

Conservation of Hoolock Gibbon (*Bunopithecus gibbon*) in Northeast India

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1. Introduction

Classified in the same Natural Order as man the nonhuman primates, which includes apes, monkeys, lemurs, and langurs, have always excited man's interest. The primates constitute the highest order of mammals from the evolutionary point of view. The fossils of primates are found from Europe and North America. Australia and the adjacent islands of New Guinea and the islands of Oceania in the Pacific are the only places with no evidence record of primates (Roonwal and Mohnot 1977). Their presence is confirmed in about 92 countries from four major regions (South and Central America, Africa, Madagascar, and Asia), making up for a total of 63 genera having more than 620 species and sub-species. Of these, about one third are ranked as endangered. Some monkeys are found in the eastern Temperate Zone (Japan and China) as well. The first living members of order primate date approximately 55 million years ago (mya) at the beginning of Eocene Epoch (Gupta 2001). Primates often perform ecological services that are important to the maintenance of tropical habitats: as seed dispersers, pollinators, and also as food for top predators, especially hawks, eagles and mammalian carnivores (Janson 1983; Terborgh 1983; Isbell 1990). Loss of one or two species out of a primate community may lead to extinction chain for a whole range of plant species getting extinct (Myers 1986). Therefore, presence of ecologically diverse primate communities is

essential to maintaining the integrity of many tropical forests.

Primates, at places, constitute an important group of mammalian primary consumers. Biomass contribution averaging 1000 kg/km² are more common in the rain forests of Africa, Asia, and the neotropics (Bourliere 1985). They are notable consumer of plants and, to a much lesser extent of animal material. At the ecosystem level they exert a very important feedback control on the vegetation itself; they are essential to maintenance of homeostasis of the forest ecosystem, especially critical for forest regeneration. Primates are also considered to be very good predictor of the richness of other mammalian fauna and in absence of other inventory information, the species richness of primates at a locality is a useful indicator of the probable richness of the non-primate mammals (Emmons 1999). The primates have developed certain ecological traits that have contributed to the rapid evolutionary success of the order, especially in the tropical environment. The following traits are noteworthy (Bourliere 1985): preference for predominantly vegetarian diet; propensity for arboreal life; opportunistic tendencies; and extended socialization periods (mostly monkeys and Apes) to name a few. Three major vegetational communities where primates dwell are: tropical forests (in areas with round the year high rainfall – 1500 to 4100mm), tropical grasslands and savanna. Tropical forests consists of primary forests (undisturbed with

proper stratification of canopy layers), secondary forests (disturbed/ modified due to biotic factors), swamp or mangrove forests, riverine forests (also known as gallery or riparian forests along the waterways), montane forests (cloud forests at 2000-3000m height), and monsoon forests (seasonal with dry months and deciduous nature of trees).

India, being richly endowed by nature in terms of great diversity of physical environment (from Indian Ocean to the lofty Himalayas and beyond to the cold deserts) and myriad of climatic situations, is among the twelve Mega-Biodiversity countries of the world. India also has great display of ecosystems being at the confluence of three Biogeographic Realms (centers of origin of life), viz. the Indomalayan, the Eurasian, and the Afrotropical. This provides India with two (Northeastern Himalayan and the Western Ghats) out of the 25 unique biodiversity 'hot-spots', which are the storehouses of nearly 50,000 species or about 20 percent of the world's flora. Primate diversity in India matches countless habitats. Some of the important ones are: tropical rain forests, tropical moist and dry deciduous, wetlands, swamps and mangroves, temperate hill forests, arid scrub-savanna, hot deserts, grasslands, vast plains, sub-alpine and alpine forests, Himalayan foothills, high peaks and cold deserts. A total of 21 species of primates are recorded from 3 families in the subcontinent, including Sri Lanka. In India alone 17 species (including the Tibetan and Arunachal macaques) are found, of which 3 (20%) are endemic. India ranks third in primate endemism. These species belong to three families: (a) Cercopithecidae (14 species), (b) Hylobatidae (1 species), and (c) Lorisidae (2 species). India falls into Oriental Region, which has two sub-regions: Indian and Indo-Chinese. Two provinces represent Indian sub-region,

namely, North India with two primate species and South India with five primate species. The Indo-Chinese sub-region has one Province (Assam-Burma) and is the richest area in respect of primate diversity with eight confirmed species (Gupta 2001).

Primate distribution range coincides with the tropical habitat of mostly over-populated (human population) developing countries whose economy is largely dependent on extraction of natural resources. Presence of dense tropical forests is the main natural resources that have been exploited to meet up the need for a vibrant economy. These are also the areas inhabited by poor tribal populations who are also dependent on forestry resources for the sustenance. To top it all is the pressure from the consumer countries for forestry resources from these producer countries. All these factors exert tremendous pressure leading to over-exploitation of forestry resources, which form the main component of habitat for primate species. Conservation threats to primates could be put broadly into two categories: Direct and Indirect. Direct conservation threats entail reduction in the number of individuals due to trade in live and dead primates, killing and hunting for food, as pests, as pet, and for other economic uses. Indirect conservation threats are associated with the loss and degradation of habitat. Main reasons for the loss of habitat are deforestation, encroachment, grazing, illicit felling for firewood, fodder and timber, shifting cultivation, and diversion of forest land for non-forestry and agricultural activities, forest fire (Gupta 2001).

Several studies have documented drastic reduction in population of primates because of loss and fragmentation of the habitat. Estrada and Coates-Estrada (1996) reported an

84% decline of an *Aloutta aloutta* population and 74% decline of *Ateles geoffroyi* in Mexico within a period of eight years. There were 80% and 25% reductions in populations of red colobus and crested mangabey, respectively, in forest fragments if the Tana river in ten years (Marsh 1986). In India, Menon and Poirier (1996) observed a 20% decline of the *Macaca silenus* population in the Puthuthotam forest fragment within a period of just three years. Lovejoy *et al.* (1986) also observed reductions in the populations of five of the six primate species studied in two fragments in the Amazon.

1.1 Forest fragmentation in Tropical Asia

Gibbons inhabit Tropical forests, which are one of the most threatened habitats in the world. Tropical forests, which cover about 6% of the land surface of the world, harbor more than 80% of extant species, with about 45 % of them highly, endangered. (Chivers *et al.*, 1977).

Hoolock gibbon (*Bunopithecus hoolock*), the only ape found in India is confined in its distribution in Northeast India; where ten out of fifteen primate species are found. Forest Survey of India recently made estimation of forest cover in India on a two-year cycle using IRS-IB data. The results are published in the State of the Forest Report 2001. Estimates suggest that country had 638,900 km² forests in 1995 and 633,400 km² in 1997 (State of Forest Report 2001, FSI), therefore there is a total loss of 5500 km² forests in the two-year period. This is reflected by the dwindling population of Hoolock gibbon in Northeast too. Forest cover in Northeast is reducing due to shifting cultivation, human population growth, logging and trade liberalization. This has resulted in fragmentation of the remaining forest cover,

so Hoolock gibbons are forced to live in highly disjunct fragmented habitats.

Characteristics of Fragmented Ecosystems

Fragmentation of the ecosystem produces a series of remnant vegetation, surrounded by a matrix of different vegetation or land use. Two primary effects of this are isolation of the remnant patches and alteration of the micro climate within these patches.

Changes in the microclimate

Fragmentation of landscape results in the changes in the physical fluxes across the habitat. Alterations in the fluxes of radiation, wind, water, can all have important effects on remnant of the vegetation and the faunal diversity as well; changes in the micro climate can be of the following types:

1. Changes in the radiation fluxes disrupting the energy balances of the habitat.
2. Changes in the wind patterns.
3. Modified or changed water flux affecting the hydrological cycle.

Isolation

Habitat fragmentation has important consequence for the biota. First, there is a reduction in the area of the habitat available, with possible increased densities of surviving fauna in the remnants, and second the habitat that is left is broken up into remnants that are isolated to varying degree (Lovejoy *et al.*, 1984, 1986); Haila and Henski 1984 state that adverse effect will depend upon the time since isolation took place, the distances between the adjacent remnants, and the degree of connectivity between them.

Causes of habitat fragmentation

Following main reasons may lead to habitat fragmentation in the tropics:

1. *Population pressure:* The population growth rate in the tropical nations is among the world's highest. Human population growth rate has a strong and direct bearing on the process of forest conversion. The unabated human population growth results in heavy pressures on the natural resources, thus becoming one of the main reasons for habitat degradation and fragmentation
2. *Expansion of Agriculture:* While the population growth rate of developed countries have slowed down, the population of developing countries in tropical Asia is still growing rapidly (e.g. during the decade of 1973 to 1983 the average population growth in most tropical Asian countries hovered around 2 to 3 %). Given the limited extent of industrialization in these countries their burgeoning population continuously reinforces pressure on available agricultural land resources, thus compelling people to encroach into forest lands. These ongoing processes of expansion of agricultural land have led to the disappearance of considerable expanses of forests; conversely the area of agricultural land has increased. Encroachment on forests solely for crop cultivation is too simple an explanation of the deforestation and fragmentation process. The major factors responsible for degradation and fragmentation of the forest cover could broadly be classified into three main groups namely, shifting cultivation, spontaneous settlers and farmers in plant settlement.
3. *Fuel wood demand:* Wood is by far the most widely used house hold fuel in the developing world. According to FAO estimates "fuel wood accounts for seventeen percent of energy consumption in the countries of tropical Asia". In the last two decades there is an increase in population growth rates in these countries, so the fuel wood demand has also accelerated. Cutting trees for fuel food is the most important causes of destruction of forests and its consequent fragmentation. The average total annual usage of fuel wood in developing countries was estimated to be 1100 million cubic meters. (Lanly et al., 1982)
4. *Weak institutions and poor policies:* Despite a number of recent government initiatives designed to slow down deforestation rates but in reality the rates have increased after the initiation of such moves. One chronic problem has been the weak enforcement of legislation designed to protect forests especially in the remote frontiers of developing countries of South East Asia.
5. *Trade Liberalization:* We live in an era of unprecedented economic globalization, trade liberalization and international free trade agreements like GATT, NAFTA etc. But many developing countries lack adequate environmental safeguards and other modifying influences like strong public sentiments, supporting forest conservation mechanisms, etc. Therefore, the development activities through the process of globalization turn out to be more a commercial venture at the cost of ecological balance.

Impacts of forest fragmentation on Primates

Forest fragmentation is apparent to have myriad effects on primate species which are one of

the good indicator species of tropical ecosystems. Small populations of species dependent on irregular resources are highly vulnerable to stochastic events or random fluctuations in the environment (Terborgh and Winter, 1980). Primates that feed on commonly available food resources, such as leaves or have the ability to switch to these items when their preferred foods are in short supply, persist longer in fragments and disturbed habitats. On the other hand, primate species, which feed selectively on patchily distributed and unpredictable resources, such as fruit, require larger areas in which to find their food (Mittermeier and Van Roosmalen, 1981) and are thus expected to be more seriously affected by habitat fragmentation. Johns (1991), studying frugivorous saki in Rio Tefe,

observed that this primarily frugivorous species rarely occurred outside the forest corridors and the unlogged forest patches because they were unable to exploit alternate food resources.

The Hoolock Gibbon

The hoolock gibbon (*Bunopithecus hoolock*), the only ape species in India, is the western most of the nine species of lesser apes in South-east Asia. Its distribution is restricted to the monsoon and evergreen rain forests of Northeast India south of Brahmaputra River, Bangladesh, Southern Yunnan and Myanmar up to the river Chindwin (**Fig. 1**).

The hoolock gibbons are specialized in many ways, viz. these are frugivorous, highly

Fig. 1 : Distribution Range of Hoolock Gibbon



territorial, practice brachiatry, and monogamous. As an extension of the above arguments, disturbance and fragmentation of the habitat, which results in reduced availability of their preferred food-fruit, may also affect the 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 makes movement out of or between forest patches impossible if there is no continuous canopy to serve as a corridor. 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.

Lowland tropical rain forests in northeast India, the habitat of hoolock gibbon, are the most species-rich of the terrestrial ecosystems. But, following large scale habitat fragmentation over the past few years, mainly due to agricultural expansion, illegal encroachment, shifting cultivation, establishment of tea and coffee estates, illegal logging, and diversion of forest land for developmental projects, the lowland tropical forests are present in form fragments of varying size, shape and succession stages. Another major reason for the habitat fragmentation and loss of forest cover in all the range states has been the faulty land-use pattern. Most of such forest areas that are under the control of communities are lost due to their diversion for non-forestry uses.

Estimates suggest that throughout its range, a 67% reduction in hoolock gibbon habitat has occurred within ten years viz. from 168,000 km² in 1987 to 56,378 km² in 1997 (Anon. 1997). In Assam, Choudhury (1990) estimates that only 4,500 km² of the approximately 7,000 – 8,000 km² of gibbon habitat is still intact.

The main management problem in the region relating to the already fragmented forest patches is to find out the ways to conserve available wildlife species. In absence of large carnivore species, the primate species form the flagship species in the fragmented forest patches and their conservation strategies shall also help other species to survive. Second aspect, which is important in terms of conservation of these patches, is the documentation of the number of main faunal and floral species and information on the population status of some flagship wildlife species therein.

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 among 15 primate species in India for its biology, ecology and conservation. Present knowledge of hoolock gibbon ecology and population estimate comes only from few studies: Tilson (1979), Siddiqui (1986), Alfred and Sati (1994), Gupta (1994), Choudhury (1987, 1991), and Kakati (1997).

In presence of the above facts, it becomes all the more essential to attempt at documenting the population status of gibbon across its distribution range in Northeast States, with special emphasis on making an assessment of the fragmented habitats. Another very crucial aspect concerning gibbon conservation is to document potential habitats based on the features that fit well as ideal gibbon habitats.

In the above backdrop, it was realized that still there are various gaps with respect to the gibbon conservation in Northeast India that require immediate attention to save this species from its current endangered status. Some of the gaps are as follows:

1. Complete knowledge on the distribution ranges of gibbon populations in northeast India.
2. Identification of the floristic and structural characteristics of rainforest habitats of the only ape species in India.
3. Identification and planting of key food species as a measure to improve the available habitat to gibbon populations.
4. Documentation of the nature and extent of fragmentation of gibbon habitat in its distribution range in northeast India.
5. Understanding and documentation of the current status of fragmentation of gibbon populations and the demographic patterns.
6. Creation of corridors to augment the availability of habitat to the gibbon populations.
7. Identification and prioritization of major conservation problems in different range states.
8. Standardization of the survey techniques and monitoring protocols for different range states based on local variations.
9. Skill upgradation of the field staff in the matters of gibbon population surveys for long-term continuation of monitoring and

evaluation schedules.

10. Identification and prioritization of the research needs for long-term conservation of gibbon populations.
11. Identification and prioritization of various management options/ alternatives to the managers for developing suitable conservation plans for long-term conservation of gibbon population.

2. Aims and Objectives

The study was undertaken in this project with the following main objectives:

1. To document the status and extent of gibbon habitat in three states vis-à-vis the protected area coverage of its habitat and potential habitat outside the protected areas (government and community lands).
2. To document the habitat fragmentation in the range areas of the gibbon populations and identify habitat.
3. To identify and document major conservation problems across the distribution range of this species and suggest mitigation measures.
4. To identify the gibbon populations that would require immediate management intervention for their survival, e.g., prevention of shifting cultivation, checking of illegal felling, encroachments and other habitat degradation factors.
5. To identify specific gaps in information to develop future long-term research projects.
6. To standardize the periodic monitoring and training protocols for the line staff at the

local level for maintaining continuity in the conservation efforts even after the termination of the current project.

3. Methods

Survey of Forest Fragments: The gibbon has its distribution in all the seven states in the northeast India: Arunachal Pradesh, Assam, Meghalaya, Tripura, Mizoram, Manipur, and Nagaland (**Fig. 2**). It would have been ideal to conduct detailed status survey in all the states to meet above stated objectives.

However, due to constraints in time, resources and other logistics, the known gibbon sites in three states, namely, Meghalaya, Tripura and Mizoram were covered in this project. However, this study can be extended in other remaining northeastern states with similar

terrain and habitat conditions by adopting the methodology and training inputs of this project. Other reasons for selecting these three states were: (a) rich field working experience of the principal investigator in Tripura and Meghalaya, (b) all the three states are located in close vicinity to each other. Mizoram and Tripura share border with each other. It was logistically more convenient to work in all three states without the loss of much time in travel, (c) all three states lack in any structured and detailed status survey on this species, excepting by Alfred and Sati (1990) in Meghalaya, and Gupta (1989) in Tripura. Both these surveys were undertaken more than 10 years ago. The gibbon habitat areas have been severely impacted due to biotic disturbance during these intervening period. It becomes relevant to record the present status of this species for comparative analysis., and (d) overall working

Fig 2: Distribution range of gibbon in northeast India



conditions in these three states was found conducive to undertake extensive field works, except in few patches.

Apart from the three states as mentioned above, Gibbon Wildlife Sanctuary located in Assam was also selected to undertake two small studies under this project. One study was on “Impact of Habitat Fragmentation on Hoolock Gibbon in Gibbon Wildlife Sanctuary, Assam” and the other study was on “Resource Utilization by Three Species of Primates in Gibbon Wildlife Sanctuary, Assam”. These two studies resulted into a Postgraduate degree in Environment Management for two M. Sc. Students of Forest Research Institute, Deemed University, Dehradun. The results of these two studies are presented in two different chapters of this bulletin.

The identified range states were surveyed to list different fragmented habitats. Information on the time since isolation of the fragment were also collected from the records maintained in the forest department, land survey offices of the given area.

Gibbon Population Surveys : Based on the previous and current information from forest department, local people and from other sources, detailed survey was conducted in all the three states. Survey was assisted by forest department staff of the respective forest division. Attempt was made to involve the local people. This was done with two reasons in mind: one, to get to know the exact areas of gibbon distribution in given forest and village areas based on the deep knowledge that the local people possess of the areas they have been residing for last many years, and two, their involvement will help them realize the importance of conserving this species and might result in decrease in poaching and habitat destruction cases. Each transect was

preferably walked twice, once in the morning and then in the afternoon. In case presence of gibbon was confirmed in the first visit, afternoon visit in the same transect was cancelled and adjoining areas were surveyed walking on the existing trails. Transect walk usually began at the first daylight, if not prevented by high wind, fog or rainfall. Typical starting time was between 0530 and 0630 h in the morning and 1430 h in the afternoon. The transect was walked at a slow speed and as quietly as possible, stopping at every 100m to take the reading on visibility and spend 2-3 minutes to listen to any sound or movement or song. In most of the cases confirmation was made after crossing the animal or while returning after finishing the transect walk. All these confirmations were included in the present analysis. In those few cases where presence of gibbon was confirmed through songs while the animal remained far away from the transect, the direction of the song was followed to locate the group and collect related information.

The sampling methodology using the songs of the gibbons and actual sightings on the randomly selected line transects (all existing paths, forest roads etc. inside the forest and non-forest areas were used as transect for the purpose of conducting this survey) was adopted. The technical assistants and the field assistants were provided initial training by the PI into this aspect to standardize the survey techniques separately for each State to avoid biases due to local variations. The survey of gibbons was undertaken as per the following steps:

1. The known gibbon sites were identified both inside and outside the protected areas in each state using the published literature and secondary information available with the respective forest department.

2. The information on the presence of gibbons was also ascertained by discussing with the forest staff of various protected areas and forest divisions.
3. Apart from the recorded information about the gibbon locations, the local people residing in and around the forest areas were also interviewed to ascertain presence of gibbons in their respective areas.
4. Besides the above, potential gibbon sites based on the habitat features were also delineated for taking up surveys at all those sites.
5. All the actual (based on secondary information) and potential sites of gibbons were marked in the map of the given state. Detailed scheduling was drawn for surveying all those sites.
6. Population survey of gibbons in each site was carried out using their songs. Sampling was repeated over days according to the feasibility (wherever possible at least 3 days) and the cumulative number of groups that sang was used as the indicator of number of groups present (Brockelman and Ali, 1987). The gibbons sing less in disturbed and fragmented habitats compared to their normal rich habitats, and therefore, it may be argued that in fragmented habitat their presence can be missed due to lack in hearing the songs. However, this short coming in enumerating the total number of groups present in the smaller fragments could be well compensated quite reliably during the course of intensive data collection in those small fragmented patches. Even otherwise too, the song method was validated in the larger fragments and continuous forests by following the gibbon groups after they were sighted or heard and by roughly mapping their ranging areas. With the help of forest department staff, project technical

assistants and local field assistants all the identified sites were surveyed to record the following information:

- a. Number of groups and the age and sex composition of gibbon groups actually sighted.
- b. When the gibbon groups were not actually sighted and only songs were heard, their location was determined based on the direction and distance of songs heard.
- c. With the help of information collected in the field from the local people, the potential gibbon areas were also identified and confirmed on the map.
- d. Floristic survey was also carried out along the transect for every 500m distance within a 10m radius plot to ascertain the qualitative and quantitative features of the habitat. For a number of reasons the placement of transects was not entirely random and they varied from 2-3.5 km. Most transects were placed in densely forested area to cover maximum potential areas of gibbon presence. Existing trails were used to approach in the core of surveyed areas and then transects were placed on both side of the existing trail. Except for very small forest patch transects were laid at least 500m inside the edges of the patch. Length of transects were determined by using Pedometer and the area covered was calculated by determining visibility on transects obtained at regular interval of 100m by Range Finder. The format followed for this study is presented in **Annexure -I**.
- e. Following information were also recorded for each gibbon site: the size of the forest patch, its location with

respect to the distance from the nearest human habitation, type of vegetation cover, nature of fragmentation, presence of other wildlife species, frequency and severity of biotic disturbance, and the status of land.

- f. Locations of the gibbon groups or their potential areas were taken with the help of a Global Positioning System (GPS) Unit. These locations were transferred on the Survey of India toposheets (1:50,000) and FSI vegetation mapping sheets, wherever feasible.

Vegetation Sampling: Vertical structure of the forest, dominant species, total number of trees in the sample plots, presence of vines and lianas, canopy cover and canopy continuity were also recorded on a format based on eye estimation. Main food trees were also recorded based on earlier studies and actual observations in the field during surveys. Area under forestry plantations was also recorded.

Biotic Pressures: Frequency and density of cut tree stumps was assessed and used as an indication of biotic disturbance. Number of humans and livestock encountered during the surveys was also recorded. The information on cases of shifting cultivation, area covered, number of families engaged in this practice inside the range areas, cultivation cycle, etc. were also be recorded from each study site. Areas under tea and coffee plantations inside the known ranges of gibbon population were also recorded.

4. Study Area

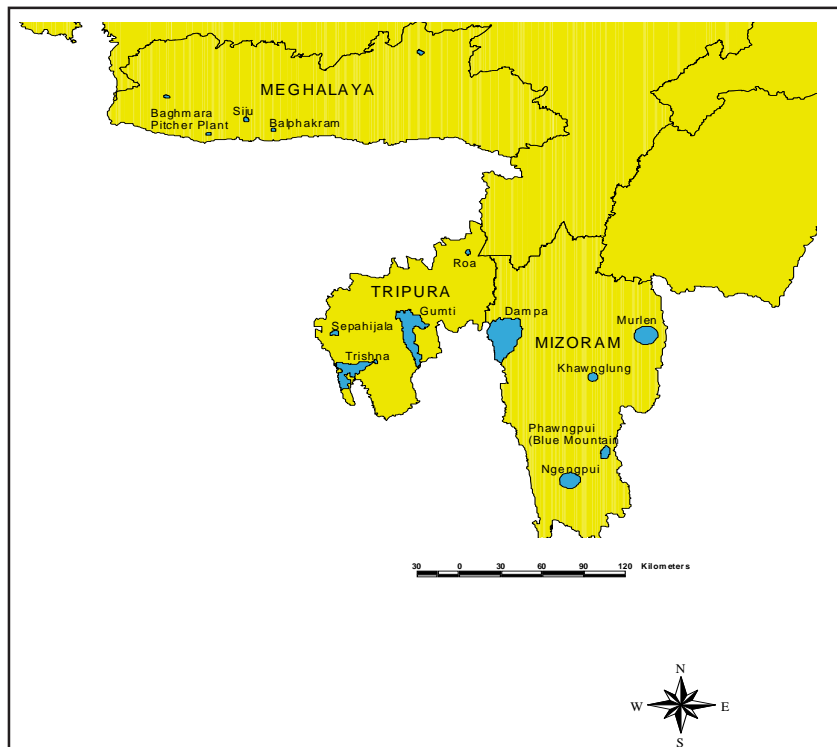
The study was conducted mainly in three states in the northeast India, namely, Meghalaya, Mizoram and Tripura (**Fig. 3**). An attempt was made to cover all the forested area of three states. However due to certain logistics problems few potential areas could not be covered under this project study. Following is the list of PAs areas, which were covered during the study:

State	Protected Area (Area in km ²)
Tripura	Trishna Wildlife Sanctuary (194) Gumti WLS (360)
Meghalaya	Balphakram National Park (220) Nokrek National Park (48) Baghmara Pitcher Plant WLS (0.02) Siju WLS (5.2) Nongkhyllum WLS (29)
Mizoram	Dampa Tiger Reserve (500) Ngengpui WLS (110) Phawngpui NP (50) Murlen NP (100) Lengteng WLS (60) Khawnglung WLS (35) Tawi WLS (35.75)

Fig. 3 Map showing three study areas: Meghalaya, Mizoram and Tripura



Fig. 4: Map showing the Protected Areas in Meghalaya, Mizoram, and Tripura



5. The Study Animal

Bunopithecus hoolock, Hoolock gibbon is the western most of the nine species of lesser apes of South east Asia. Its range is restricted to the monsoon and evergreen rain forests of North-east India , south of Brahmaputra River. Bangladesh, Myanmar up to the river Chindwin. (Tilson 1979, Mukherjee 1982, Alfred & Sati 1986, 1990, Choudhury, (1987, 1990, 1991). It has been categorized as endangered by IUCN (Groombridge 1993) and listed in Schedule 1 of the Wildlife (Protection) Act, 1972.

MacKinnon & MacKinnon (1987) estimated the world population of Hoolock gibbons to be 170000. It is likely that the population has since decreased significantly over much of its range. Available population estimates are 6000 in Assam (Choudhury, 1987), less than 200 in Bangladesh (Feroz & Islam 1992). Figures from other NE Indian states and Myanmar are not authentically available.

The main cause of the decline of the Hoolock gibbon is the destruction of its habitat due to agriculture, plantations , illegal felling and hunting. Estimates suggest that throughout its range a 67% reduction in Hoolock gibbon habitat has occurred within ten years viz. from 168000 km² in 1987 to 56378 km² in 1997 (Anon 1997).

5.1 Classification and Distribution

Hoolock is also known commonly as Hoolock gibbon or White-browed gibbon. Its Scientific name is *Bunopithecus hoolock*.

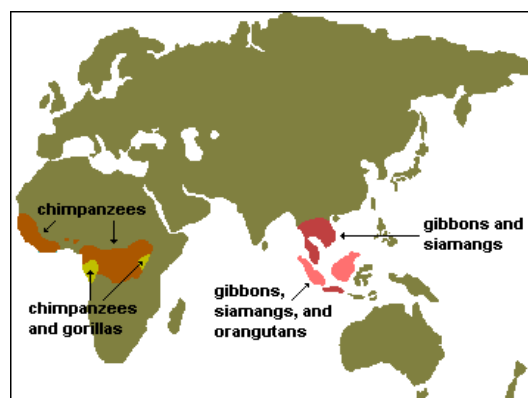
Classification:

Kingdom: Animalia
Phylum: Chordata

Class: Mammalia
Order: Primates
Family: Hylobatidae
Genus: *Bunopithecus*
Species: *hoolock*

The family Hylobatidae includes the lesser apes (gibbons and siamangs) found in South and South East Asia (Assam east to Borneo). About one million years ago the ancestral Gibbon spread down into the Sunda- Shelf to be isolated in the South West, North East and East Asia, this three lineages gave rise to the Siamang, the Concolor and the rest respectively. The greatest changes occurred in the eastern group, which spread back to the Asian main land during the inter glacials, giving rise first to Hoolock (and the Kloss gibbon in the west), then to the Pilated and finally, during and since the last glaciations to the Agile and Lar gibbon. A total of 28 species have been identified in the 4 genera (Brandon-Jones *et al* 2004).

1. *Bunopithecus* (2 species): distributed in Bangladesh, Myanmar, India, China (Western Yunnan).
2. *Hylobates* (15 species): distributed in Malaysia, Thailand, Indonesia, Borneo, China, Java, Laos, Cambodia, etc.
3. *Nomascus* (9 species): It has got almost same distribution as above.
4. *Symphalangus* (2 species): distributed in Indonesia (Sumatra), Penninsular Malaysia.



Traditionally, the Hoolock has been considered a member of the genus *Hylobates* and the monotypic representative of the subgenus *Bunopithecus* (e.g. Geissmann 1995; Rowe 1996; Marshall & Sugardjito 1986). Recent molecular evidence documented that the distance among gibbon subgenera was as large as or larger than the distance between chimpanzees (*Pan*) and humans (*Homo*) (Roos & Geissmann 2001). As a consequence of this finding, all four subgenera are now recognized as full genera, and the traditional scientific name of the hoolock changes from “*Hylobates hoolock*” to *Bunopithecus hoolock*. Two subspecies of the hoolock are known: the western hoolock (*B. hoolock hoolock*) and the eastern hoolock (*B. hoolock leuconedys*). The Chindwin River in Burma forms the boundary between the two subspecies (Groves 1967).

Global distribution:

India, Myanmar, Bangladesh

Distribution in India: Hoolock gibbon inhabits the states of Assam, Arunachal Pradesh, Mizoram, Nagaland, Meghalaya, Manipur and Tripura in northeast India. Distributed from 100m to about 1370m altitudes. The northern, northeastern and northwestern limit of its range is the river Brahmaputra (Dibang in Arunachal Pradesh) which act as physical barrier for its distribution. Earlier three main genera of gibbons were identified:

1. The Siamang with diploid number of fifty chromosomes.
2. The Concolor gibbon (*Hylobates concolor*) with about six sub species having fifty-two numbers of diploid chromosomes.
3. The Lar group with forty four chromosomes in the *Hylobates* comprising of seven species.

The Hoolock gibbon is the largest among them with thirty-eight numbers of diploid chromosomes. Based on the new classification (Brandan Jones et al. 2004) a total of 28 species have been identified in the 4 genera.

Group size and social structure: Hoolock live in small, monogamous family groups. Typical groups consist of an adult pair with 0-4 immature offspring. Average group size ranges from 2.7 to 4 (2-6) (Alfred, 1992; Choudhury 1990, 1991, 1996a; Feeroz & Islam 1992; Gittins and Tilson 1984; Mukherjee 1992; Siddiqi 1986; Tilson, 1979). Young gibbons leave their natal group when they become adult. One untypical group which included two adult females (probably sisters) was unstable and ended up with one female permanently leaving the group (Ahsan, 1995a). Like other gibbons, hoolocks are territorial. Each family group occupies a home range of about 14-55 hectares (Alfred & Sati, 1990; Feeroz, 1996; Feeroz & Islam, 1992; Gittins & Tilson, 1984, Tilson, 1979). One solitary female covered an area of about 73 ha which overlapped nearly 15% with the home ranges of three neighboring groups (Feeroz, 1996). Much larger home ranges of 300-400 ha were reported by Mukherjee (1982), whereas particularly small home ranges were found by Kakati (1999). On average, a group covers a day range of about 600-1200 m (300-1600 m) (Feeroz & Islam 1992; Mukherjee 1986). Territories are defended from intrusion by other gibbons by loud morning songs and by actively chasing intruders off the territory.

Age and Sex categories in gibbon

Infant

Age

- ◆ 1 day to 2 years of age

Characters

- ◆ 20-35 cm in length
- ◆ Thin hair coat

- ◆ Always carried by mother and sleep with mother
- ◆ Coat colour:
 - Milky white (3-4 months)
 - Greyish white to dark grey (4-9 months)
 - Black (above 1 months to 2 years)

Juvenile

Age:

- ◆ 2 to 4 years old

Characters

- ◆ 35-44 cm length
- ◆ Black in colour
- ◆ Distinct eye-brows
- ◆ Never carried by mother
- ◆ Sleep away from mother

Sub-Adult

Age

- ◆ 4 to 7 years

Characters

- ◆ 45-52 cm length
- ◆ Jet black coat colour
- ◆ Male SA with emerging scrotum
- ◆ Female SA with broad grayish patches on a black body coat

Adult

Age

- ◆ Above 7 years

Characters

- ◆ Adult Male with distinct coat scrotum
- ◆ Adult Male with jet black coat colour
- ◆ Adult Female with buff coat colour

5.2 Ecology and Behaviour

Male Hoolock gibbons are black, with white eyebrows that turn up at the end. Females are copper tan, with a whitish eyebrow band. Whitish hair encircles the face & contrast with darker brown cheeks. The neonatal coat is milky white; by 9 months the coats change to gray, then dark gray. Juveniles of both genders are black, with white eyebrows. Female sub-adults change from black to gray to the tan color of adult females.

The Hoolock gibbon is found in several types of habitats: tropical evergreen forest, the wetter tropical semi-evergreen forests, sub-tropical monsoon evergreen broadleaf forests, and sub-tropical evergreen broadleaf hill or mountain forests. The species appears to be less common in deciduous forest and scrub forest, and absent in mangrove (Choudhury, 1996a; Gittins & Tilson, 1984; Lan, 1994). It occurs at altitudes of 80-1500 m (Choudhury, 1996a; Mukherjee, 1986).

Gibbons inhabit primary evergreen and less seasonal parts of semi-evergreen rain forest, and very rarely semi-deciduous forests. Gibbons are prototypical brachiates with flexible forelimb joints and use their long hands and legs to collect food selectively. It is still a point of debate among researchers whether these morphological adaptations originally evolved for efficient food collection or for efficient travel between food sources (Choudhury, 1991).

Gibbons spend 25-40% of the time feeding; 15-20% in locomotion; and 24% resting (Alfred & Sati 1986, Islam and Feeroz 1992). The feeding strategy of gibbons is “feeding all along the way” up to the fruit trees and back to a suitable roosting tree. It is quite likely that their travel and feeding is goal directed. They mostly feed on ripe, sugar rich juicy fruits and also figs. There is no difference in feeding by sex in adults and juveniles (Choudhury 1991). The typical diet of gibbons consist of 51- 65% fruits ; 5-23% leaves, 13% - buds, 12% - flowers, 0.1% animal prey (including insects and bird eggs) (Tilson 1979, Gittins and Tilson 1984). Climbers also constitute an important diet constituent at least in the dry season. This feeding pattern may got altered to a great extent in degraded habitat (e.g. in Gibbon Wildlife Sanctuary, Assam). In a degraded habitat, the

gibbons have been observed feeding on bamboo shoots and spending 40% of time feeding on fruits, 40% on young leaves, 14% on leaf buds and 5% on mature leaf. The main preferred fruit species are *Artocarpus chaplasha*, *Anthocephalus kadamba*, *Bischofia javanica*, *Amoora walichara*. The preferred roosting trees are *Dipterocarpus macrocarpus*, *Mesua ferrea* and *Castanopsis indica* (Choudhury 1991). The gibbon is an arboreal and a diurnal species. It prefers the upper canopy of the forest, and sleeps and rests in emergent trees (Leighton 1987). Like other gibbons, the hoolocks eat mostly fruits (51-89%), with the main supplement being leaves (6-32%); in addition, Hoolock also consume smaller quantities of flowers and insects (Alfred 1992; Feeroz & Islam 1992; Gittins & Tilson 1984; Islam & Feeroz 1992; Tilson 1979). Mukherjee (1986) found lower amounts of fruits (30-40%) and higher amounts of leaves (40-60%) in the diet of gibbons in Tripura. Among fruits, figs appear to be the most important food item and make up about 60% of the fruits consumed by them (Alfred, 1992) and about 38% of their total diet (Feeroz & Islam, 1992; Islam & Feeroz, 1992). Hoolock gibbons are diurnal and arboreal. Normally they are active for 8 to 10 hours of a day, and activity usually starts at dawn and ends a few hours before sunset. Most intensive feeding and singing occurs in the morning. They maintain their home range by morning song bouts, which can be heard clearly from a distance of 1 km. Adult males sing long solos usually in the darkness just prior to sunrise. The female's song is sung as a duet with the male. Gibbon pairs normally duet any time between seven and ten o'clock in the morning. During foggy days in winter and the rainy season the frequency is reduced; otherwise they sing almost every day. Gibbons responded frequently and aggressively to 'play back' experiments at

Panbari Reserve forest and Kaziranga National park. However, after repeated attempts they lost interest and did not respond at all. The female leads troop movement. Grooming, play, and social interaction take less than 10% of the day. Occasionally, juveniles come to the ground to cross the gaps of more than 15 meter that they cannot leap. Inter-troop encounters consist of singing and counter singing, with males frequently chasing each other for several meters. Growls, whoops and more singing and counter singing follow this. Ultimately the inter-group distance increases as they leave to forage. They lead a monogamous lifestyle with a single male pairing with a female with offspring in a cohesive family group. Extra pair copulation is very rare. Solitary males and females have been reported from various locations. Average group size is 3.5 with a range from two to six individuals at the most. Home range is relatively small (300-400ha) which they potentially defend from intruders. Therefore inter-troop encounters are very frequent. The daily travel distance is between 300 to 1000 m depending upon the season. The gibbons are almost entirely arboreal, ascending and descending by swinging from branches. The brachiation and leaping is frequent. However, in degraded environments they adopt bipedal movement. The pair duets when another group is nearby calling. A 15-20 minute duet songs is usually observed in the morning. During other occasions they have different songs. The female sleeps with her infant and the adult male. Older offspring sleep separately; occasionally adult males sleep with the older offspring under natural condition gibbons sleep too high in the canopy to encounter a predator. Most of the bodies and skeletons examined showed multiple fractures which indicate fractures and injuries as a result of falls are a major cause of mortality in gibbons (Shrivastava 1990).



5.3 Reproduction and ontogeny

Hoolock gibbons are strictly monogamous. Mating appears to occur more often in March-May (Feeroz & Islam 1992). Extra-pair copulations are very rare (Das cited in Srivastava 1999; Feeroz 1996). Menstrual cycles have an average duration of 28 days (Matthews 1946). Gibbons give birth to single offspring. Birth typically occurs from November to February (Alfred 1992; Alfred & Sati 1990; McCann 1933, Tilson 1979). The birth interval in gibbons is about 2-3 years. The gestation period is about 7 months, i.e. about 183-225 days (Geissmann 1991). Young gibbons are born with hairless ventral parts and must rely on their mothers for warmth. Nursing lasts about two years. Young gibbons will stay with their parents until they are past adolescence. In captivity, gibbons usually attain sexual maturity at an age of about 6-8 years, but this appears to be highly variable (Geissmann 1991; Matthews 1946). At

maturity, offspring probably leave the natal group or may be chased off by their parents. Life span: in captivity probably up to 50 years, but Hoolock show very low survival rate in captivity (Geissmann 1991; Matthews 1946).

5.4 Vocal communication

Gibbon groups produce loud, stereotyped song bouts in the early morning. Songs probably serve to defend resources such as territories, food trees, partners, but may also help to attract potential mates. Gibbon songs include species specific characteristics which are inherited and not learned (Geissmann 1993). Mated hoolocks typically produce duet songs which consist of coordinated vocal interactions by both partners using sex-specific phrases (Choudhury 1989; Geissmann 1993, 1995; Gittins & Haimoff 1984; Haimoff 1985). In contrast to other gibbon species, however, no sex-specific note types are used during hoolock songs. Duet song

bouts had an average duration of 15-18 min (Feeroz & Islam 1992; Gittins & Haimoff 1984; Tilson 1979). Other family members may participate in the song bout. Solo song bouts are typically produced by unmated hoolocks only. Most song bouts are produced from preferred calling trees, mostly situated near the territorial border (Feeroz & Islam 1992).

5.5 Predators

Adult gibbons typically live in the crown region of the forest where eagles and vultures may act as natural predators besides men. In the lower storeys of the forests, leopards, clouded leopards, and pythons may be potential predators of gibbon.

5.6 Status and conservation

The gibbons are ranked endangered under (criteria: A1cd) IUCN Category of threat (Hilton-Taylor. 2000). The species is threatened by habitat loss and by hunting for food, for Oriental medicine and for the pet market (Ahsan 1995b; Choudhury 1990, 1991, 1996a; Mukherjee et al. 1992). Hunting for food is the single most important reason for the decline of the species in several regions, except probably in Myanmar where people do not kill gibbons for food (Dr. A. J. T. Johnsingh, personal communication). Slash-and-burn shifting cultivation (Jhum) is the main factor leading to the destruction and fragmentation of gibbon habitat, but conversion of tropical forest to teak plantations, betel-leaf (Piper betle) plantation, and encroachment of forest land for settlement (Choudhury 1996a; Mukherjee et al. 1992) are equally important factors. Several other traditional uses of forests for commercial purposes contribute to habitat degradation, these

include introducing exotic tree species, extracting fuel wood, extracting tree bark, extracting timber, and livestock herbivory (Ahsan 1995b). In Bangladesh, NE India and SW China, much of their habitat is extremely fragmented (Alfred & Sati, 1990; Choudhury 1996b; Lan 1994). This makes gibbons particularly vulnerable to hunting and predation. Most populations are very small and declining (Choudhury 1996b; Mukherjee et al. 1992), and many populations in small patches of habitats will probably go extinct in the near future (Alfred & Sati 1990). Not much information is available on the status of the gibbons in Burma (Myanmar). There have been virtually no studies on gibbon in Myanmar since the Vernay-Hopwood-Chindwin expedition in the mid-1930s. Recent information suggests that hoolocks have disappeared from many forested areas in Myanmar, but a substantial number of sightings have been reported along the lower Salween River, a region of intensive logging (Anonymous 1990; Eudey 1990; Marshall 1990).

Status of hoolock gibbon in Meghalaya, Mizoram and Tripura

Based on the results of the Wildlife Institute of India (WII) and United States Fish and Wildlife Services (USFWS) collaborative project, a total of 194 gibbon groups were identified based on actual sightings, based on songs and based on personal communications with the local people and forest staff.

Mode	Meghalaya	Mizoram	Tripura	Total
Personal communication	29	39	16	84
Songs	32	30	15	77
Actual sightings	22	03	08	33
TOTAL	83	72	39	194

Except in Tripura, the most gibbon groups were found located in community/village and private forests compared to protected areas.

State	Study sites	Intensive Survey sites	Transects	Vegetation Plots
Meghalaya	8	76	56	160
Mizoram	7	70	50	197
Tripura	5	19	-	-
TOTAL	20	165	106	357

The above information was collected from 165 intensive survey sites spread over 20 study sites in three states. The vegetation survey was also conducted to study the habitat quality on selected transects in Meghalaya and Mizoram. The vegetation survey in Tripura could not be conducted due to paucity of time and other resources.

Location	Meghalaya	Mizoram	Tripura	Total
Private Forests	06	-	08	14
Songachams	23	-	-	23
Village Forests	23	34	-	57
Private + RFs	02	03	07	12
Reserved Forests	15	10	23	48
National Parks	02	05	-	07
Wildlife Sanctuary	12	20	01	33
TOTAL	83	72	39	194

The details on the above is presented in the individual chapters on Meghalaya, Mizoram and Tripura.

Status of Hoolock Gibbon in Assam

Assam is the probably the only state in northeast India where extensive study and survey for gibbons has been taken up by many institutions and organizations. Assam (78348

km²) is second highest in its geographical spread after Arunachal Pradesh. having geographical areas. A total of 36 forest divisions together make up for 28185 km² forest area in the state, of which almost half (14517 km²) is present as dense and remaining as open forests. The legal classification of forests consist of the reserved forests (14958 km²) protected forests (3436 km²), District Council Reserved Forests (1081 km²), proposed reserved forests (2815 km²), and unclassed forests (5894 km²). There are 23 protected area (PA) in the state, of which 5 are National Park (NP 1968.6 km², 2.5% of total geographical area) and 18 Wildlife Sanctuaries (WLS 1439.6 km², 1.9% of the total geographical area) (**Fig. 5**).

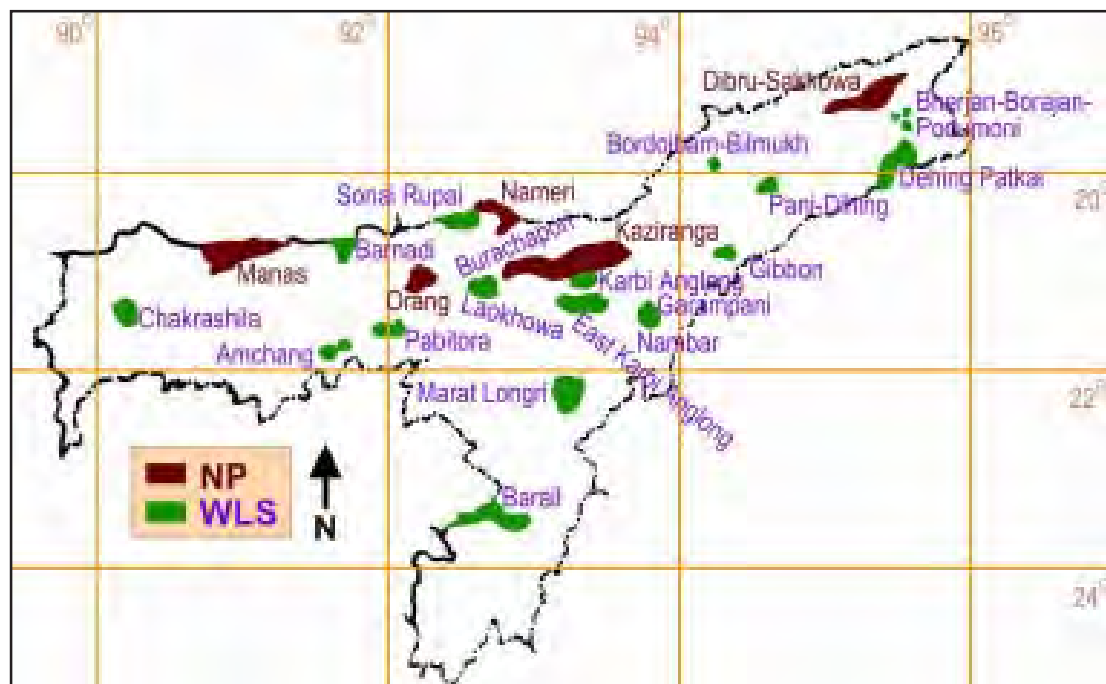
There are 27 districts in Assam and 14 districts (Cachar, Dibrugarh, Goalpara, Golaghat, Hailakandi, Jorhat, Karimganj, Karbi-Anglong, Marigaon, Nagaon, North Cachar Hills, Sibsagar, and Tinsukia) are reported to have gibbon populations (Das *et al.* 2004).

Of the total 23 PA, 13 protected areas (2 NP and 11 WLS) are having gibbon populations (Dibru-Saikhowa NP, Kaziranga NP, Garampani WLS, Namor WLS, Hollongapara Gibbon WLS, Bherjan-Borajan-Padumani WLS, Karbi-Anglong WLS, East Karbi-Anglong WLS, Nambar-Doigrung WLS, Marat Longri WLS, Dhing Patkai WLS, Amchang WLS, and Barail WLS) (**Fig. 6**).

Fig. 5 : Location of Protected Areas in Assam



Fig. 6 : Protected Areas with gibbon populations (from Das *et. al.*, 2004)



According to Das et al (2004), a total of 8200 km² forest area within 20 forest divisions support 62 groups (219 individuals) of gibbon. Based on the survey over 12772 km² area in the state (of the total 196 reserved forests surveyed, the gibbons were found in 89 reserved forests), Das *et al.* have estimated presence of 1248 km² of intact (not fragmented) forest habitat likely to support 1264 groups of gibbons with a total of population of 4404 individuals. Second estimate consists of fragmented forest habitat to the tune of 7065 km², which is likely to support 1429 groups consisting of 4980 individuals. Based on the landscape features (fragmentation, porosity, disturbance from road and settlement, interspersions to derive the disturbance regime and biological richness) and primate diversity, a total of 60 conservation priority with 5 different levels of integration matrix areas have been identified in Assam (Das et al., 2004).

Conservation threats to gibbons in Assam

Unlike other northeastern states, the fragmentation of forest habitat is much less (1.15% of the total forest area of the state), but equally alarming is the proportion of man-made landscapes, which account of about 52% of the total forest area and is mainly responsible for the decimation of most of the gibbon populations in the state. A total of 8 Conservation Landscapes have been identified by Das et al. (2004) across the state [(Langlakso-Mikir Hills-Kalion landscape (1044.26 km²), Joypur – Dirak – Upper Dehing landscape (500 km²), Barail-North Cachar landscape (300 km²), Borjuri-Junthung-Western Mikir Hills landscape (286.82 km²), Innerline-Kathakhal-Singhla landscape (190.10 km²), Khurimming-Panimur-Amreng landscape (186.06 km²), Dhansiri-Borlanfer landscape (105.39 km²), and Rani – Garbhanga – Pantan landscape (+100 km²)]. The study has also identified 7 reserved forests and protected areas as Priority Areas for gibbon management

(Borajan WLS, Hahkati R.F., Dolamora P.R.F., Gibbon WLS, Pophanga R.F., Kashumari PRF, and Khongkhal PRF).

Similar to other northeastern states of gibbon distribution, Assam also presents different conservation threats to the biology, ecology and genetic viability of the gibbons.

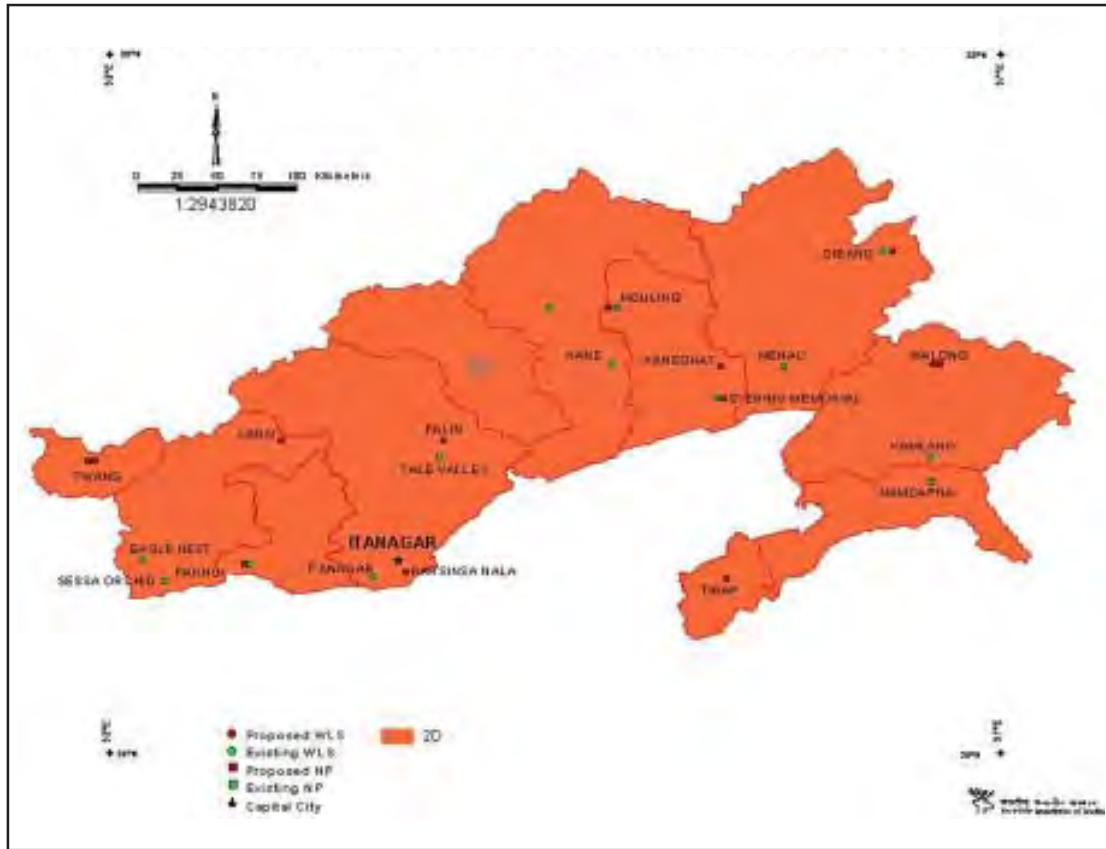
STATUS OF HOOLOCK GIBBON IN ARUNACHAL PRADESH

Arunachal Pradesh is the biggest state in the Northeast India with an area of 83,743 km². The state is very rich in forest cover, which accounts for 61.5% (51542 km², which is the highest among the seven states of north-east India). The forest area in the state is 81.9% (68620 km²), out of which 79.4% consists of closed forest (density 40 percent and above) and 20.6% consists of open forest (density 10 to 40 per cent). The state also contains around 16% of the total timber growing stock of the country. The state has 2 National Parks covering an area of 2.7% (2291 km²) and 11 Wildlife Sanctuaries covering 9.1% (7606 km²) of the total land area of the state (**Fig. 7**).

The status of gibbons in the state is not conclusively known excepting mention on their presence or absence from the protected areas. There is hardly any information on the population estimation of gibbons based on a systematic study in the state. The Dibang wildlife sanctuary constitutes the north-western boundary for the distribution of this species. Choudhury (2001) has reported confirmed sightings of gibbons from Kamlang and Mehao Wildlife sanctuaries and unconfirmed presence from Dibang wildlife sanctuary and Namdapha National Park in Arunachal Pradesh. However, no population estimation is given with respect to the gibbons in these areas.

The main conservation problem to the gibbons in the state could be common with other northeastern states. Shifting cultivation and

Fig. 7 : Location of Protected Areas in Arunachal Pradesh



indiscriminate destruction of forests could be named as two main reasons for the conservation problems to the biodiversity of the area in general and gibbons in particular. This gets further compounded by the peculiar land tenure system. Almost all the tribes have the community forests, which is controlled by the village council. In some areas, clan ownership is recognized in the forest areas falling within the village jurisdiction. Around 62.2% of the total forest is under community ownership which is present as unclassified state forest (USF) and presently there is a growing tendency of individual ownership. Reserve forests constitute nearly 37.3% of the total forest area which is much less than the national average of around 53%. The above mentioned land use pattern is only going to favour the destruction and fragmentation of the forest habitat thus adversely impacting the survival

of biodiversity in general and the gibbons in particular. It is reported that between 1991 and 1997, there has been a reduction in the forest cover to the tune of 155 km² in the state (Forest Survey of India, 1997). Since there is no Autonomous District Council forest areas in the state, this loss in the forest cover has been mainly from the unclassified forest cover under community control. Moreover, there has been profuse growth in forest based industries (a total of 242 saw and veneer mills) in the state over the last few decades. These industries have prompted destruction of forests with added pace, the benefit of which only goes to the few rich industrialist. This brings in the local people into direct conflict with the natural resources who are exploited by them for earning their livelihood in absence of any other means to earn their livelihood.

STATUS OF HOOLOCK GIBBON IN MANIPUR

Manipur (22327 km²) is also very rich in forests resources having an area of about 15154 km² (67.9). The forest cover in the state is about 17418 km² (78%). The state has only 1 national park (40 km²) making up for 0.2% of the total land area of the state and 5 wildlife sanctuaries (185 km²) covering an area of 0.8% of the total land area of the state (Fig. 8).

The land use pattern in Manipur is also in favour of the local tribal communities. Of the total forest area in the state, only 9.7% is present as Reserved Forests. The protected forests in the state constitute about 27.5% of the total forest area, while the unclassified/clan/private forests make up for the huge 62.8% of the total

forest area of the state. This lop-sided land use pattern has been one major stumbling block for measures related with conservation of biodiversity in general and the gibbons in particular. The adverse impact of this faulty land use pattern get further compounded due to presence of Autonomous areas in 6 districts of the state (Ukhrul, Senapati, Tamenglong, Chandel, Sadar Hills and Churachandpur). In Manipur, all unclassified forest areas are under the management of Councils. The diverse ownership pattern of forest land with similar diverse management priorities pose serious difficulties when the recognized need of a uniform approach to management of this important resources is considered. The adverse result of these multi-level controls of the forest resources is getting reflected in reduction in the

Fig. 8 : Location of Protected Areas in Manipur



forest area to the tune of 267 km² for a period from 1991 to 1997 (Forest Survey of India, 1997). Of this total loss in the forest cover, a loss of 140 km² took place within a period of two years (1995-1997). The state has registered a reduction in dense forest over 381 km², while a gain in the open forest to the tune of 241 km² has compensated a bit. But this compensation will not be of any use for the gibbon conservation. The shifting cultivation has led to reduction of forest cover comprising of 603 km², which has also resulted into conversion of primary dense forests into scrub/nonforest over an area of 463 km². There are almost 207 forest based industrial units (saw and veneer mills) across the state, which brings in added pressure on the natural forestry resources rendering biodiversity elements homeless.

Similar to Arunachal Pradesh, there is no published document available on the population estimation of gibbons. However, their confirmed presence is reported from 4 WLS, namely, Jiri-makru WLS; Kellam Hill WLS; Yangoupokpi-Lockchao WLS; and Zeilad WLS and confirmed presence is reported from Bunning WLS (Choudhury 2001). Hoolock Gibbon, locally known as Yongmu in Manipur, commonly occurs in all the five hill districts of Manipur

Given the similar land use pattern in Manipur compared to with other northeastern states, one can easily visualize the conservation problems with respect to the biodiversity in general and the gibbons in particular. Lack of any published scientific report and study on this highly endangered primate study in the state only speak of the lack of serious efforts on the part

of the concerned department to even document the population estimation across the state.

STATUS OF HOOLOCK GIBBON IN NAGALAND

Nagaland (16579 km²) is also very rich in forests resources having an area of about 8629 km² (52%). The forest cover in the state is about 14221 km² (86%). The state has only 1 national park (202 km²) making up for 1.2% of the total land area of the state and 3 wildlife sanctuaries (20.4 km²) covering an area of 0.1% of the total land area of the state (**Fig. 9**).

The land use pattern in Nagaland is also in favour of the local tribal communities. Of the total forest area in the state, only 0.9% is present as reserved forests. The protected forests in the state constitute about 5.9% of the total forest area, while the unclassed/cla/private forests make up for the huge 93.1% of the total forest area of the state. This lop-sided land use pattern has been one major stumbling block for measures related with conservation of biodiversity in general and the gibbons in particular. The adverse impact of this faulty land use pattern get further compounded due to presence of Village Councils in absence of Autonomous areas in Manipur. In Nagaland, all the unclassified forest areas are under the management of Village Councils. The diverse ownership pattern of forest land with similar diverse management priorities pose serious difficulties when the recognized need of a uniform approach to management of this important resources is considered. The adverse result of these multi-level controls of the forest resources is getting reflected through reduction in the forest area to the tune of 100 km² for a

Format of Survey

S. No.	DATA		
1	Date		
2	Transect Number		
3	Area: Beat/Range/Division		
4	Time (start and finish)		
5	Weather		
6	Group Structure and Composition		
	Number of Groups		
	Number of Individuals		
	Sex		
	Songs	Direction	
		Intensity	
		Distance from Transect	
		GPS Reading	
	Major identification morphological features		
	Activity: If Feeding	Name of Plant species	
		Plant parts	
	Forest Types	Bamboo Patches	
		Sal	
		Teak	
Miscellaneous			
Status			
7	Vegetation		
	No. of Tree (species)		
	Main dominant species		
	Vines and Lianas in %		
	Canopy Cover in %		
	Canopy Cover Continuity in %		
	Type of Vegetation		
	Herb/Shrub density (%) within 10 m radius	5m for shrubs	
		1m for herbs	
8	Biotic Pressures (10m radius plot)		
	Number of cut stumps		
	Cattle Grazing	Direct	
		Indirect	
	Human Presence		
	Shifting Cultivation	Areas	
		Number of Families	
Distance from Sighting			
9	Fragmentation		
	Areas		
10	Direct	Species	
		No. of sightings	
	Indirect	Sign	
		Species	
		No. of sightings	