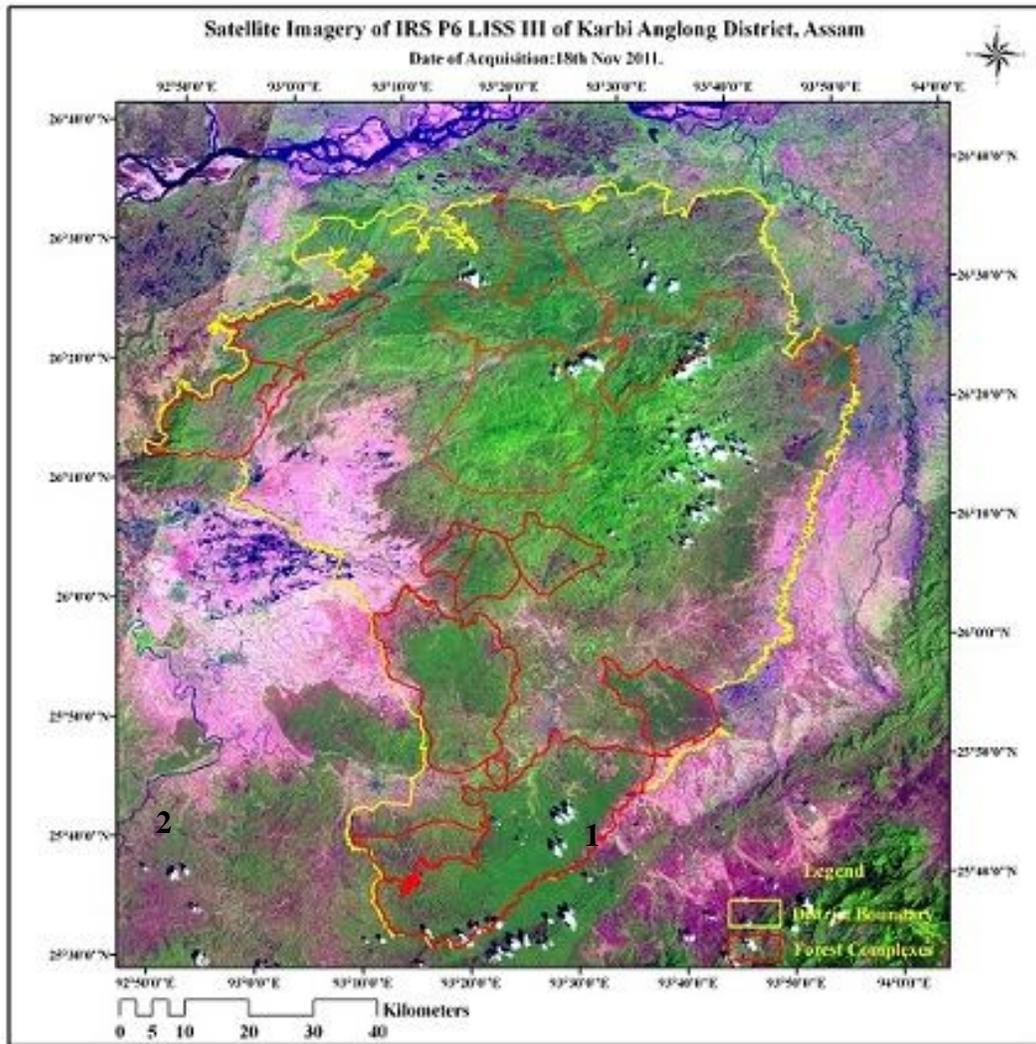


Fig-6: Satellite images of all forest complexes under Karbi Anglong district showing the forest cover and different land use pattern.

We estimate the available gibbon habitat from satellite data. Figure 7 & 8 and table – 5 & 6 shows the current status and land use pattern of different forests as well as encroachment areas within the gibbon habitat in these two forest complexes. These data also tally with our vegetation sample data, which indicate that only 38.3% of the total vegetation cover under Dhanshiri - Borlangfer forest complex excluding Daldali RF constitutes the gibbon habitat.

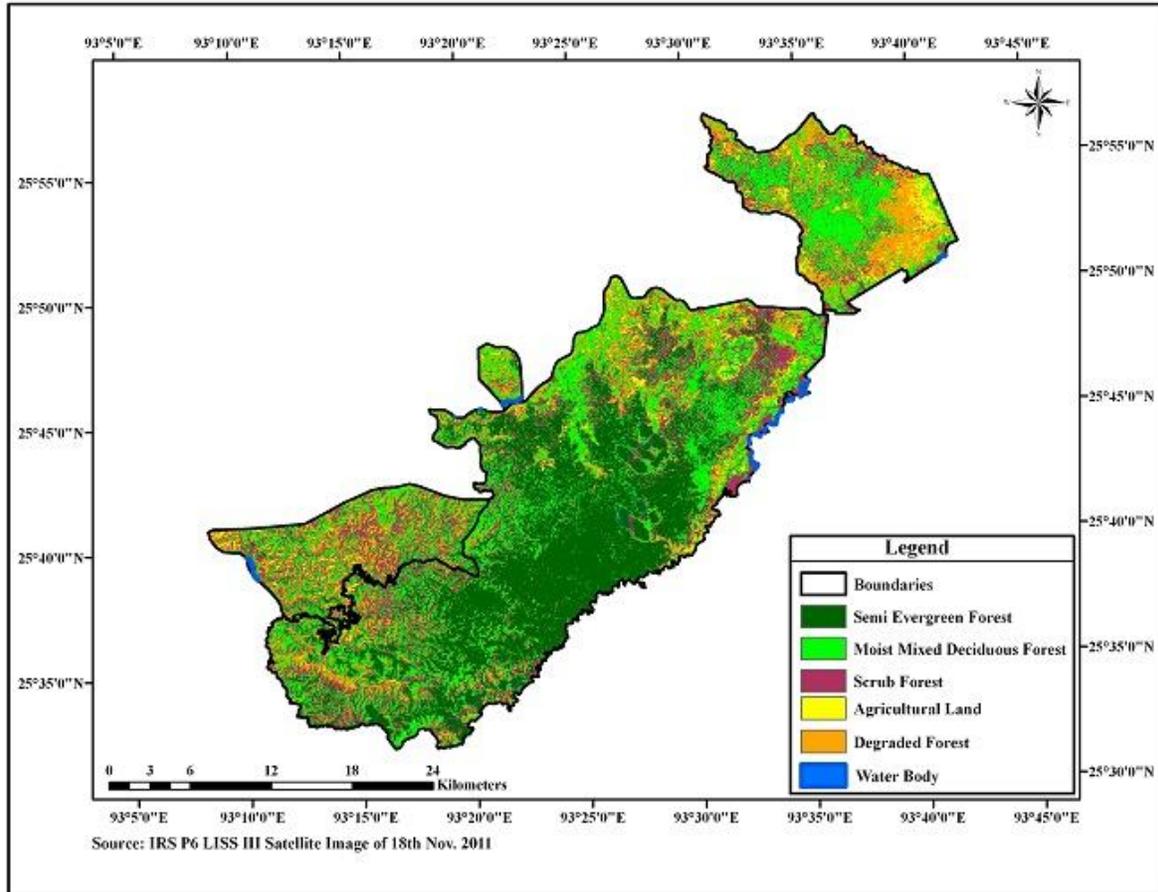


Fig-7: Forest cover of Hoolock gibbon habitat in Dhanshiri - Borlangfer complex as on November, 2011

Land use	Dhanshiri RF		Borlangfer RF	
	Area (sq. km)	Percentage	Area (sq. km)	Percentage
Semi Ever green	265.23	34.4%	11.16	14.4%
Moist Deciduous	236.12	30.6%	21.98	28.4%
Scrub land (jhoom abandoned)	141.98	18.4%	24.65	31.9%
Degraded forest	70.15	9.11%	13.1	16.9%
Agricultural land	10.2	1.3%	3.1	4%
Water body	46.72	6.1%	3.3	4.3%

Table-5: Forest cover of Hoolock gibbon habitat in Dhanshiri - Borlangfer complex and Khuriming – Panimur - Amren complex as on November, 2011

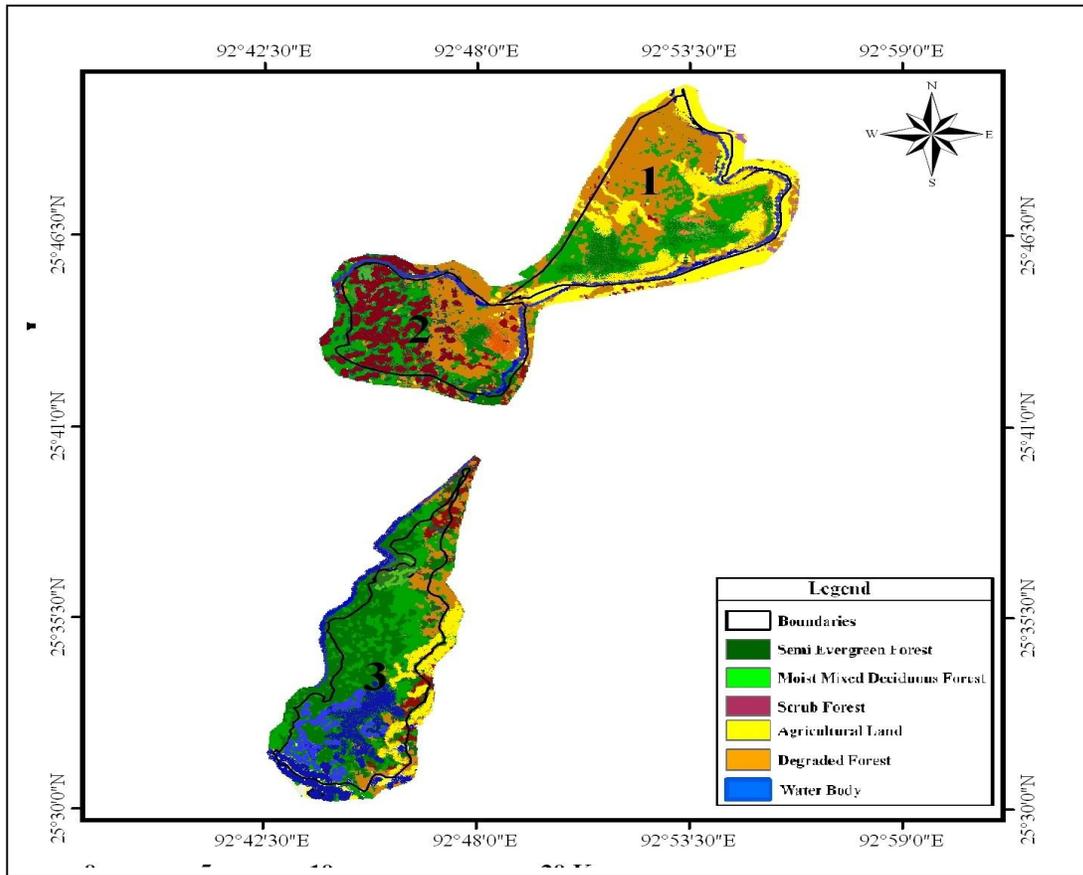


Fig-8: Forest cover of Hoolock gibbon habitat in Khuriming – Panimur - Amren complex as on November, 2011

Land use	Khuriming RF		Panimur PRF		Amren RF	
	Area (km ²)	Percentage	Area (km ²)	Percentage	Area (km ²)	Percentage
Semi Ever green	15.87	23.37%	1.9	3.44%	7.33	11.67%
Moist Deciduous	21.09	31.06%	12.76	23.07.%	16.09	25.62%
Scrub land (jhoom aban)	3.12	4.59%	17.58	31.78%	2.56	4.08%
Degraded forest	5.12	7.54%	14.42	26.07%	18.9	30.10%
Agricultural land	5.6	8.25%	6.45	11.67%	15.92	25.35%
Water body	17.10	25.18%	2.19	3.97%	2.0	3.18%

Table-6: Forest cover of Hoolock gibbon habitat Khuriming – Panimur - Amren complex as on November, 2011

From these satellite images and from our survey, we calculated the habitat available to gibbon in Dhanshiri - Borlangfer forest complex is about 325.7 km² of which 60.6 km² is dense forest that constitutes the primary habitat having $\geq 50\%$ canopy cover and 265.12 km² is the secondary forest of Hoolock gibbon having moderate canopy cover ($\leq 50\%$). Similarly, in Khuriming – Panimur - Amren forest complex, only 26.2% of total vegetation cover have attributed to gibbon habitat. From this satellite image and from our survey, we have calculated the available habitat of gibbon in Khuriming – Panimur - Amren forest complex is about 48.72 km² of which only 15.28 km² is dense forest that constitutes the prime habitat having $\geq 50\%$ canopy cover and 33.44 km² is the secondary forest of Hoolock gibbon having moderate canopy cover ($\leq 50\%$).



Photo: Primary habitat with good forest canopy



Photo: Secondary habitat with moderate forest canopy



Photo: Jhoom abandoned forest



Photo: Illegal logging

QUESTIONEIR SURVEY

To know the socio economic condition and forest dependency in and around the forest, we conducted household survey in the fringe areas of the forest complexes. Altogether 220 household samples were collected from Dhasiri-Borlangfer forest complex of which, 91% of them collect firewood from forest for personal use while 22.7% were found to be collecting firewood for commercial purpose. 75.5% household in the sample area found to be practice jhoom cultivation and the average area of jhoom cultivation per family is about 1.74 acre of land. We also found that peoples in fringe areas also depend on forest for fodder (80%) and house hold materials (95%). Hunting and trapping found to be important factor the forest complex which may have resulted low population density along with poaching for local consumption as well as for international trade. In this regard, Dhansiri-Barlangfer forest complex considered to be the major corridor for poachers.

	Seret Signar Village	Thomas Timun village	Seret Tisso village	Srmen Hanse village	Tokbi Arthemlang soi village
Sample size (n)	69	46	15	79	11
~ Member/family	6.6	5.5	6	6.02	4.3
~ No. of House/family	1.6	1.5	1.75	1.7	1.18
Profession	Cultivation	Cultivation	Cultivation	Cultivation	Cultivation
~ Firewood collection/family	31 kg	26 kg	23 kg	22 kg	22 kg
Firewood selling %	65.3%	0	0	0	45.4%
NTFP collection %	100%	100%	100%	100%	100%
Bush meat consumption %	100%	100%	100%	100%	100%
Poaching for commercial %	7.5%	8.7%	0	4%	0
Hunting %	100%	8.7%	26%	100%	100%
Trapping %	100%	100%	100%	100%	100%
Jhoom Cultivation %	100%	76%	60%	43.6%	100%
~ Area of Jhoom/family	2.24 Acre	1.36 Acre	1.4 Acre	1.68 Acre	2 Acre

Table -7: Results of questioner survey showing the forest dependency and hunting pressure.

DISCUSSION

Western Hoolock gibbon seems to be one of the most wide ranging lesser ape species, which is not only successfully adapted to tropical and subtropical forest ecosystem of South and Southeast Asia but also in diverse topographic conditions. Due to its specialist feeding and brilliant locomotory habits, the species need closed canopy cover for brachiatory mode of transport. But in certain areas the taxon reported to adjust even in the secondary and human altered habitats. So, it is not entirely surprising when the taxa of this genus reported from moderate to open canopy forest patches surviving and reproducing successfully.



Present study recorded 48 individuals in 16 family groups and 95 call bouts from two important forest complexes of Assam prioritized for long term conservation of Hoolock gibbon. The average density 0.36 ± 0.32 groups / km² and average group size is 2.8 ± 0.6 is invariably low in both the complexes although size, composition and density vary from forest to forest depending on the structure and quality of habitat. The smaller group size of 2.8 ± 0.6 individuals per group, with lower percentage of infants (14.5%) and juvenile (18.15%) compared to adult (67.4%) indicates low recruitment rate and high infant mortality. Cross section analysis of each forest complex suggested that, the ratio of adult to immature in Dhanshiri - Borlangfer forest complex is lower (1 : 0.41) compared than in Khuriming – Panimur - Amren complex (1 : 0.55), which depict lower recruitment rate in Dhanshiri - Borlangfer forest complex. Although, the scenario of Dhanshiri RF alone is comparatively better (1 : 0.44) than other forests under this forest complex, but is invariably low in comparison to other habitat of Hoolock gibbon elsewhere in Assam and North east India (Das *et. al.*, 2009). This might be attributed to open

canopy structure of the habitat. The hypothesis that reproduction and group size in the more open and deciduous forest like Borlangfer RF or Amren RF are lower than those in the more optimal, moister forest and should be further tested. In siamang gibbon, O'Brien *et al.* (2003) found that habitat quality can affect infant and juvenile survival.

The estimated population of western Hoolock gibbon in Dhanshiri - Borlangfer forest complex is between 100 to 125 groups and 300 to 350 individuals with the mean number predicted at approximately 325 (excluding solitary individuals) and the total area of gibbon habitat as 325.8 km². Similarly, the estimated population of Hoolock gibbon in Khuriming – Panimur - Amren forest complex is between 25 to 30 groups and 70 to 85 individuals with the mean number predicted at approximately 80 individuals and the total area of gibbon habitat as 48.8 km². Thus from these observations, we estimate the population of Hoolock gibbon in both the forest complex of Karbi Anglong, Assam would be between 125 to 155 groups and 370 to 450 individuals in 374.6 km² of available habitat.

Our calculation assumed that gibbon densities are equal across all areas of appropriate habitat while, in fact, Hoolock densities are higher in some forest type than others. In Dhanshiri - Borlangfer forest complex, despite having more closed canopy forest (60.6 km²) with that of Khuriming – Panimur - Amren complex (15.3 km²), density is considerably low resulting overall low population size. So the area of intact forest is not a good predictor of Hoolock numbers in this region. This might be attributed to the fact that in certain areas under Dhanshiri - Borlangfer complex has hunting pressure, particularly areas bordering Nagaland and need to be addressed properly.

Habitat on the other hand was much shrink, degraded qualitatively resulting small gibbon population. Thus for any long term conservation initiatives, it is imperative, therefore to have, information on suitable habitats of gibbon. Data on vegetation sampling suggested that, the suitable or prime habitat of gibbon in terms of quality i.e. more than 50% canopy cover was converted considerably in to moderate forest and open forest area. The qualitative degradation of habitat in terms of canopy cover conversion was evident in both the forest complexes, where these changes were visible (fig- 6 & 7; table - 5 & 9) and affects on the gibbon density and group structure. The anthropogenic pressures have resulted not only the in an overall decrease in the

amount of suitable habitat, but also in discontinuities in the distribution of the remaining intact habitats. This suggests that, widespread gibbon population in the past are now cutoff in to small size and split in many small populations within a large area.

The remote sensing data on habitat indicates that the Dhanshiri - Borlangfer forest complex has about 60.6 km² of relatively closed canopy, semi evergreen and moist deciduous forest that is suitable for Hoolock gibbon and considered to be the primary habitat and 285.2 km² as moderate canopy and the total area of gibbon habitat as 325.8 km². Khuriming – Panimur - Amren complex on the other hand has only 15.3 km² of relatively closed canopy of semi evergreen and moist mixed deciduous forest considered to be the primary habitat and 33.44 km² as moderate canopy or secondary habitat and the total area of gibbon habitat is 48.72 km².

Data on socio-economic survey suggests that 76% house hold in the fringe areas cultivate about 1.7 acre of land as jhoom cultivation. This might have causes cascade of effects through the loss of important feeding and sleeping trees and breakage of canopy highways, which can lead to population fragmentation, increased mortality, reduced reproductive outputs, increased risk of disease transmission and demographic instability. Although the local Karbi tribe does not kill gibbons but other tribes like Kuki and tribes from Nagaland often come across and hunt gibbon along with other primate. Low population density in Dhanshiri RF under Dhanshiri - Borlangfer forest complex and Khuriming RF under Khuriming – Panimur - Amren forest complex despite having closed canopy forest is due to easy access of poacher. Bush meat consumption is another big as 66.9% local tribes hunt and consumed bush meat ranging from wild boar, deer, porcupine, pangolin and even primates, while 2.3% population involved in poaching and commercial trade of wild animals.

So, to maintain a viable gibbon population in these priority forest complexes and to reduce further habitat fragmentation and protection of existing habitat, special integrated management strategy involving communities on board should be implemented. Since, maintenance of adequate population size and management of larger landscapes is essential to ensure the long-term persistence of Hoolock gibbon in the state

CONSERVATION EDUCATION CAMPAIGN

A mass awareness campaign was carried out in the fringe villages of Dhanshiri - Borlangfer forest complex under Karbi Anglong district of Assam to bring about awareness about the importance of the forest and Hoolock gibbon conservation and the role of local communities in conservation of the forest resources. Our objective was to protect and promote the Western Hoolock Gibbon by teaching students and community members an active learning methodology for creating interest and affection for WHG using a whole gamut of teaching techniques. For that we used a manual featuring Hoolock Gibbon called Help(ing) Hoolock Gibbon Hang on! It was developed by Zoo Outreach Organization, India in collaboration with Wildlife Conservation Society, USA. It has five units viz., Introduction and evaluation methods; introduction to South Asia's only lesser apes; Hoolock Gibbon in our culture; Understanding and acting and; understanding species problems and solutions. Apart from the manual, 12 different educational items, like posters, packets, musk, stickers, were given to each participant. In addition to this, all participants received other items of related teaching literature. The program has two phases – (i) one day long program, which was short term in nature and (ii) three days long nature camp in the vicinity of Gibbon bearing PA.

Awareness campaign at School level:

For school level awareness campaign different teaching modules adopted in the Hoolock Gibbon (Hang on) and Teachers for Tiger Manual of WCS/ZOO were used apart from direct deliberation of interactive lecture. Different audio visual aids like slide projector, LCD projector, sound system etc were used during the program. Resource persons were also invited for these school programs and students interacted with the speakers.

Total of 11 schools from fringe areas of Dhansiri-Borlangfer forest complexes comprising 779 participants were covered during the education campaign (table – 10). These one day long programs were organized in the school premises during the school hours. For which necessary

arrangements were made in consultation with the school Head Master / Mistress. In the school level awareness campaign, the general components were:

- a) A preliminary session of introduction and conveying the objectives of the program.
- b) Distribution of education materials like sticker, pamphlet, poster etc.
- c) Lecture on biodiversity, role of animal and plant on ecosystem and the importance of forest and wildlife and Hoolock gibbon conservation.
- d) Demonstration of different facts and figure of Hoolock gibbon and different ecological models.
- e) Screening of wildlife films.
- f) Light refreshment and appraisal.

Sl no	Name of the School	Male Student	Female Student	No. of Teacher
1	DALDALI RAIJAUDISA L.P. SCHOOL	15	18	2
2	KATHALGURI NEPALI BASTI ENGLISH L P SCHOOL	22	22	3
3	DHANSIRI BENGALI L P SCHOOL	21	22	2
4	DHANSIRI JUNIOR BASIC L P SCHOOL	22	23	3
5	DHANSIRI ME SCHOOL	39	37	6
6	BHETAGAON ENGLISH LP SCHOOL	43	48	3
7	DHANSIRI HIGH SCHOOL	44	34	11
8	DHANSIRI ENGLISH EVEREST SCHOOL	34	35	7
9	KHRIST JAYANTI SCHOOL	42	54	4
10	DHANSIRI ENGLISH HIGH SCHOOL	52	64	5
11	MORNING STAR ENGLISH LP SCHOOL	21	19	2

Table - 10: List of school and student participants in awareness campaign.





Photo: Different participatory outdoor activities were performed during education and awareness programs.





Photo: School education and awareness programs.

Three days long Education Camp for senior level students:

Apart from one day long school program, one three days long in-house nature orientation camp was organized, at Guijan, Dibru Saikhowa NP, where participant from Christ Jyoti school were participated. The camp had a capacity of 30 participants. Details of the camp are given below.

The inaugural function was followed by animal sound-off activity as an icebreaker, followed by assessment methods. In these assessment methods we introduced concept maps or brain mapping and attitudinal survey techniques. Participants made individual concept maps on the subject of Hoolock Gibbon or Biodiversity as a whole. In order to highlight the plight of the Hoolock Gibbon, a special lecture by our field biologist was arranged. Also, special lectures on the venue i.e. Dibru-Saikhowa National Park itself were given.

It is important that student understand present distribution details of any animals they study in context with conservation, so they were directed to study historical and current distribution maps of Hoolock Gibbon. Towards the end of first day, different indoor and outdoor activities like HELP, Habitat Ecology, Learning Program, Observation games were performed from the manual.



Photo: Inaugural function



Photo: Ice breaking game: Animal sound off



Photo: Assessment through concept mapping activities



Photo: Power presentation on Dibru-Saikhowa NP & Hoolock gibbon



Photo: Observation game & group presentation

Hoolock Gibbon behavior was the first event of the second day program and was introduced to the participants through an activity named Hoolock behavior. This is a most interesting activity where the participants were taken out of doors and taught to compare themselves with Hoolock gibbon to understand its behavior, brachiating, jumping, walking, eating, etc. Next we took primates in culture. Teams came up with many stories, songs and movies, names of places featuring primates and competed with one another using raucous shouts and whoops of laughter.

Role playing is very effective in changing attitudes. Roles are assigned to participants who play advertising executives, zoo architects, song writers, artists, acrobats, TV crew. A participant who facilitates very serious conservation actions was amazed at the

effectiveness of role playing. The same participant wrote that Role Play, for instance, made me empathize with the compulsions of politicians, forest officials, tribal etc. in ways I hadn't in the past. This leads to a willingness to negotiate rather than confront which seems to be the driving force of conservation today. This is one of the most powerful objectives we try to achieve with this training. An activity called Resource roundup was also carried out.

Mini dramas were the most dynamic activity and it created much interaction within the group. The participants were divided into smaller groups and they were assigned drama topics such as poaching, locomotion/communication, habitat loss, parental care and courtship etc. which was staged in the last evening.



Photo: Activity on behavior and adaptation



Photo: Activity on resource round up



Photo: Gibbon in culture & group presentation



Day three started with a demonstration of census techniques of Hoolock gibbon. Later the participants were taken to Borajan - Bherjan – Podumoni WLS to observe Hoolock gibbon in the morning session and Dibru – Saikhowa NP for field trip in afternoon session. The most interesting activity of the day was the Citizens Debate and drama, which was centered around a proposed rehabilitation package for people residing within Hollongapara Gibbon Wildlife Sanctuary. At the end of the last day a drama of hunting and logging was staged by participants. Participants came away with an understanding of these processes.

In the workshops participants were taught methods for using the education materials supplied to them. At the end of the workshop participants made personal written commitments to take up two projects that they could carry out in the next 6 months. A post workshop assessment and an evaluation using a concept map conducted.



Photo: Citizen Debate – a role play



Photo: Drama on Habitat loss & hunting

CAPACITY BUILDING

Karbi Anglong being the Autonomous Council (KAC) under the ‘VIth Schedule’ of the Indian Constitution, where forest and environment is council subject and state cannot interfere on it. In absence of any separate wildlife division, there is very weak capacity of protection and tasks for managing the PAs are by the normal territorial forest department of and most staff are trained in traditional forestry.

Recently, one of our recommendation based on our previous project, which was articulated in ‘Draft Action Plan of Hoolock gibbon in KA’ for the establishment of one Wildlife Division and three wildlife range to exclusively look after the wildlife and its management issues in Karbi Anglong is under review. For initial stage, forest department, KAC has agreed to establish one such range office in the strategic location of Haldibari under North Karbi Anglong WLS by upgrading the existing Haldibari Beat to Wildlife Range with deployment of more staff, which will strengthen the protection and enforcement. The KAC forest authority has already started construction of its office and the camp at Haldibari (see photographs) and once the range office is being in place, deployment of more staff and supplies will automatically come in to force.



Photo: Forest Office & Camp for staff at Haldibari under construction

Since, one of the objectives of the current project is to achieve much needed conservation intervention of gibbon in Karbi Anglong through infrastructure development and capacity building of the front line forest staff. We have already procured the materials to be supplied to front line forest staffs from the current project and from the matching grant from USFWS like

field kits, field gears and vehicle for patrolling which will be handed over shortly as a part of our next year activities. Similarly to boost the morale and provide basic knowledge to front line forest staffs, three training program will be conducted phase by phase to 60 number of staffs which will be done in our next year activities.

Thus, any conservation intervention in Karbi Anglong in terms of enhancement of protection and infrastructure development will have great impact on overall conservation scenario of the region and reducing the poaching menace.



Photo: A Vehicle has been purchased for patrolling



Photo: Materials have been procured

ACTIVITIES TO BE CARRIED OUT IN NEXT YEAR

1. Long term gibbon population monitoring.
2. Capacity building cum training of front line forest staffs: 3 Nos.
3. Facilitating field kits and field gears to front line forest staff of Karbi Anglong (60 Nos)
4. Socio-economic study and threat assessment of Khuriming – Panimur – Amren forest complex.
5. One day long conservation education campaign (10 Nos)
6. Three days long in house nature orientation camp (2 Nos).
7. Community education campaign (10 Nos)
8. Organizing strategic planning workshop
9. Publication of Conservation Action Plan for Hoolock gibbon in KA.

