FINAL REPORT FOR MAJOR RESEARCH PROJECT

TITLE OF THE PROJECT:

Status survey of Western Hoolock Gibbon and conservation initiative through Mass awareness in the Reserve Forest areas of Barak valley, Assam, India

Name of Project Investigator: Prof. Parthankar Choudhury
Dept. of Ecology and Environmental Science
Assam University, Silchar

Name of Project Fellow: Dr. Mofidul Islam
Dept. of Ecology and Environmental Science
Assam University, Silchar

Sanction letter No. F. No. 42 – 429 / 2013 (SR) dt. 12 / 03 / 2013

2016

CERTIFICATE

I, Prof. Parthankar Choudhury, Ph.D., declare that the work presented in this report is original and carried throughout independently by me during the complete tenure of major research project of U.G.C., New Delhi.

(Prof. PARTHANKAR CHOUDHURY)
Principal Investigator
Dept. of Ecology and Environmental Science
Assam University, Silchar, Assam, India

ACKNOWLEDGEMENT

Principal Investigator of the Major Research Project is thankful to the University Grants Commission, New Delhi, for the award of project and financial assistance to pursue the research work in the Department of Ecology and Environmental Science, Assam University, Silchar, Assam, India. P.I. also conveys his sincere thanks to the authorities of the Assam University, Silchar, for their help and support throughout the tenure of the project. P.I. is also indebted to the services of project fellow, Dr. Mofidul Islam, and research scholar, Anup Dey, Dipankar Debnath, Anisur Rahman, Soumya Dasgupta for their sincere support in carrying out the project work. P.I. thankfully acknowledges all teaching and non-teaching staff, Department of Ecology and Environmental Science, Assam University for their helping hand throughout project work. P.I. also thankful to the forest personel of the Forest department of Cachar and Karimganj districts for their active help during the field work.

Prof. Parthankar Choudhury
Principal Investigator
Dept. of Ecology and Environmental Science
Assam University, Silchar, Assam, India

CONTENTS

Status survey of Western Hoolock Gibbon and conservation initiative through Mass awareness in the Reserve Forest areas of Barak valley, Assam, India

1. INTRODUCTION:

The North-East India (22.30˚ N and 89.97˚E) represents the transitional zone between the Indian, Indo-Malayan and Indo-Chinese biogeographic regions, characterized by a variety of climatic, edaphic and altitudinal gradients. Consequently, the area is one of the richest zones in terms of varieties of biological species. North-East India is one of the 35 biodiversity Hot Spots of the world which is extremely rich in species and also blessed with a wide range of physiographic and eco-climatic conditions (Myers et al., 2000)**.**

The Barak-Valley of Assam is represented by three districts viz. Cachar, Hailakandi and Karimganj. These three districts include a total of 16 Reserve Forests, out of which two are located in Hailakandi, seven each in Karimganj and Cachar respectively. These forests were once inhabited by Sambar, Barasingha, Leopard, Barking Deer, Civet Cats, Otter, River-Dolphin and also Rhinoceros, Elephant and many others (Hunter, 1879). Many of those wildlife species are no more observed these days and are living only in history. India harbours 32 taxa of primates in the wild (Molur et al., 2003). Of these, the Western Hoolock Gibbon (*Hoolock hoolock*) and Eastern Hoolock Gibbon (*Hoolock leuconedys*) are the two lesser ape species that occur in India (Das et al., 2006). The Hoolock Gibbon was formerly associated with genera Hylobates (Prouty et al., 1983a, 1983b) and Bunopithecus (Brandon-Jones et al., 2004; Groves 2005). Later on, it has been changed as the genus Hoolock (Mootnick and Groves 2005) with two species: Western Hoolock Gibbon (*Hoolock hoolock*) that occur in northeastern India south of the Brahmaputra River

(Mukherjee 1982; Alfred and Sati 1986; Choudhury 1987), Bangladesh (Anderson 1878; Siddiqi 1986; Das et al., 2003a) and western Myanmar (Tickell 1864), and Eastern Hoolock Gibbon (*H. leuconedys*) occurring in Lohit District of Arunachal Pradesh, India (Das et al., 2006), Myanmar and China (Groves 1971; Anderson 1978; Lan 1994). The Debang-Bramhaputra river system in the west (Tilson, 1979) and Chindwin in the east act as physical barriers for the distribution of species (Parsons 1941; Groves 1967, 1972; Choudhury, 1986). Along the range of their distribution in India and Bangladesh, Hoolock's survival is strongly associated with the occurrence of contiguous canopy, broad-leaved, tropical wet evergreen and semi- evergreen forests (Anderson 1878; Siddiqi 1986; Das et al., 2003a).

The Hoolock gibbon (*Bunopithecus hoolock*) known as one of the White-Browed gibbons was first described as S*imia hoolock* by Harlan (1834) from the Garo Hills in Assam (now in Meghalaya). Among the nine known species of lesser apes (*Hylobatidae:Hylobates*) from Southeast Asia, the hoolock is the largest gibbon after the siamang (Groves, 1970; Napier and Napier, 1967). Adults of the hoolock are sexually dichromatic - they undergo a sequence of colour changes from infancy to the sexually dichromatic adults (Peart, 1934; Pocock, 1939; Groves, 1970; Alfred and Sati, 1990a). While the coat of the adult male is always black, it has prominent white eyebrows and a big genital tuft. The adult female is golden or buff or brownish buff. At birth, hoolocks are pale greyish-white to milky- white and the skin is dark black. Infants above 10 months of age, juveniles, and sub-adults have a black coat colour. Males continue with this coat colour till their adulthood, whereas the coat colour of females changes from black to buff, at puberty. The head and body length of an adult hoolock usually measures 45.7– 63.0 cm.

The body weight of males varies from 6.1 7.9 kg and of female from 6.0 to 6.6 kg (Shortridge, 1914; Schultz, 1969).

Scientific name of Western Hoolock is *Hoolock hoolock* (Harlan, 1834), where '*Hoolock*' is the generic name and '*hoolock*' is the name of the species. Till the end of the year 2006, Western Hoolock gibbon was considered as one of the subspecies of Hoolock gibbon. But in 2006, the status of both the Western and Eastern subspecies of Hoolock gibbon had been raised to species. As such according to the recent taxonomy there are two species of Hoolock gibbons: Western Hoolock gibbon (*Hoolock hoolock)* and Eastern Hoolock gibbon (*Hoolock leuconedys).*The IUCN category of Western hoolock gibbon is Endangered (A2acd + 3cd + 4acd). It is listed in Appendix –I of CITES and Schedule –I of Wildlife Protection Act of India, 1972.

The population of *H. hoolock* in the wild has declined over the past three decades due to numerous anthropogenic threats (Walker et al., 2007). The debilitating threats include habitat destruction and fragmentation as a result of agricultural expansion, shifting cultivation, establishment of tea gardens, coffee plantations, timber logging, developmental projects, hunting and poaching for food, traditional medicine, body parts, pet collection and illegal trade (Choudhury 1990, 1991, 1996a; Mukherjee et al., 1992; Srivastava 1999; Ahmed 2001; Malone et al., 2002; Solanki and Chutia 2004; Das et al., 2006; Walker et al., 2007). These threats occur in Arunachal Pradesh as well as in other areas of its distribution (Srivastava et al., 2001a, 2001b) and may have a direct impact on the population growth and distribution pattern of Hoolock hoolock due to its dependency on forest canopy for habitat, its being frugivorous, a brachiator and its territorial behaviors. Owing to its frugivorous food habit, the species plays a vital role in seed dispersal and pollination

(Howe, 1986; Terborgh, 1990) in lowland tropical rain forest ecosystems. Because of the evidence of widespread and rapid population decline, *H. hoolock* is listed by the IUCN Red List of Threatened Species as Endangered (A2acd+3cd+4acd) (Brockelman et al., 2008). In Bangladesh it is categorized as Critically Endangered, while in India it is endangered as per the IUCN Red List (Molur et al., 2003). In India the species is listed in Schedule I of the Indian Wildlife (Protection) Act 1972 (amendment, 2003), and also in Appendix I of CITES.

The northeast region in India with highest primate diversity has the most intense conservation problems and social unrest in this region has increased pressure in the forest in the form of selective logging and encroachment. Gibbons are brachiators and depends solely on the continuity of the forest canopy. Habitat loss in the form of breaking of the continuity of forest canopy have restricted and isolated their populations to smaller patches (sub-populations), even within a forest. Gibbon population are more prone to extirpation from a particular area at a faster rate than the other primates, as they have inter group spacing, small group size (2-3 individuals), longer inter birth interval (3- year), long parental care (2- years), late sexual maturity (7- years) and less reproductive turnover (Adult female gives birth to 6 individuals approximately in the reproductive life of 20 years) (Mittermeier et al., 2007). Although, the distribution range of the species has remained almost the same, expansion of human habitation, destruction of habitat for agriculture including jhum cultivation, and poaching have resulted in a sharp decline in the populations, besides severely fragmenting all their major habitats. Developing a long-term strategy for primate conservation is of utmost importance, given the rapid loss of habitat and poaching. Due to fragmentation, a number of small and isolated populations are formed and only parts of this population are protected under the Protected Area network.

The decline of the hoolock gibbon has been caused by the destruction, degradation and fragmentation of its forests for settled and shifting agriculture, plantations, logging, fuel-wood collection, and development projects such as mining, roads, and railways. Poaching of wildlife, including gibbons, for food and trade is common among the hill tribes of northeast India (Srivastava, 1999; Choudhury, 2006) leading to empty forests even where the habitat might be intact. A clear understanding of the distribution of organisms in time and space is central to the evaluation of the conservation status of threatened species and critical for the formulation of appropriate conservation strategies. The hoolock gibbon has a broad geographic distribution across tropical and subtropical regions of Bangladesh, China, India, and Myanmar. Groves (1967) distinguished two subspecies of hoolocks based on the variation in pelage coloration on opposite banks of the river Chindwin in Myanmar: Hoolock hoolock hoolock (the western hoolock gibbon) and Hoolock hoolock leuconedys (the eastern hoolock gibbon). Subsequently, Mootnick and Groves (2005) described these taxa as distinct species. The eastern limit of the western species is believed to be the river Chindwin of Myanmar (Groves 1967, 1972). Hoolock gibbons have become rarer due to habitat loss and hunting and, except for a few protected areas and larger reserved forests, they are found in scattered groups, where they may not survive for long. The hoolock gibbon is protected by law and occurs in all the five protected areas and in at least 20 reserved forests and 14 proposed reserved forests in the district. Of these, its continued presence is doubtful in at least four reserved forests and one proposed reserved forest (Choudhury, 2009).

As canopy-dependent animals, gibbons are particularly vulnerable to habitat loss and disturbance due to human activities. The hoolock's area of occupancy has declined by more than 30% in the past decade due to habitat loss, habitat fragmentation, and human encroachment. There has also been a reduction in the quality of remaining habitat fragments due to loss of fruiting trees and sleeping trees and the creation of gaps in the canopy (Das et al., 2005).

The Barak Valley, Assam, is one of the largest landscapes left for western hoolock gibbons, which have a substantial population in the area (Das, 2002). This valley is facing much encroachment, particularly from illegal timber harvesting and procuring of non-timber forest products. Reserve Forests in Barak Valley are very important for primate conservation, as it supports eight different primate species. The purpose of this study was to identify the population status of Western Hoolock gibbon in the secluded habitat, and to form a database that would throw some light on the factors that act as barrier in the survival of the gibbons in the region.

The Hoolock gibbon was first described by Harlan (1834) and assigned to the genus *Hylobates* by Blanford (1888-1891). Most of the earlier descriptions of the hoolock are of taxonomic interest or natural history observations (Alfred and Sati 1986). After McCann's (1933) two months study on the behavior of the hoolock in the Naga hills in 1930, followed by an exploratory study conducted by Tilson (1979) in the Hollangapar Reserve Forest in Upper Assam. Since 1980s, there has been a keen interest in primate studies in North East.

Several studies were carried out on the ecology and behavior of hoolock gibbon. Mukherjee (1984) in Tripura, Islam and Feroz (1992) in Bangladesh, Alfred and Sati (1987, 1990, 1991) in the Garo Hills of Meghalaya, many abundance and survey studies by Choudhury (1990, 1991, 1996, 2000, 2006), Kakati (1997) and others.

The Hoolock gibbon has a broad geographic distribution across tropical and subtropical regions of Bangladesh, China, India, and Myanmar. Groves (1967) distinguished two subspecies of hoolocks based on the variation in pelage coloration on opposite banks of the river Chindwin in Myanmar: *Hoolock hoolock hoolock* (the Western hoolock gibbon) and *Hoolock hoolock leuconedys* (the Eastern hoolock gibbon). Subsequently, Mootnick and Groves (2005) described these taxa as distinct species.

The species is categorized as endangered by IUCN and listed in Schedule I of the Indian Wildlife (Protection) Act of 1972. It has been on the list of the World's 25 Most Endangered Primates since 2006 (Walker et al., 2007), with the global population estimated to be about 5,000 animals: 2600 to 4450 in India (Molur et al., 2005, Choudhury 2006). Because of unrelated destruction of its habitat in terms of commercial logging, fragmentation and degradation, coupled with hunting pressures, most populations of the western hoolock are isolated and small, with 80% of those assessed in India and Bangladesh harboring fewer than 20 individuals, and over half having fewer than 10 (Walker etal., 2007).

The Western hoolock gibbon (*Hoolock hoolock*) occurs in the western-most extreme of the distribution of the 16 gibbon species currently recognized (Geissmann, 2007). Its range is restricted to the evergreen and semi-evergreen rain-forests of North-east India south of the Brahmaputra River (between latitudes 22°N and 28°N and longitudes 90°E to 98°E), Bangladesh, Southern Yunnan and Myanmar up to the river Salween. The western subspecies *Bunopithecus hoolock hoolock* is found in the northeastern and southeastern region of Bangladesh, seven states of northeastern India and western

Myanmar. Debang-Brahmaputra river system in the west (Tilson, 1979) and Cindwin River in the east act as barriers for the distribution of this sub-species (Groves, 1967; 1972).

Anderson, in the year 1878, first reported the presence of Hoolock Gibbon in the Chittagong Hill Tracts of Bangladesh. Prater (1971), Green (1978), Khan (1981), Gittins (1980), Gittins and Akonda (1982), and Siddiqi (1986) have also recorded the presence of Hoolock Gibbon in different forests of Bangladesh. Besides specimen collection localities, several authors have recorded the distribution in different states of northeastern India. In Meghalaya (Alfred and Sati, 1986, 1990; Choudhury, 1991), in Tripura (Mukherjee, 1984, 1986; Singh, 1989; Gupta, 1994), in Arunachal Pradesh (Tilson, 1979; Choudhury, 1991; Borang and Thapliyal, 1993; Mukherjee et al., 1988; 1991-92), in Nagaland (McCann, 1933), in Assam (Choudhury, 1987, 1988, 1990, 1991, 1996, 2000) and in Mizoram (Raman et al., 1995).

Molur et al., (2003) point out that gibbons are losing 3-4% of their habitat every year and their population is declining by 1-2% in a year in their distributional range. Mukherjee et al., (2008) reported that in Garo Hills of Meghalaya, gibbons are localized in small fragmented and discontinuous forests. Molur et al. (2005) also stated that the isolated forest fragments holding the families of about 2–4 individuals are insufficient for long-term survival of the Western hoolock gibbon.

The hoolock population living in the Borajan Wildlife Sanctuary was estimated to comprise 30 individuals in 1995 (Choudhury, 1996b), but counted only eight individuals in 2005 (Molur et al., 2005). The Borajan forest supports several primate species other than hoolocks, including Assamese macaques (*Macaca assamensis*), northern pig-tailed macaques (*M. leonina*), rhesus macaques (*M. mulatta*), capped leaf monkeys

(*Trachypithecus pileatus*), and the nocturnal Bengal slow loris (*Nycticebus bengalensis*) (Choudhury, 1996b).

North-eastern India is a multicultural area with many different ethnic groups, some of which still hunt gibbons for meat, blood and bones (Das et al., 2003b). Molur et al., (2005) reported that because of the small size of the forest patch, the low number of gibbons, and the continuing deterioration of the habitat, it appears unlikely that this population is viable. Recent population viability analysis suggests that it will go extinct within the next 70 years or earlier (PHVA report, 2005). First distribution records of the Eastern hoolock Gibbon, *Hoolock leuconedys* was reported from Lohit district of Arunachal Pradesh, India by Das et al., in 2006.

Most of the studies on the Western Hoolock Gibbons population and distribution status have been conducted in northeastern India including Assam (Choudhury, 1990, 1996a, 1996b, 2000, 2001, 2009; Das et al., 2003a, 2003b, 2004, 2005, 2006), Meghalaya (Tilson, 1979; Alfred and Sati, 1986, 1990; Choudhury, 1998, 2006; Gupta and Sharma, 2005a), Mizoram (Misra *et. al*,1994; Gupta and Sharma 2005b; Choudhury, 2006), Tripura (Das et al., 2005; Gupta and Dasgupta, 2005), Nagaland (McCann, 1933; Choudhury, 2006) and Manipur (Choudhury, 2006). A few studies were conducted between 1988 and 2003, and these were concerned only with general distribution patterns (Mukherjee et al., 1988, 1991- 92; Borang and Thapliyal, 1993; Singh, 2001; Choudhury, 2003). The sole exception is Chetry et al., (2003) who conducted a quantitative study on the population status of gibbons in Namdapha National Park (NNP), Arunachal Pradesh.

Study was carried out by Mackinnon and Mackinnon (1987) and Chivers in the year 1977 and reported 170,000- 532,000 nos. of Hoolock gibbon from South Asia. In

Assam it was estimated 6000 by Choudhury (1987) and 1000- 1400 in Tripura by Mukherjee (in 1982). Gittins, 1984 and Feeroz and Islam, 1992 reported 3000 and 200 nos. of hoolock gibbon respectively in Bangladesh. A study carried out by Haimoff et al., (1987) found 100-300 hoolock gibbons in Yunnan. Molur et al., (2005) reported 750-2896 nos. of gibbons in India and Bangladesh whereas Das et al., (2006) reported the number of Hoolock gibbon in Arunachal Pradesh was 328 and Biswas et al., (2010) reported the number to be +309.Mohnot, in 2000 reported 244 nos. of gibbon from Assam; whereas in 2005 it was found +5000 by Das et al. In Meghalaya 259 nos. of gibbons was reported by Gupta et al., (2005) and 220 nos. of gibbon reported by Choudhury in 2006.Gupta et al., (2005) also reported 299 and 83 nos. of hoolock gibbon in Mizoram and Tripura respectively.

The project work entitled, "Status survey of Western Hoolock Gibbon and conservation initiative through Mass awareness in the Reserve Forest areas of Barak valley, Assam, India." aims towards having baseline information about the status of the Hoolock gibbon in the Reserve Forests of Barak Valley and to identify the threats of diverse types faced by them. The ultimate objective would be to conservation of the western hoolock gibbon through Community education and mass awareness programme for the villagers of the fringe areas of species inhabited reserves forests.

2. MATERIALS AND METHODS:

2.1 STUDY SITE:

The Barak Valley (comprising Cachar, Karimganj & Hailakandi districts) is located in the southern part of Assam (India). The Valley districts include a total of sixteen Reserve

Forests, out of which two located in Hailakandi district, seven reserve forest each in Karimganj and Cachar district respectively. Barak Valley is located at an altitude of 39.6 M above MSL and falls under 24˙8′ and 25˙8′ N latitude and 92˙15′ and 93˙15′ E longitude. The southern part of Assam comprising the districts of Cachar, Karimganj, and Hailakandi covers a total area of 6962 km^2. Of the total area, the Barail Wildlife Sanctuary (Cachar district), Katakhal Reserve Forest, and Inner Line RF (of Hailakandi district) cover 1067 km^2. Other reserve forests of southern Assam include Badshaitilla RF, Duhalia RF, Longai RF, Patharia RF, Singla RF, Tilbhum RF, and NC Hills RF of Karimganj district, which cover a total area of 73,295.437 ha; while, Barak RF, Inner Line RF (parts), Katakhal RF (parts), Lower Jiri RF, Sonai RF, Upper Jiri RF, and Barail RF of Cachar district cover an area of 86,284.54 ha.

Geographically, Barak valley is surrounded by United Mikir Hills, North Cachar hills & united Khasi & Jaintia hills in the north, Manipur state (India) in the east, in the south by Mizoram state (India) and in the west by Tripura state (India) and Sylhet dist. of Bangladesh (Map-1).

Barak Valley of Assam (India) comprises of three districts covering an area of 5829 sq. kms. The area has three districts, viz., Cachar, Karimganj and Hailakandi (Map-1). The present work was carried out in the four selected reserve forests of Barak valley where Hoolock gibbon occurs / has been reported to occur in the past. The four reserve forests are Inner line Reserve Forest (Cachar district), Patharia Reserve Forest, Longai Reserve Forest and Singla (Cheragi) Reserve Forest (Karimganj district).

- **Inner-line reserve forest (ILRF):** ILRF is one of the major reserve forest of Cachar district, southern Assam. The total area is 424 km^2, lying between 24° 22/ N and 25°8 /N latitude and 92°24′ E and 93°15′ E longitude (Map- 2). Manipur and Mizoram borders lie in the east and south, respectively. There are 24 forest villages inside the reserve forest (notified by the Forest Department, Cachar dist, Assam). Of the 24 forest villages, 12 are inhabited solely by tribal groups, such as Halem, Jaintia (P'nar), Reang, Mizo, Hmar, Dimasa, Khasi and Kuki; 7 solely by nontribal people, such as Bengali Hindu (scheduled caste), Bengali Muslims, north Indian and ex-tea garden labourers and the remaining 5 by a mixed population of tribal and non-tribal people.

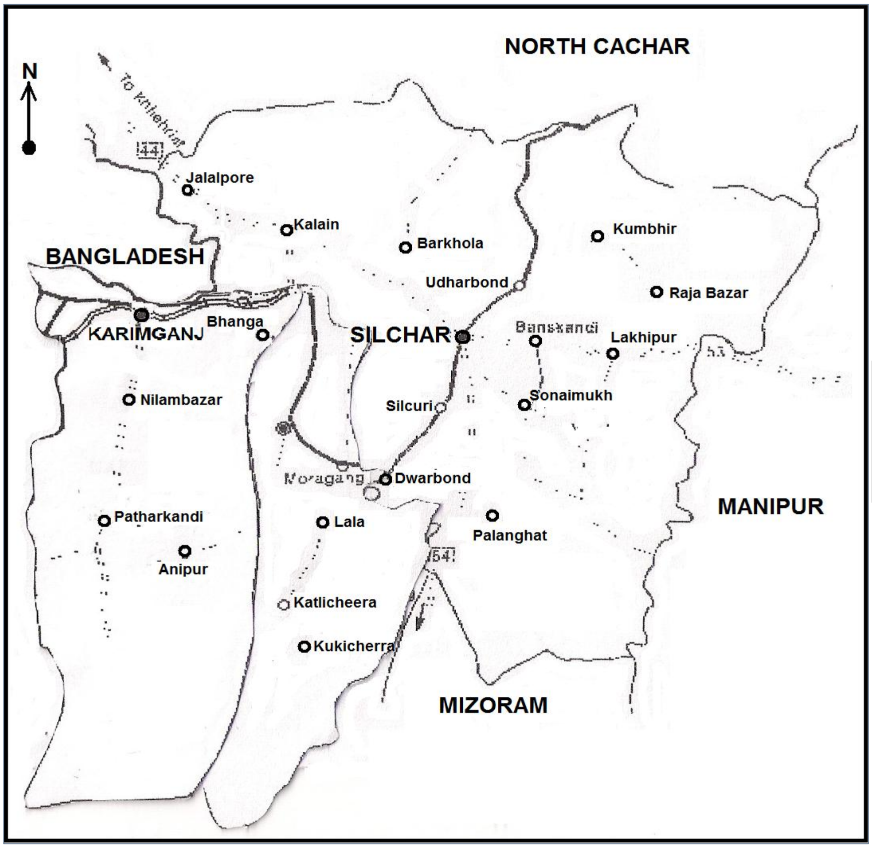
- **Patharia Reserve Forest (PRF):** The Patheria Reserve forest lies between the 24˚45'00" N to 24˚31'59" N latitude and 92˚18'56" E to 92˚11'59"E longititude and covers a geographical area of about 7647.30 hectare. In the west of Patheria RF is the neighbouring country Bangladesh, to its south is the Adamtilla and Champabari tea garden .In the north is Madaupur Tea garden and Mohisasan and in east is Champabari and Bubrighat. This Reserve forest is unique of its types because the part of the forest falls partly in the neighboring country Bangladesh. This range has forest continuity between the two countries (i.e. Bangladesh) and serves as corridors for many wild animals especially Elephants. This reserve forest marks the western boundary of the district forming the International border with Bangladesh (Map- 3). Its length is about 28 miles and breadth about 7 to 8 miles. In Patheria there are as many as 13 forest village (notified by forest Department, Karimganj district). Of the 13 villages, 5 are inhabited by the tribal groups such as khasi, Reang, Dimasa and Kuki; the 4 villages are inhabited by non-tribal people such as Bengali Hindu (both general and Sheduled caste), Bengali Muslim, ex-tea garden labours and remaining 4 are inhabited by mixed population, both tribal and non-tribal.
- **Longai Reserve Forest (LRF):** Longai Reserve forest lies between 24˚26'19" N to

24˚15’00"N longitude and 92˚15’45" E to 92˚18’08"E latitude and covers a geographical area of about 15,139.90 hectare. It is having International border with Bangladesh in the South-east and Tripura state in the west. To its north is Lowaipowa, NH 44 and Tilbhum Reserve forest (Map- 3). In Longai reserve forest there are as many as 28 forest villages. Of the 28 villages, 9 are inhabited by the tribal groups such as Khasi, Reang, Dimasa, Chakmas and Kuki; the 13 villages are inhabited by non-tribal people such as Bengali Hindu (both general and scheduled caste), Bengali Muslim, Manipuri, ex-tea garden labourers and remaining 6 are inhabited by mixed population, both tribals and non-tribals.

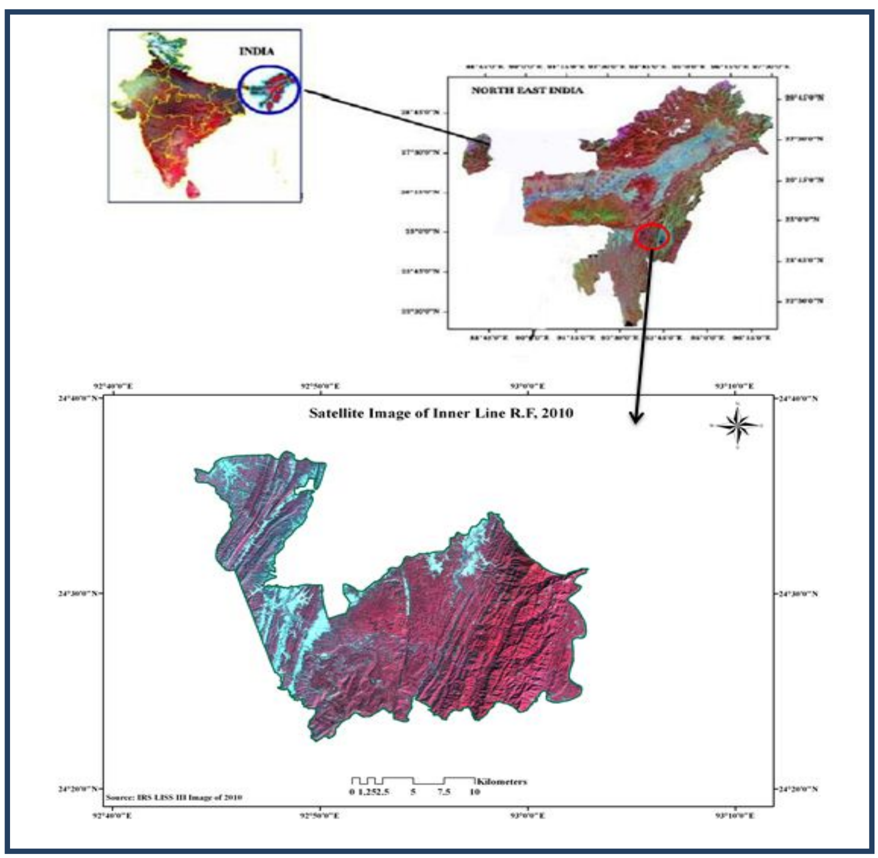
- **Singla Reserve Forest (SRF):** The Singla (Cheragi) Reserve forest lies between 24˚15’19" N to 24˚23’15"N longititude and 92˚23’21"E to 92˚24’31"E latitude and covers a geographical area of about 13429.28 hectare. This forest is predominated by tall trees. The forest is bordered by state Mizoram and Hailakandi district in the South, Aamtilla, Mohan Kachari basti and Ganeshpur in the North, Hailakandi district in the east and Tripura state in the south east (Map- 3). In Singla (Cheragi) reserve forest there are as many as 16 forest villages. Of the 16 villages, 6 are inhabited by the tribal groups such as Khasi, Reang, Dimasa, Chakmas, Mizo and Kuki; the 8 villages are inhabited by non-tribal people such as Bengali Hindu (both general and scheduled caste), Bengali Muslim, Manipuris, ex-tea garden labours and remaining 2 are inhabited by mixed population, both tribals and non-tribals.

The vegetation of the Reserve forests (Inner-line, Patheria, Longai and Singla Reserve Forest) is mostly mixed evergreen and deciduous forest. The vegetation represents a diverse type with a variety of man-made disturbances. The Reserve Forests includes mixed forest types like evergreen forest, semi evergreen forest along with a number of deciduous plant species. The vegetation of the study area includes 'jhum' cultivated areas, agricultural cropland of various communities with a variety of rice species and monoculture plantation by the forest department etc. Common deciduous trees in the forests of study area are *Artocarpus lakoocha, Anthocephalus codombo, Anthocephalus chinensis, Mangifera indica, Dillenia indica, Desmodium sp., Syzigium obalata, Alianthus integrefolia, Ficus religosa, Tectona grandis, Gamelina arborea, Michelia champaca, Musua ferrea* etc. Most of these trees make up a close canopy about 20-30 m above the ground. Other notable vegetation includes bamboo and canes. Adjacent to the Reserve Forests, all fringe forest patches are surrounded by jhum cultivation. Cultivated orchard fruit trees (mango, guava, jackfruit, orange and many more) also form a part of the habitat.

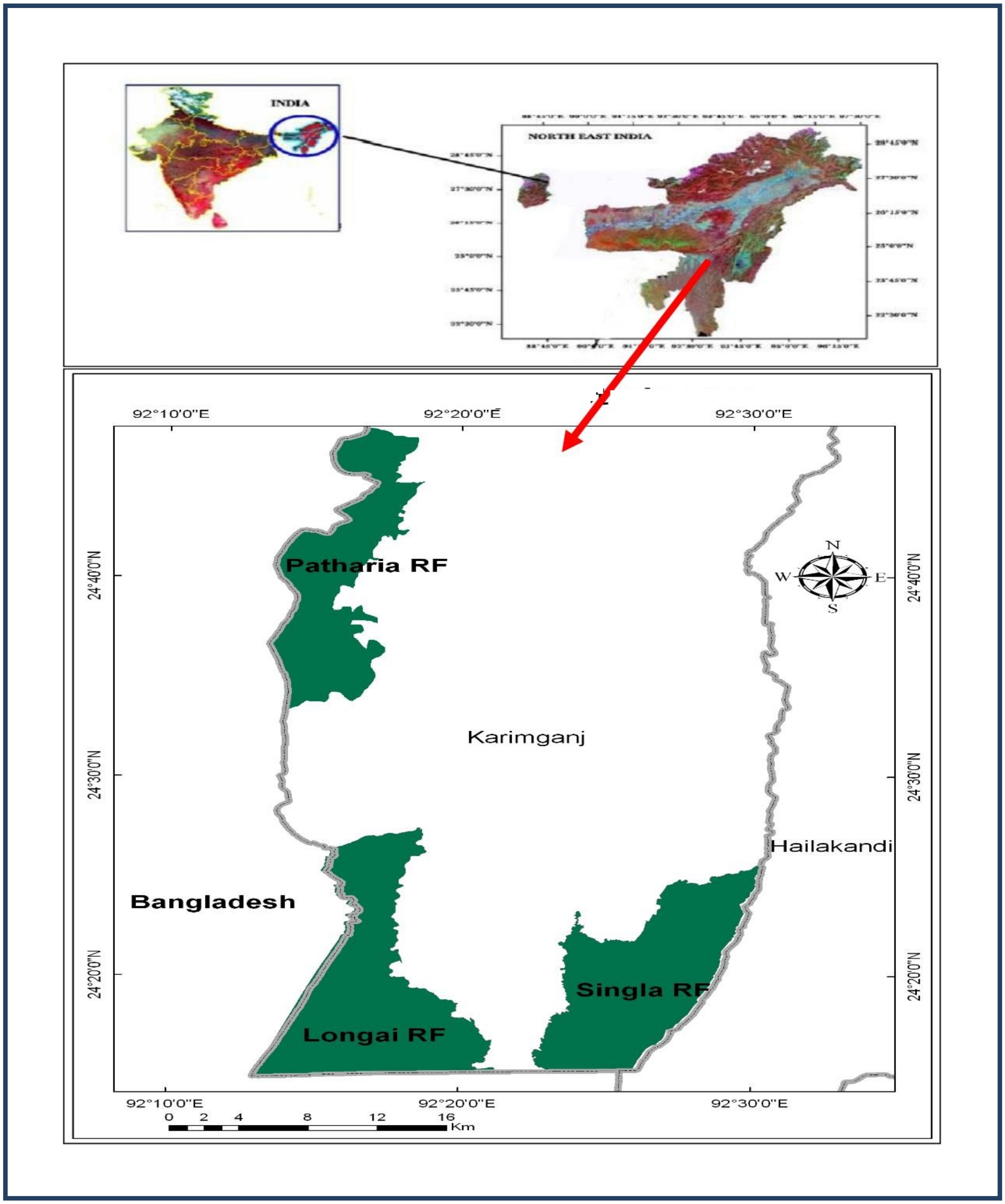
The reserve forests are rich in wildlife species including primates [Caped langur (*Trachypithecus pileatus*), Phyre's leaf monkey (*Trachypithecus phayrei*), Rhesus monkey (*Macaca mulatta mulatta*), Assamese monkey (*Macaca assamensis*) and Slow loris (*Nycticebus bengalensis*)], Barking deer (*Muntiacus muntjak*), Samber (*Cervus unicolor*), Red serow (*Capricornis rubidus*), Jungle cat (*Felis chaus*), Marble cat (*Pardofelis marmorata*), Large Indian civet (*Paradoxurus hermaphrodites*), Small Indian civet (*Vivericula indica*), Pangolin (*Manis pentadactyla*), Jackal (*Canis aureas*) etc., many of which are listed in the IUCN Red data list and some are included in Schedule- I and part of Schedule- II of the wildlife (Protection) Act, 1972.



Map-1. Areas under Barak Valley.



Map-2.Inner-line reserve forest (Cachar district, Assam).



Map.3. Patharia, Longai and Singla Reserve forest (Karimganj district).

2.2 METHODOLOGY:

- **POPULATION ESTIMATION OF HOOLOCK GIBBON:**

The following methods were used during assessment of the population status of Hoolock gibbon in the study sites (four reserve forests of Barak Valley).

- **Direct Method:** Modified line transect method(Burnham et al., 1980; NRC, 1981);and
- **Indirect method:** Call record. (Brockelman and Ali, 1987).

Direct Method: Line transects or modified line transects method was followed depending upon the habitat and the forest condition. Transects were laid in a stratified random manner to cover all representative areas of the area. Observers (two or three) walked randomly through existing forest trails or without forest tracts. The walk transects were initiated in the morning at around 5 am up to 5 pm. The observer walked slowly through the transect pausing at regular intervals of 500m. On sighting gibbon, the GPS (Global Positioning System) location, the group structure and individual details like age, sex and number of individuals were recorded.

Indirect method: It is very well known that Hoolock gibbon emits loud '*Hoo-Ku, Hook u*'- calls which can be heard clearly at a distance of 1 km. Fringe people in the gibbon's habitat are very much familiar with the typical '*Hoo… ku.. Hoo… ku*' call of the species. Therefore, while visiting any forest area if the typical call of gibbon was heard then it could be easily confirmed the presence of Hoolock gibbon in that particular area. Also the direction and number of calls could be recorded. It is one of the easiest ways for recording presence as well as the number of the species in the given area. But one should keep in mind that gibbon does not give call regularly. Again, it does not give any idea about the population status.

- **HABITAT ASSESSMENT:**

Habitat assessment (vegetation characteristics) was done by strip sampling method (Strushaker, 1975 and Williamson, 1993) in daytime to characterize the different habitats, where hoolock gibbon was encountered in the surveyed areas. To assess the habitat (vegetation characteristics) in those sites, 20 X 10 meter strip sampling was done; 10 plots in each site at 50 m interval.

In each plot the following data were recorded:

1) Canopy cover at 20m, at each 5m interval throughout the plot, using visual estimation (Point intercept method, Mueller-Dombois et al., 1974) by the same observer throughout the survey;

2) Diameter at breast height (DBH) of all trees having ≥ 10cm DBH;

3) Height of all trees exceeding 10cm DBH, placing each tree into classes from 05m to 35m+ by using clinometer;

4) Local name of the species of all measured trees (Initially plants were identified by local name with the help of local field assistants and later on plant species were identified with the help of standard field guide following Hajra and Jain, (1978) and Kanjilal et al., (1934-1940).;

5) Total number of trees in the plot.

6) Total cross-sectional area of known gibbon food trees (exceeding10cm DBH).

Tree species that represent food resources for western hoolock gibbon were assessed following Chetry et al., (2007), Muzaffar et al., (2007) and Mathur et al., (2002). For every identified genus we calculated the relative density [RD = (number of individuals of a *taxon* / total number of plots) X 100], the relative frequency [RF = (number of plots containing a *taxon* / total number of plots) X 100] and the relative dominance [RDo = (basal area of a *taxon* / total basal area of *taxa*) X 100] and thus the Importance Value Index (IVI = RD + RF + RDo) per each identified genus, following Hadi et al., (2009). All the calculations were done using MS Excel, 2010.

All vegetation characteristics were then averaged for each study site, except median tree height which was directly calculated for all measured trees within a study site. Measures of species diversity were then added to the analysis: species richness, defined by the number of tree species identified in each study site.

Shannon index of diversity (H), Evenness index (Pielou 1975), Margalef index (Margalef 1968) and Simpson dominance index (D) (Shannon and Weaver 1963, Simpson 1949) were calculated by using PAST software to analyze species diversity and dominance in the community.

- **THREAT ANALYSIS:**

During the field survey for population estimation vis-à-vis habitat study, data on various threats were collected using questionaries, interaction with local villagers, hunters, occasionally poachers and the inhabitants of forest fringe villagers in and around the Reserve forest. The interview were done in 10 villages in each Reserve forest in a stratified random sampling technique The primary data are collected through field observation and questionnaires; secondary data was collected from published reports, research papers and articles, as well as through interviews of forest department officials. All the observations emerge out as potential threat of various degrees for the gibbons in thestudy area. These include Ecological threats, threats from anthropogenic origin, threats emanating from policy decision and threats in relation to their conservation and management.

3. RESULTS:

3.1 DISTRIBUTION AND POPULATION STATUS OF HOOLOCK GIBBON:

Hoolock gibbon population status survey was done in four reserve forests of Barak Valley. The detail result of the distribution and population status of Hoolock gibbon in each reserve forest is mentioned as follows;

- **Distribution and Status of Hoolock gibbon in Inner-line reserve forest (ILRF):**

During the status survey, information about their presence was obtained from 13 locations [direct: 7; indirect (call count): 6] (Table 1 and 2; Map- 4). Nine groups of individuals and 1 solitary sub-adult male, a total of 33 individuals, were sighted in 7 localities (Table 1). Of these 7 localities, only 1 area was found to contain 4 family groups, where the habitat was small forest patches surrounded by tea gardens. The mean group size of the 9 study groups was 3.6.

The result indicated a density of 0.26 groups/km^2 and 0.83 individuals/km^2. The adult males and females formed nearly 56% of the total population (Table-1; Fig.- 1). All family groups had at least 1 mated pair. The adult sex ratio (male: female) was 1: 1. All mated pairs had offspring. The sub-adults (male and female) formed only 27.3% of the total population and, in this category, the sex ratio (male: female) was 2: 1. Juveniles and infants made up 12.1% and 6.1% of the total population, respectively. In these two categories, sex differentiation was difficult to ascertain. No newborn infants were observed during the period of survey in the area. The study revealed 5 individuals to be the maximum and 3 the minimum number in a family group.

Table-1. Distribution, group size and composition of hoolock gibbons in the Inner- line Reserve Forest and the adjoining area.

Locality No.	Locality name	GPS point	Area surveyed (Km^2)	Groups (n)	Individuals, (n) adults		Sub-adults		Juv.	Inf.	Total
					M	F	M	F			
1	Chourashikona	$24^{0}35^{/}31.91^{//}$N, $92^{0}45^{/}09.78^{//}$E	3.2	1	1	1	1	-	-	-	3
2	Nagathal (Khasipunji)	$24^{0}32^{/}31.87^{//}$N, $92^{0}47^{/}35.68^{//}$E	4.1	0	-	-	1	-	-	-	1
3	Dholabalu	$24^{0}32^{/}37.45^{//}$N, $92^{0}46^{/}12.16^{//}$E	5.3	1	1	1	-	-	1	-	3
4	Maragang	$24^{0}33^{/}27.03^{//}$N, $92^{0}46^{/}40.03^{//}$E	4.2	1	1	1	-	-	1	-	3
5	Shantasora	$24^{0}33^{/}27.03^{//}$N, $92^{0}46^{/}40.39^{//}$E	4.3	1	1	1	-	1	-	-	3
6	Sephaipunji (Jaroiltola)	$24^{0}32^{/}11.60^{//}$N, $92^{0}52^{/}08.50^{//}$E	4.1	1	1	1	1	-	-	1	4
7	Fragmented-area (adjoining Rose-kandy Tea Estate)	$24^{0}25^{/}$N&$24^{0}44^{/}$N $92^{0}40^{/}$E&$92^{0}45^{/}$E	14.5	4	4	4	3	2	2	1	16
Total			**39.7**	**09**	**9**	**9**	**6**	**3**	**4**	**2**	**33**
Percentage of total individuals (n = 33) (Mean group size = 3.6)			-	-	27.3	27.3	18.2	9.1	12.1	6.1	
M = Male; F = Female; Juv. = Juvenile; Inf. = Infant											

Table - 2. The details of the call records of the gibbon groups in indirect method.

Sl. No.	Place name	GPS points	Groups (n)	Call intensity	Distance (m)	Altitude (m)
1	Panchhara	$24^0 27^/ 55.32^{//}$N, $92^0 51^/ 48.80^{//}$E	1	+	700	113
2	Lailapur	$24^0 31^/ 39.18^{//}$N, $92^0 46^/ 55.49^{//}$E	1	+++	300	77
3	Anandakhal	$24^0 29^/ 27.81^{//}$N, $92^0 53^/ 13.62^{//}$E	1	++	500	103
4	Barakhal	$24^0 31^/ 0.52^{//}$N, $92^0 59^/ 26.43^{//}$E	1	++	550	140
5	Sandikhal	$24^0 29^/ 26.30^{//}$N, $93^0 10^/ 10.25^{//}$E	1	+	600	330
6	Natachhara	$24^0 25^/ 32.12^{//}$N, $92^0 49^/ 47.97^{//}$E	1	+	650	123

‘+’= poor; ‘++’= medium; ‘+++’= high

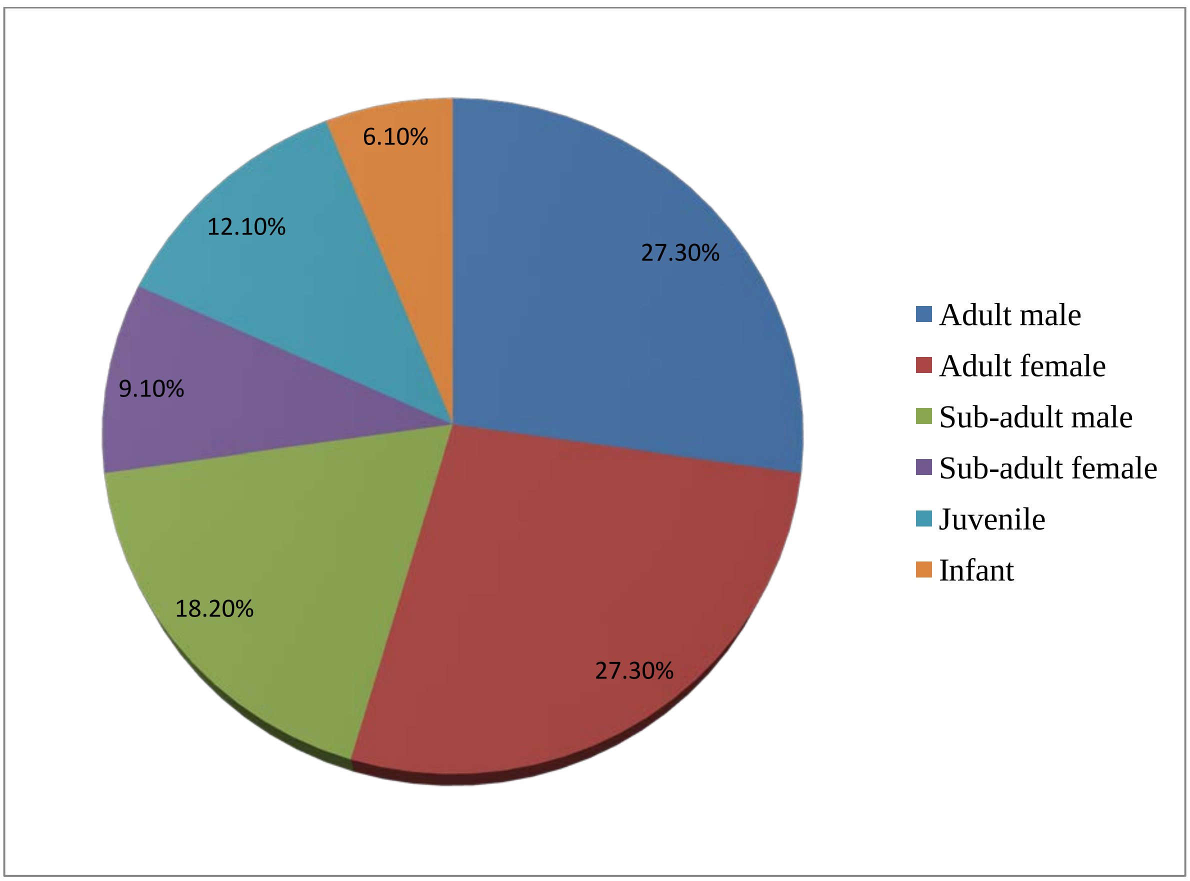
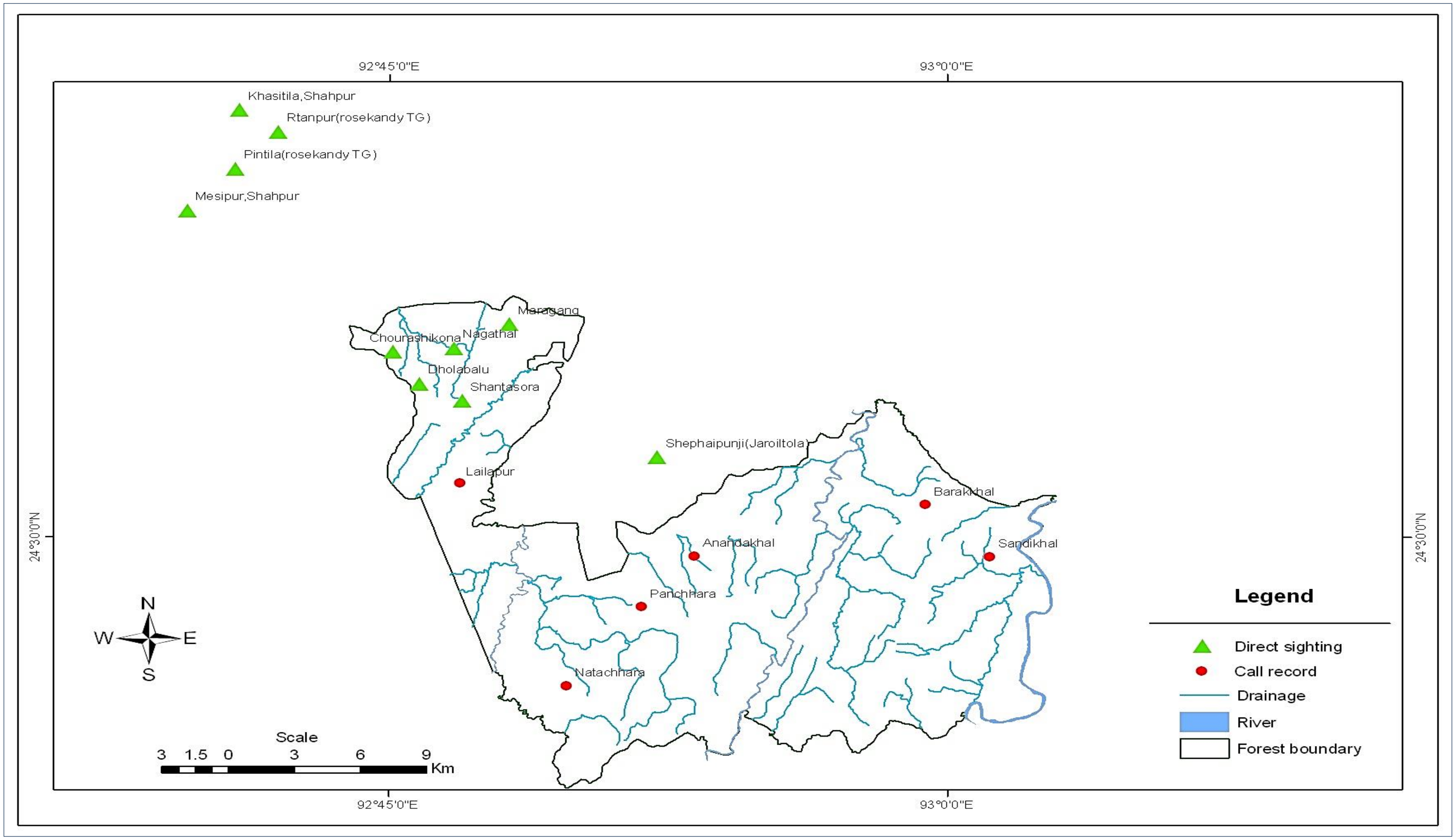


Fig. - 1. Age- sex composition of Hoolock gibbon groups in ILRF.



Map. 4. Distribution map of hoolock gibbons in the Inner-line Reserve Forest and the adjoining areas.

➢ **Distribution and Status of Hoolock gibbon in Patharia reserve forest (PRF):**

A total of 18 groups of Hoolock gibbon comprised of 56 individuals were recorded from 16 localities in Patharia reserve forest (PRF) (Table- 3; Map- 5). The average group size of the gibbon population was calculated and found that it is around 3.11 individual per group.The density of Hoolock gibbon was found 0.9 groups/km^2 and 2.9 individuals/km^2. In case of sex-age composition both adult male and adult female population (32% each) is equally higher than other sex-age groups.The adult sex ratio (male: female) was 1: 1. The sub-adult male and female formed only 11% and 7% respectively of the total population, Juveniles and infants made up 09% and 09% of the total population, respectively (Fig- 2).

Table-3. Distribution, group size and composition of hoolock gibbons in the Patharia R.F. of Karimganj district.

Sl. No.	GPS Location	No of groups	Adults		Immature				Total	Avg. Group size
			M	F	SAM	SAF	JUV	INF		
1	24°44′0.539″N 92°17′25.405″E	1	1	1	_	_	1	_	03	03
2	24°43′6.281″N 92°17′49.896″E	1	1	1	1	_	_	_	03	03
3	24°42′23.618″N 92°17′11.075″E	1	1	1	_	_	_	1	03	03
4	24°41′53.042″N 92°17′13.107″E	1	1	1	_	_	_	_	02	02
5	24°41′37.457″N 92°16′56.88″E	1	1	1	_	_	_	1	03	02
6	24°39′21.9543N 92°16′16.332″E	1	1	1	_	_	1	_	03	03
7	24°39′7.877″N 92°16′1.537″E	1	1	1	_	1	_	_	03	03
8	24°37′54.823″N 92°16′3.823″E	1	1	1	1	_	1	_	04	4
9	24°37′13.953″N 92°15′45.473″E	1	1	1	_	_	_	1	03	3
10	24°36′39.479”N 92°14′7.169″E	1	1	1	_	1	_	_	03	3
11	24°36′41.291″N	3	3	3	2	2	_	2	12	4

	92˚14′29.461″E									
12	24˚36′25.952″N 92˚14′20.261″E	1	1	1	1	_	_	_	03	3
13	24˚36′5.767″N 92˚15′1.269″E	1	1	1	_	_	1	_	03	3
14	24˚36′21.143″N 92˚15′17.905″E	1	1	1	1	_	_	_	03	3
15	24˚35′49.051″N 92˚15′57.121″E	1	1	1	_	_	1	_	03	3
16	24˚33′5.397″N 92˚14′10.0326”E	1	1	1	_	_	_	1	03	2
Total		**18**	**18**	**18**	**06**	**04**	**05**	**05**	**56**	**3.11**

M=Male, F=Female, SAM=Sub-adult male, SAF=Sub-adult female, JUV=Juvenile, INF=Infant

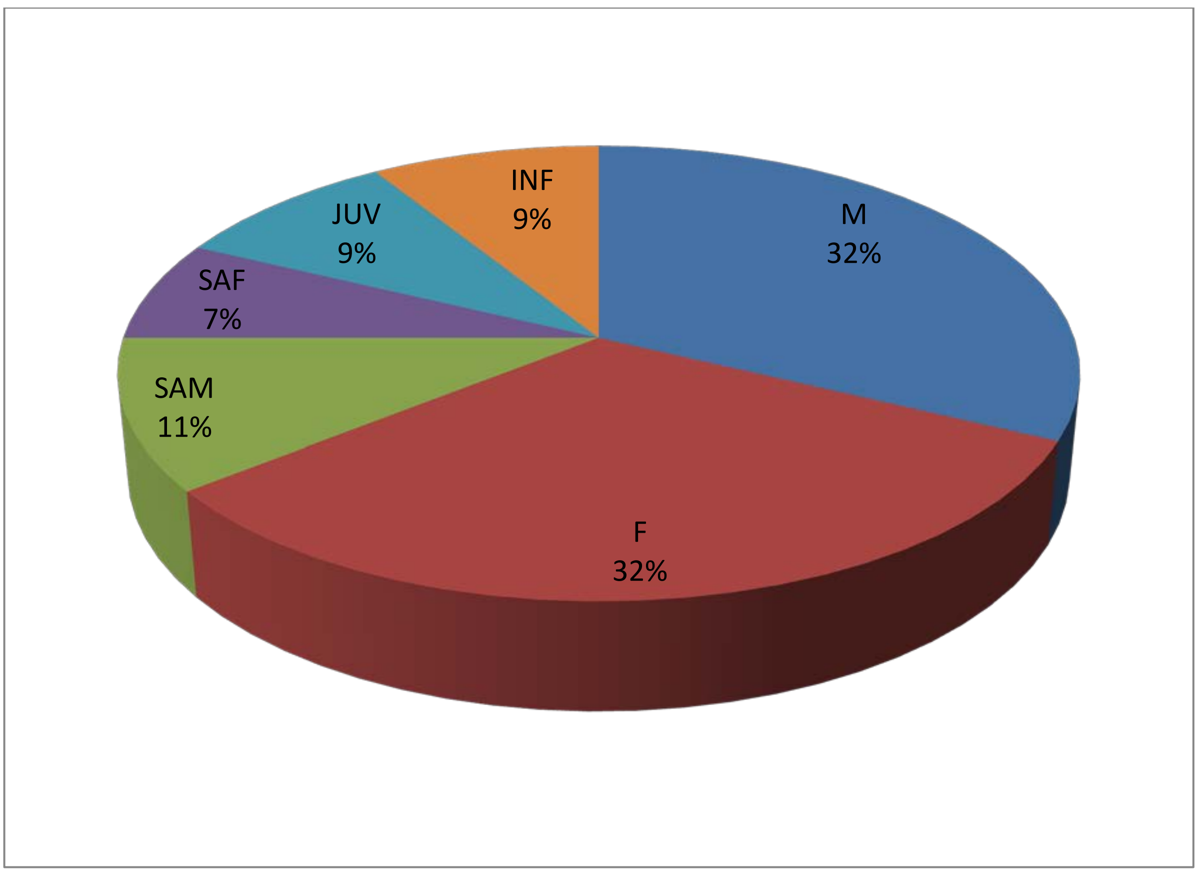
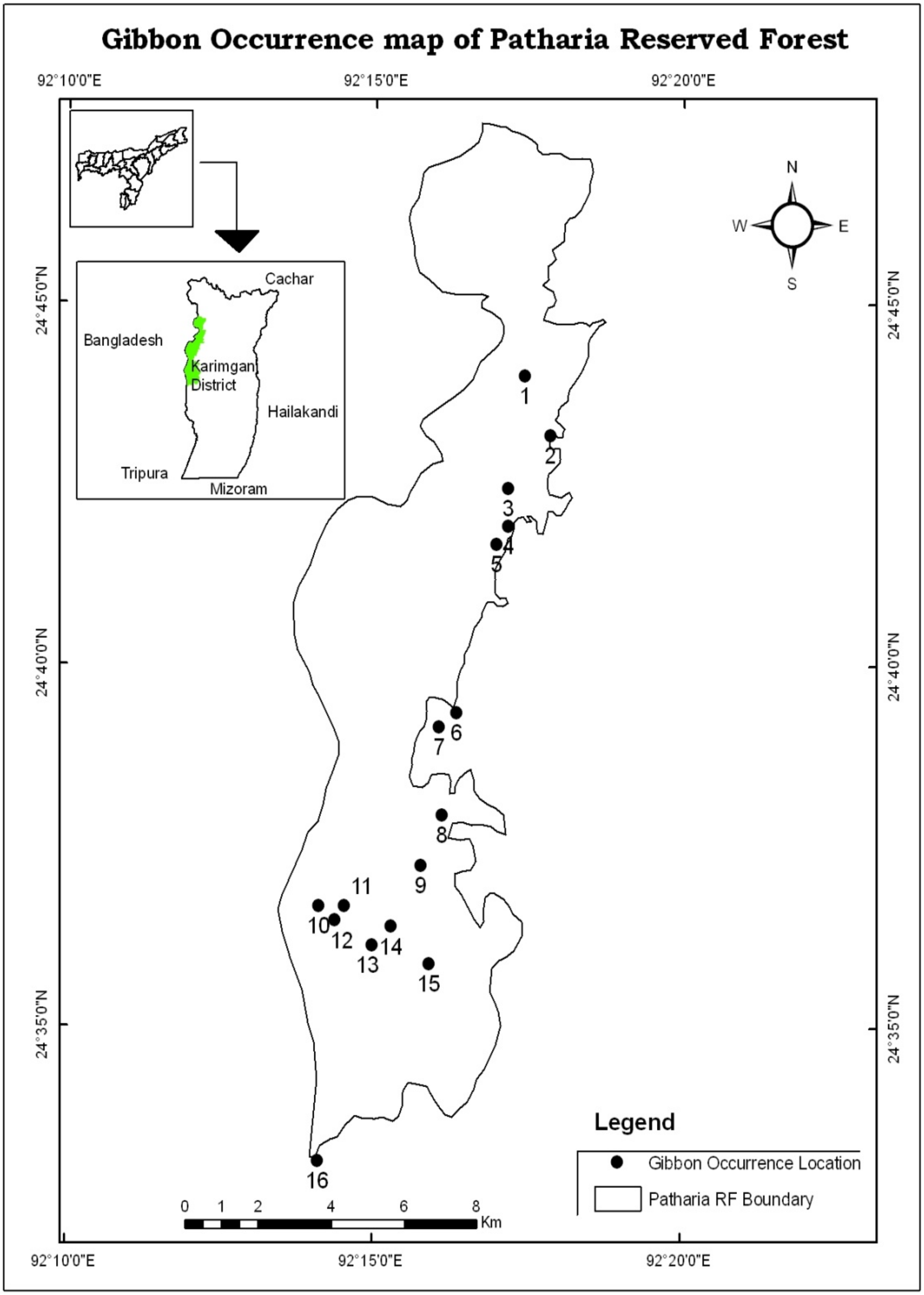


Fig. 2. Age-sex composition (%) of Hoolock gibbon in Patharia RF.



Map. 5. Hoolock Gibbon occurrence map of Patharia RF.

➢ **Distribution and Status of Hoolock gibbon in Longai Reserve Forest (LRF):**

Survey yielded total of 13 groups of Hoolock gibbon comprised of 33 individuals from 12 localities in Longai reserve forest (LRF) (Table- 4; Map- 6). The average group size of the gibbon population was found to be2.53 individual per group.The density of Hoolock gibbon was found to be 0.7 groups/km^2 and 2.0 individuals/km^2. In case of sex-age composition both adult male and adult female population (40% each) is equally higher than other sex-age groups.The adult sex ratio (male: female) was 1: 1. The sub-adult male and female formed only 09% and 03% respectively of the total population, Juveniles and infants made up 06% and 06% of the total population, respectively (Fig- 3).

Table 4. Distribution, group size and composition of hoolock gibbons in the Longai R.F. of Karimganj district.

Sl. No	GPS Location	No of Groups	Adult		Immature				Total	Avg. Group size
			M	F	SAM	SAF	JUV	INF		
1	24°26′18.561″N 92°17′51.63″E	1	1	1	_	_	_	1	3	3
2	24°25′35.753″N 92°17′32.969″E	1	1	1	1	1	_	_	4	4
3	24°24′1.354″N 92°16′57.844″E	1	1	1	_	_	1	_	3	3
4	24°23′24.034″N 92°17′15.407″E	1	1	1	_	_	_	_	2	2
5	24°22′17.077″N 92°16′30.403″E	1	_	_	1	_	_	_	1	1
6	24°21′19.999″N 92°16′33.696″E	1	1	1	_	_	_	1	3	3
7	24°20′36.093N 92°16′1.864″E	1	1	_	_	_	_	_	1	1
8	24°19′21.452″N 92°16′27.11″E	1	1	1	_	_	_	_	2	2
9	24°18′14.495″N 92°15′42.106″E	2	2	2	1	_	_	_	5	2.5

10	24°17′27.296″N 92°15′58.571″E	1	2	2	_	_	_	_	4	4
11	24°16′21.437″N 92°16′13.938″E	1	1	1	_	_	1	_	3	3
12	24°15′53.995″N 92°15′33.325″E	1	1	1	_	_	_	_	2	2
	Total	**13**	**13**	**12**	**3**	**1**	**2**	**2**	**33**	**2.53**

M=Male, F=Female, SAM=Sub-adult male, SAF=Sub-adult female, JUV=Juvenile, INF=Infant

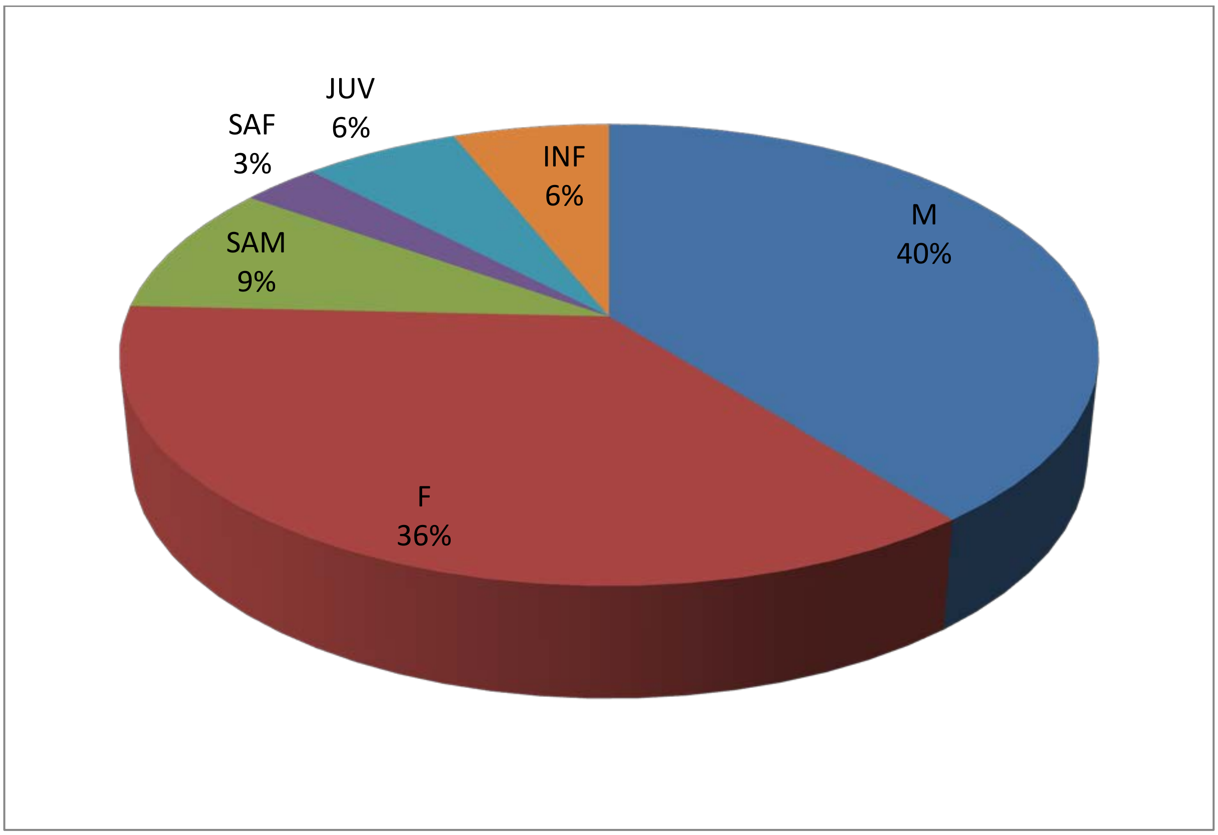
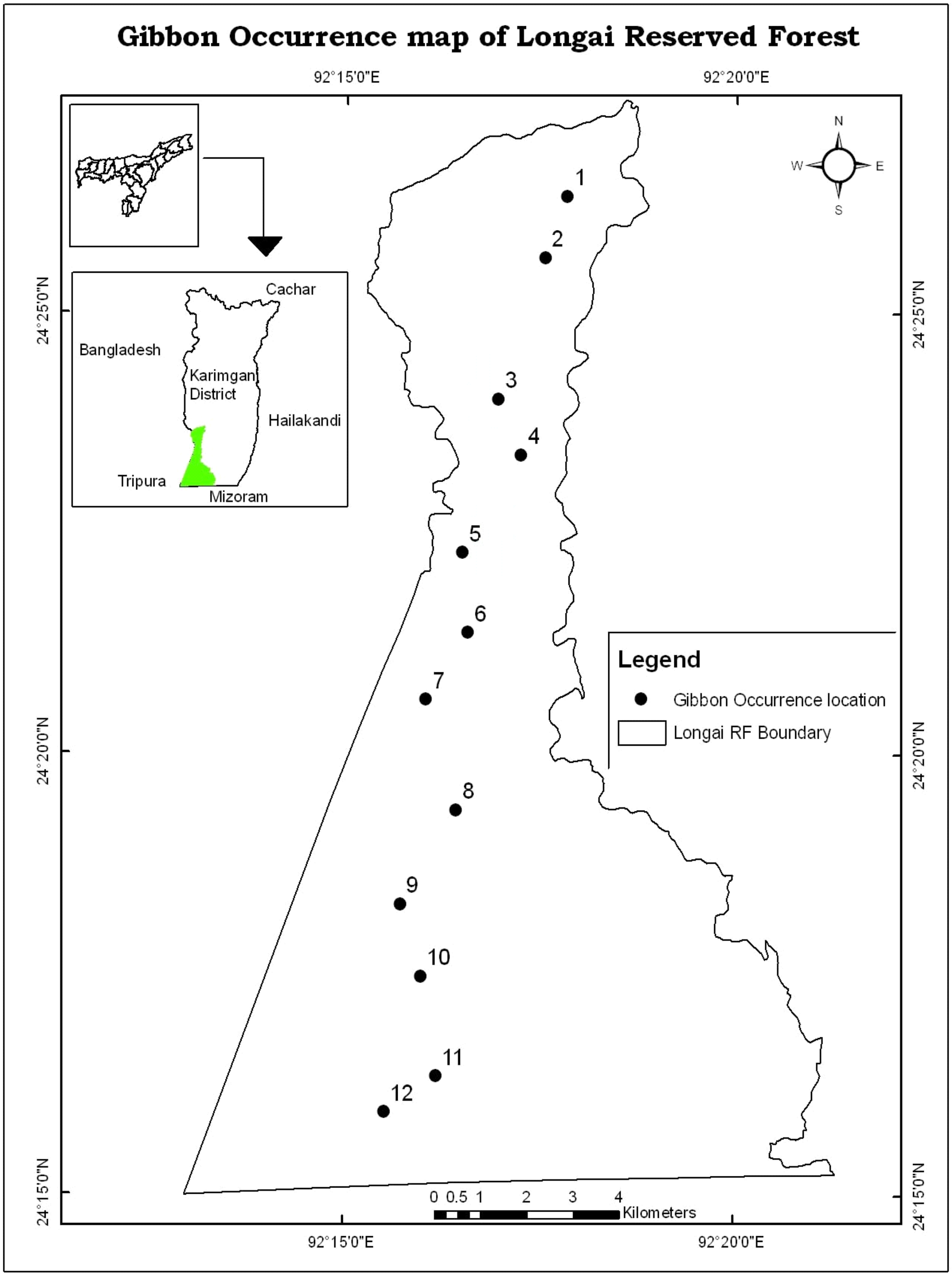


Fig. 3. Age-sex composition (%) of Hoolock gibbon in Longai RF.



Map. 6. Hoolock gibbon occurrence map of Longai RF.

➢ Distribution and Status of Hoolock gibbon in Singla Reserve Forest (SRF):

During the status survey a total of 51 individuals of Hoolock gibbon from 15 groups were recorded from 10 localities in Singlareserve forest (SRF) (Table- 5; Map- 7). The average group size of the gibbon population was calculated and found that it is around 3.4 individual per group.The density of Hoolock gibbon was found to be 0.8 groups/km^2 and 2.6 individuals/km^2. In case of sex-age composition both adult male and adult female population (29% each) is equally higher than other sex-age groups.The adult sex ratio (male: female) was 1: 1. The sub-adult male and female formed only 14% and 12% respectively of the total population, Juveniles and infants made up 06% and 10% of the total population, respectively (Fig- 4).

Table 5. Distribution, group size and composition of hoolock gibbons in the Singla R.F. of Karimganj district.

No	GPS Location	No of Groups	Adult		Immature				Total	Avg. Group size
			M	F	SAM	SAF	JUV	INF		
1	24°24′29.645″N 92°28′15.081″E	1	1	1	_	_	_	1	3	3
2	24°24′4.386″N 92°27′4.794″E	1	1	1	1	1	_	_	4	4
3	24°22′43.116″N 92°26′41.731″E	2	2	2	1	1	1	1	8	4
4	24°21′47.106″N 92°26′43.928″E	1	1	1	_	_	_	_	2	2
5	24°20′59.882″N 92°26′51.615″E	3	3	3	2	2	_	1	11	3.6
6	24°20′34.622″N 92°26′15.373″E	1	1	1	_	_	_	1	3	3
7	24°19′29.826N 92°25′24.854″E	2	2	2	1	2	_	_	7	3.5
8	24°18′51.388″N 92°25′21.56″E	1	1	1	_	_	2		4	4

9	24˚17′54.279″N 92˚24′34.335″E	2	2	2	1	_	_	_	5	2.5
10	24˚16′23.125″N 92˚24′6.879″E	1	1	1	_	_	_	2	4	4
	Total	**15**	**15**	**15**	**7**	**6**	**3**	**5**	**51**	**3.4**

M=Male, F=Female, SAM=Sub-adult male, SAF=Sub-adult female, JUV=Juvenile, INF=Infant

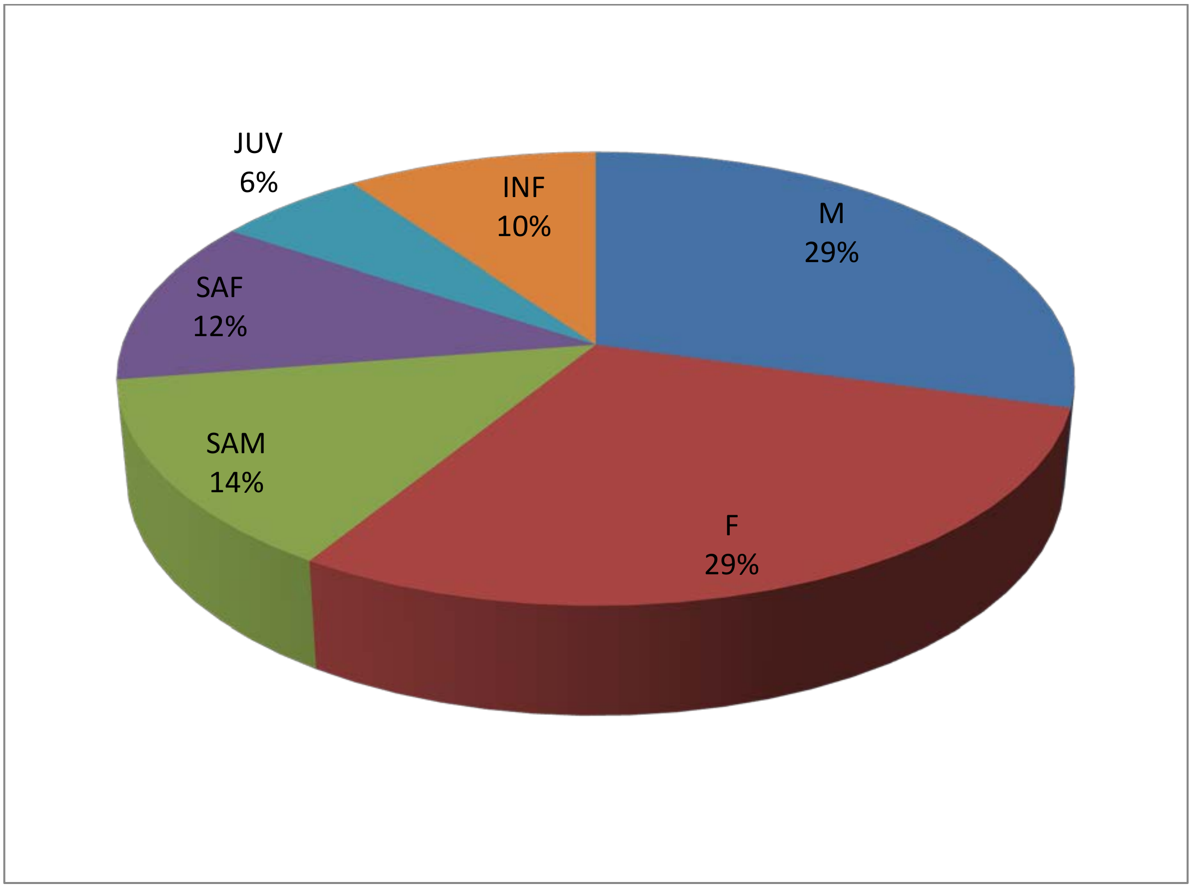
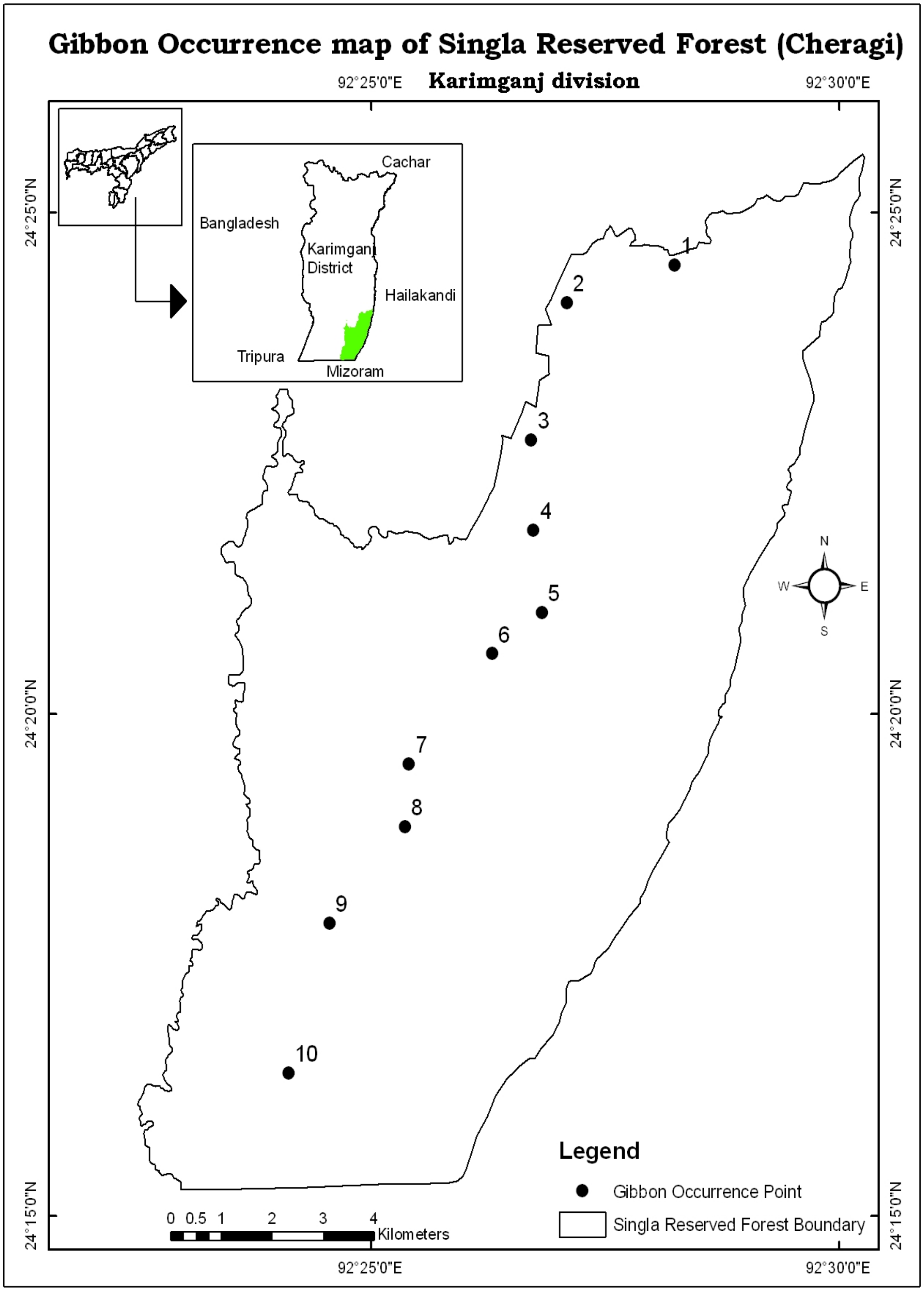


Fig. 4. Age-sex composition (%) of Hoolock gibbon in Singla RF.



Map. 7. Hoolock gibbon occurrence map of Singla RF.

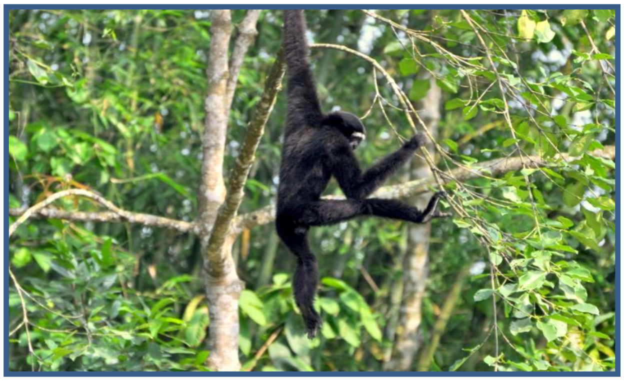
From the above result of distribution and population status of Hoolock gibbon, it is found that the highest number of groups recorded from Patharira RF (18) followed by Singla RF (15), Longai RF (13) and Inner-line RF (09). Total no. of group is 55 and total individual is 173. Mean group size high in ILRF i.e. 3.6, followed by Singla RF (3.4), Patharira RF (3.11) and Longai RF (2.53); Average group size across the four reserve forest is 3.16± 0.47 (Table- 6).

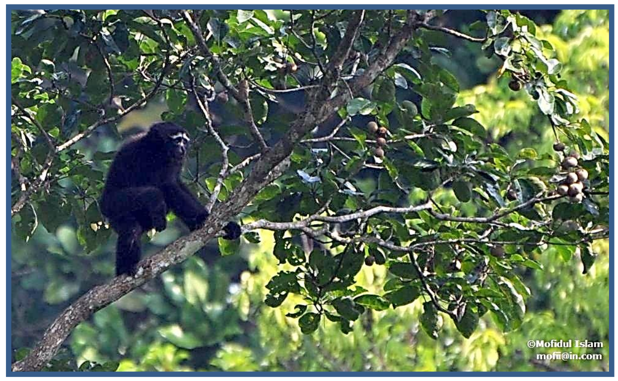
Table 6. Summary of Hoolock gibbon population status in four reserve forests of Barak Valley, Southern Assam.

	Inner-line RF	**Patharia RF**	**Longai RF**	**Singla RF**
No. of localities	13	**16**	12	10
No. of group	09	**18**	13	15
No. of total individuals	33	**56**	33	51
Adult male	9	**18**	13	15
Adult female	9	**18**	12	15
Sub-adult male	6	06	03	**07**
Sub-adult female	3	04	01	**06**
Juvenile	4	**05**	02	03
Infant	2	**05**	02	**05**
Mean group size	**3.6**	3.11	2.53	3.4
Group/km2	0.26	**0.9**	0.7	0.8
Individuals / km2	0.83	**2.9**	2.0	2.6


(c)mofii@in.com


©mofii@in.com

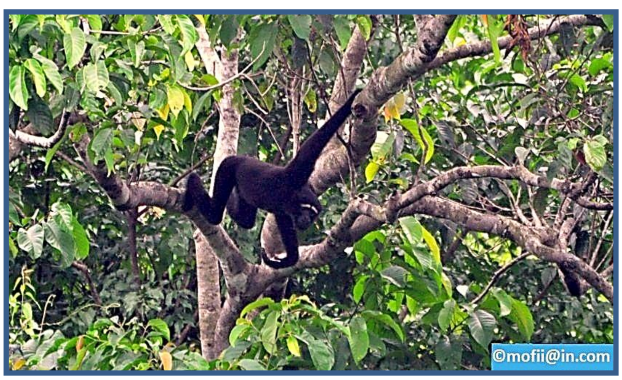



©Mofidul Islam
mofi@in.com


©mofidul
©mofii@in.com


15.05.2012
(C) Mofidul & Anisur


©mofii@in.com


©mofii@in.com


©mofidul

3.2 HABITAT ASSESMENT:

A total of 143 tree species belonging to 45 families were recorded from the gibbon habitat of the four reserve forests (Appendix-I). The Moraceae family has the hieghest number of species followed by Euphorbiceae, Fabecea and Anacardiceae. Most of the tree of these families belongs to the food plants of Hoolock gibbon. Of the 143 species, 143 species are present in Inner-line RF, 94 in Patharia RF, 91 in Longai RF and 87 in Singla RF. Most of the species are familiar in all the four reserve forests. Out of the 143 tree species, food plants of gibbon comprised of 56 plant species belonging to 31 families (Table 20). All these species were found present quite abundantly in the four reserve forests.

The different diversity indices such as Shanon Weiner index, Evenness, Simpson index, Margalef index and species richness and their mean values for each of the survey site are calculated for all the study sites of the four reserve forests. The mean species richness was found to be high in Inner-line reserve forest i.e. 90±17.5 followed by Patharia RF (84.3±2.5), Longai RF (80.3±2.1) and Singla RF (77.6±4.04) (Table 7 and 8).

Table 7. Tree species richness and diversity indices at each site in Inner-line RF of Cachar district.

Forest Name	Site No.	Species richness (S)	Shanon-Wiener index (H)	Evenness (J)	Simpson's index (C)	Margalef Index
Inner-line reserve forest	Site 1	61	3.7	0.6631	0.966	11.04
	Site 2	68	3.864	0.7007	0.965	12.56
	Site 3	114	4.496	0.7867	0.985	19.42
	Site 4	109	4.457	0.7909	0.985	18.62
	Site 5	101	4.375	0.7861	0.983	17.44
	Site 6	92	4.334	0.8287	0.984	15.73
	Site 7	82	4.217	0.8269	0.982	14.73

	Site 8	94	4.383	0.8518	0.985	16.5
	Site 9	102	4.455	0.8441	0.986	17.57
	Site 10	78	4.142	0.8067	0.981	13.36
	Mean	**90±17.5**	**4.24±0.3**	**0.79±0.1**	**0.98±0.0**	**15.70±2.7**

Table 8. Species richness and diversity indices at each site in three reserve forests of Karimganj district.

Forest Name	Site No	Species richness(S)	Shanon Wiener index(H)	Evenness(J)	Simpson's index(C)	Margalef Index
Patheria RF	Site-1	87	4.274	0.8854	0.9832	15.73
	Site-2	84	4.234	0.8669	0.9856	14.32
	Site-3	82	4.100	0.8267	0.9845	14.67
	Mean	**84.3±2.5**	**4.2±0.1**	**0.86±0.01**	**0.98±0.00**	**14.9±0.7**
Longai RF	Site-1	82	4.192	0.8269	0.9822	13.87
	Site-2	81	4.194	0.8273	0.9815	13.37
	Site-3	78	3.964	0.7887	0.9512	11.79
	Mean	**80.3±2.1**	**4.1±0.13**	**0.81±0.02**	**0.97±0.02**	**13.01±1.1**
Singla RF	Site-1	80	4.192	0.8273	0.9822	13.87
	Site-2	80	4.194	0.8287	0.9815	14.37
	Site-3	73	4.100	0.08267	0.9812	13.79
	Mean	**77.6±4.04**	**4.2±0.05**	**0.58±0.43**	**0.98±0.00**	**14.01±0.3**

The data on vegetation characteristics such as canopy cover, Tree height, DBH (Diameter at breast height) of all trees, DBH of food trees, abundance of all trees, abundance of food trees, and mean tree density and mean food tree density was calculated for all study sites of the four reserve forests (Table 9 and 10). Comparison of average vegetation characteristics across the four reserve forests is shown in Table 11. From the calculation vegetation parameters it is found that the mean canopy cover, tree height, tree DBH, tree density and food tree density are higher than the other three reserve forests. Species richness and food tree abundance is found to be high in Inner-line reserve forest. From the study it is found that the abundance of gibbon food tree species is about half of the abundance of total tree species in the gibbon habitat of the four reserve forests (Table 11).

Table 9. Average vegetation characteristics of the Inner-line reserve forest (Cachar dist.). All values are given with standard errors.

Name of reserve Forest	**Sites**	**Mean canopy cover (%)**	**Median tree height (m)**	**Mean DBH (≥10 cm)**	**Mean DBH of large trees (DBH>20cm)**	**Mean DBH of food trees (≥10 cm)**	**Mean DBH of large food trees (DBH>20cm)**	**Mean abundance of all trees (no./plot)**	**Mean abundance of food trees (no./plot)**
Inner-line reserve forest (ILRF)	Site1	49.5±2.8	16-20	20±0.85	31±1.66	20±1.70	32±2.19	22.9±2.19	13.1±1.31
	Site2	47.5±2.5	11-15	20±0.99	34±2.04	22±1.32	36±2.63	20.8±3.81	11.3±1.76
	Site3	56.5±3.3	16-20	29±1.21	38±1.61	32±1.74	41±2.22	33.7±0.75	19.5±0.95
	Site4	61.5±2.4	21-25	27±1.14	34±1.52	31±1.83	37±2.34	33±0.82	16.5±1.81
	Site5	62±2.8	16-20	22±0.84	32±1.31	25±1.26	34±1.87	30.9±1.54	16.8±1.35
	Site6	58.5±4.2	21-25	26±0.98	34±1.40	30±1.72	38±2.27	32.5±0.89	14.1±1.50
	Site7	53.5±2.9	16-20	23±0.95	32±1.28	23±1.22	34±1.87	24.4±1.67	15.1±1.30
	Site8	49.5±2.2	11-15	22±0.70	30±0.94	22±0.92	30±1.21	28±1.40	14.1±1.42
	Site9	63.5±2.2	21-25	22±0.59	29±0.71	22±0.84	29±1.11	31.4±1.77	17.7±1.96
	Site10	57.5±4.0	16-20	21±0.57	28±0.76	21±0.74	29±1.05	31.9±1.46	19.6±1.89
	Mean	**55.95±1.8**	**19.2±1.0**	**23±0.98**	**32±0.93**	**25±1.42**	**34±1.28**	**29±1.46**	**16±0.86**

Table 10. Average vegetation characteristics of the reserve forests of Karimganj district (Patharia,Longai and Singla Reserve Forest).

Name of Reserve forest	Sites	Mean canopy cover (%)	Mean tree height (meter)	Mean DBH of trees (≥10 cm)	Mean DBH of food trees (≥10 cm)	Mean abundance of trees (no./plot)	Mean abundance of food trees (no/ha)	Tree density (trees/ha)	Food trees density (trees/ha)
Patheria (PRF)	Site-I	54.8	17.4±1.92	22.3±1.66	29.7±1.70	23.4±0.75	13.4±1.31	1368±45	725±62
	Site-2	60.2	23.6±2.03	24.1±0.71	32.4±0.84	27.3±0.89	16.2±1.22	1566±52	929±38
	Site-3	52.6	18.2±0.97	26.4±1.61	31.6±1.74	24.3±1.40	14.8±1.19	1466±67	832±55
	Mean	**57.8±3.9**	**19.2±0.67**	**24.36±0.58**	**29.93±1.2**	**25.76±1.41**	**14.7±0.86**	**1464±62**	**835±34**
Longai (LRF)	Site-1	50.2	17.3±1.87	24.2±1.52	27.2±1.83	21.6±2.14	11.8±1.56	1237±54	675±38
	Site-2	48.6	14.1±2.03	21.8±1.31	25.5±1.26	25.2±1.83	13.3±1.80	1174±52	619±56
	Site-3	54.6	19.2±1.14	23.2±1.40	30.3±1.72	26.5±2.28	14.1±1.76	1248±66	664±44
	Mean	**51.13±3.1**	**17.2±0.86**	**23.06±0.52**	**27.66±0.92**	**24.43±1.51**	**13.00±0.66**	**1219±74**	**653±53**
Singla (SRF)	Site-1	56.4	18.6±1.51	25.4±1.28	29.1±1.22	25.3±0.76	13.8±1.34	1382±39	753±61
	Site-2	56.8	13.8±0.78	23.6±0.94	28.3±0.92	24.7±0.82	14.1±1.45	1445±51	824±49
	Site-3	56.2	14.6±0.84	21.6±0.76	30.5±1.32	22.6±1.54	14.7±1.32	1416±56	921±46
	Mean	**54.53±0.3**	**17.8±0.55**	**23.56±0.78**	**30.62±0.72**	**24.76±0.86**	**14.3±0.72**	**1416±57**	**826±38**

Table 11.Summary of mean vegetation parameters across the four reserve forests

S. No.	Vegetation parameters	ILRF	PRF	LRF	SRF
1	Canopy cover (%)	55.95±1.8	**57.8±3.9**	51.13±3.1	54.53±0.3
2	Tree height (m)	19.2±0.95	**19.2±0.67**	17.2±0.86	17.8±0.55
3	DBH (≥10 cm)	23±0.98	**24.36±0.58**	23.06±0.52	23.56±0.78
4	DBH of food trees (≥10 cm)	25±1.42	29.93±1.2	27.66±0.92	**30.62±0.72**
5	Tree abundance (no./plot)	29±1.46	25.76±1.41	24.43±1.51	24.76±0.86
6	Food tree abundance (no./plot)	**16±0.86**	14.7±0.86	13.00±0.66	14.3±0.72
7	Tree density (tree/ha)	1447±74	**1464±62**	1219±74	1416±57
8	Food tree density (tree/ha)	806±42	**835±34**	653±53	826±38
9	Species richness (taxa/site)	**90±5.53**	84.3±2.5	80.3±2.1	77.6±4.04

The dominant tree species all over the study sites are *Vitex altissima* L.f., *Zanthoxylum rhesta* Roxb., *Mangifera sylvatica* Roxb., *Ficus benghalensis* L., *Hydnocarpus kurzii* Warb., *Artocarpus chama* Buch- Ham., *Artocarpus lakoocha* Roxb., *Ficus auriculata* Lour., *Gmelina arborea* Roxb., *Plumeria acuminata* Ait., *Syzygium fruticosum* DC., *Anthocephalus cadamba* Miq., *Castonopsis indica* DC., *Chrysophyllum lanceolatum* DC., *Mesua ferra* L., *Bombax ceiba* L., *Garcinia cowa* Roxb., *Elaegnus caudata* Schlechi ex.

In respect of different sites the relative frequency (RF), relative density (RD), and relative dominance (RDom) and importance value index (IVI) values varied between species. The RF, RD, RDom and IVI of all the tree species found across the gibbon habitat are shown reserve forest wise in the following table (Table 12; 14; 16 and 18) The top fifteen species which were found to be have highest IVI (importance value index) mostly comprised of *Artocarpus chama* Buch- Ham., *Syzygium cumini* L., *Syzygium fruticosum*

DC., *Diospyras taposia* Ham., *Dysoxylum gobora* Miq., *Toona ciliata* M. Roem., *Chrysophyllum roxburghii* G.Don, *Gmelina arborea* Roxb., *Artocarpus lakoocha* Roxb., *Madhuca indica* Gmel., *Cynometra polyandra* Roxb.*Castonopsis indica* DC., *Euphorbia pulcherrima* Willd., *Mesua ferra* L., *Vitex altissima* L.f. etc. which is mentioned separately reserve forest wise in the following table (Table 13; 15; 17 and 19).

Table 12. Tree species across the habitat of **Inner-line Reserve Forest** and their relative calculated parameters.

Tree species	Family	RF	RDen	Rdom	IVI
Drymicarpus racemosus Hook.f.	Anacardiaceae	0.42	0.42	0.70	1.54
Linnea grandis A. Rish.	Anacardiaceae	0.62	0.59	0.70	1.92
Mangifera indica L.	Anacardiaceae	0.83	0.63	0.89	2.34
Mangifera sylvatica Roxb.	Anacardiaceae	0.42	0.42	0.00	0.84
Rhus semialata Murr.	Anacardiaceae	0.62	0.59	0.84	2.05
Semecarpus anacardium L.	Anacardiaceae	1.32	1.46	0.86	3.63
Spondias pinnata Kurz.	Anacardiaceae	0.90	0.73	0.01	1.64
Annona squamosa L.	Annonaceae	0.14	0.07	0.70	0.91
Polyalthia longifolia Thw.	Annonaceae	0.69	0.63	0.86	2.18
Alstonia scholaris R. Br.	Apocynaceae	0.90	0.90	1.41	3.21
Plumeria acuminata Ait.	Apocynaceae	0.76	0.87	0.84	2.47
Sterospermum chelonoides DC.	Bigoniaceae	0.90	0.87	0.71	2.48
Bombax ceiba L.	Bombaceae	0.62	0.52	0.00	1.15
Bombax insigne Wall.	Bombaceae	0.28	0.31	0.71	1.30
Bursera serrata Coleb.	Burseraceae	0.76	0.80	1.67	3.23
Canarium benghalense Roxb.	Burseraceae	0.90	0.97	0.89	2.77
Garuga floribunda Deen.	Burseraceae	0.62	0.63	0.02	1.26
Bauhinia malabarica Roxb.	Caesalpiniaceae	0.28	0.31	0.48	1.07
Bauhinia purpurea L.	Caesalpiniaceae	0.62	0.63	0.00	1.25
Caesalpania pulcherrima Sw.	Caesalpiniaceae	0.21	0.24	0.72	1.17
Cassia fistula L.	Caesalpiniaceae	0.42	0.45	0.72	1.59
Saraca asoca Roxb.	Caesalpiniaceae	0.42	0.31	0.86	1.59
Tamarindus indica L.	Caesalpiniaceae	0.28	0.14	0.72	1.14
Crataeva religiosa Frost. f.	Capparaceae	0.35	0.35	0.72	1.42
Garcinia assamica Kost.	Clusiceae	0.69	0.76	0.72	2.18
Garcinia cowa Roxb.	Clusiceae	1.04	1.08	0.02	2.14
Garcinia pedunculata Roxb.	Clusiceae	0.07	0.07	0.22	0.36
Mesua ferra L.	Clusiceae	1.60	1.70	0.86	4.16

Termanilia chebula Retz.	Combretaceae	0.55	0.56	0.72	1.84
Termanilia myriocarpa Heurck	Combretaceae	0.35	0.24	0.73	1.32
Terminalia arjuna DC.	Combretaceae	0.42	0.28	0.86	1.55
Terminalia belerica Roxb.	Combretaceae	0.49	0.56	0.01	1.05
Dipterocarpus manni King	Dipterocarpaceae	0.49	0.42	0.73	1.63
Dipterocarpus turbinatus Gaertn.	Dipterocarpaceae	0.49	0.49	0.01	0.98
Shorea assamica Dyer	Dipterocarpaceae	0.69	0.73	0.73	2.16
Vatica lanceifolia (Roxb.) Blume	Dipterocarpaceae	0.35	0.31	0.80	1.46
Diospyras taposia Ham.	Ebenaceae	2.36	2.74	0.90	6.00
Cordia fragrantissima Kurz.	Ehretiaceae	0.42	0.52	0.74	1.68
Elaeocarpus floribundus Bl.	Elaeocarpaceae	0.83	0.63	0.01	1.47
Elaeocarpus robustus Roxb.	Elaeocarpaceae	0.83	0.87	0.84	2.54
Elaeocarpus sphaericus Gaertn.	Elaeocarpaceae	0.76	0.63	0.06	1.45
Aleurites moluccana (L.) Willd.	Euphorbiaceae	0.35	0.38	0.27	1.00
Antidesma acidum Retz.	Euphorbiaceae	0.21	0.10	0.75	1.06
Antidesma ghaesembilla Gaertn.	Euphorbiaceae	0.35	0.45	0.59	1.38
Antidesma velutinosum Blume	Euphorbiaceae	0.28	0.35	0.81	1.43
Baccaurea remiflora Lour.	Euphorbiaceae	0.35	0.21	2.45	3.00
Balakata baccata (Roxb.) Esser	Euphorbiaceae	0.35	0.42	0.49	1.25
Bischofia javanica Bl.	Euphorbiaceae	0.49	0.49	0.75	1.72
Bridelia stipularis Bl.	Euphorbiaceae	0.49	0.42	0.75	1.65
Croton roxburghii Balak.	Euphorbiaceae	0.62	0.59	0.75	1.96
Drypetes assamica Hook.f.	Euphorbiaceae	0.35	0.28	0.75	1.37
Endospermum chinense Benth.	Euphorbiaceae	0.21	0.10	0.85	1.16
Euphorbia neriifolia L.	Euphorbiaceae	0.42	0.38	0.75	1.54
Euphorbia pulcherrima Willd.	Euphorbiaceae	1.53	1.84	0.89	4.26
Glochidion lanceolarium Roxb.	Euphorbiaceae	0.14	0.14	0.20	0.48
Sapium baccatum Roxb.	Euphorbiaceae	0.35	0.56	0.88	1.79
Sapium eugeniaefolium Benth.	Euphorbiaceae	0.49	0.52	0.76	1.76
Trewia nodiflora L.	Euphorbiaceae	0.49	0.45	0.00	0.94
Castanopsis purpurella (Miq.) Balak.	Fagaceae	0.42	0.24	0.85	1.51
Castonopsis indica DC.	Fagaceae	1.60	1.39	1.77	4.76
Casearia glomerata Roxb.	Flacourtiaceae	0.35	0.38	0.00	0.73
Flacourtia cataphracta Roxb.	Flacourtiaceae	0.55	0.38	0.76	1.69
Gynocardia odorata R. Br.	Flacourtiaceae	0.35	0.28	0.76	1.38
Hydnocarpus kurzii Warb.	Flacourtiaceae	1.25	1.35	0.03	2.63
Engelhardtia spicata Lechan ex Bl.	Juglandaceae	0.76	0.83	0.76	2.35
Couroupita guianensis Aublet.	Lacythidaceae	0.69	0.90	0.76	2.35
Lagerstroemia reginae Roxb.	Lacythidaceae	0.62	0.63	0.76	2.01
Garcinia xanthochymus Hook.f.	lamiaceae	0.55	0.59	0.86	2.00
Vitex peduncularis Wall. Ex. Schauer	Lamiaceae	0.21	0.17	0.73	1.12

Alseodaphne owdenii Parker.	Lauraceae	1.18	0.97	0.89	3.04
Beilschmiedia assamica Meissn.	Lauraceae	0.62	0.76	0.64	2.03
Cinamomum cacharensis R.N.Parker.	Lauraceae	1.18	1.28	0.76	3.22
Cinamomum cecicodaphne Meissn.	Lauraceae	0.69	0.66	0.00	1.36
Cinamomum tamala Buch- Ham.	Lauraceae	0.69	0.69	0.64	2.02
Cryptocarya amygdalina Nees.	Lauraceae	0.69	0.69	0.63	2.02
Albizia lebbeck (L.) Benth.	Leguminosae	0.42	0.42	0.89	1.73
Cynometra polyandra Roxb.	Leguminosae	1.04	0.83	3.06	4.94
Lagerstroemia speciosa (L.) Pers.	Lythraceae	0.42	0.45	0.86	1.72
Magnolia insignis Wall.	Magnoliaceae	0.69	0.63	0.00	1.32
Kydia calycina Roxb.	Malvaceae	0.28	0.24	0.81	1.33
Pterygota alata (Roxb.) R.Br.	Malvaceae	0.69	0.90	0.50	2.10
Azadirachta indica A. Juss.	Meliaceae	0.69	0.45	0.00	1.15
Cedrela febrifuga C. DC.	Meliaceae	0.76	0.66	0.76	2.18
Dysoxylum gobora Miq.	Meliaceae	2.08	2.08	1.70	5.87
Toona ciliata M. Roem.	Meliaceae	1.60	1.67	2.49	5.75
Walsura robusta Roxb.	Meliaceae	0.35	0.28	0.76	1.39
Acacia auriculiformis Benth.	Mimosaceae	0.49	0.52	0.63	1.64
Acacia catechu Willd.	Mimosaceae	0.28	0.21	0.76	1.25
Acacia lebek Benth.	Mimosaceae	0.49	0.45	0.77	1.70
Parkia bigemium Benth.	Mimosaceae	0.42	0.42	0.01	0.84
Samanea saman Merr.	Mimosaceae	1.46	1.42	0.02	2.90
Artocarpus chama Buch- Ham.	Moraceae	3.33	4.10	3.63	11.06
Artocarpus gomeziana Wall.	Moraceae	0.28	0.24	0.77	1.29
Artocarpus heterophyllus Lamk.	Moraceae	0.55	0.38	0.86	1.79
Artocarpus lakoocha Roxb.	Moraceae	2.36	2.47	0.17	4.99
Ficus auriculata Lour.	Moraceae	1.39	1.39	0.01	2.79
Ficus benghalensis L.	Moraceae	0.90	0.56	0.86	2.32
Ficus benjamina L.	Moraceae	1.04	1.32	0.79	3.15
Ficus fistulosa Reinwdt. Ex Bl.	Moraceae	0.69	0.83	0.01	1.53
Ficus glomerata Roxb.	Moraceae	0.14	0.14	0.77	1.05
Ficus heterophylla L.f. Supl.	Moraceae	0.28	0.31	0.01	0.60
Ficus hirta Vahl.	Moraceae	0.42	0.56	0.01	0.98
Ficus hispida Vahl.	Moraceae	0.62	0.63	0.01	1.25
Ficus lamponga Miq.	Moraceae	0.28	0.38	0.52	1.18
Ficus racemosa L.	Moraceae	0.55	0.59	0.69	1.83
Ficus religiosa L.	Moraceae	1.04	0.73	0.87	2.64
Morus australis Poir.	Moraceae	0.49	0.45	0.80	1.74
Morus laevigata Wall.	Moraceae	0.62	0.63	0.80	2.05
Moringa oleifera Lamk.	Moringaceae	0.35	0.21	0.80	1.36
Myrica esculenta Buch- Ham.	Myricaceae	0.21	0.21	0.80	1.22

Eucalyptus maculata Hook.	Myrtaceae	0.21	0.14	0.80	1.15
Syzygium balsameum Wall.	Myrtaceae	0.42	0.42	1.35	2.19
Syzygium cumini L.	Myrtaceae	3.54	3.58	0.15	7.26
Syzygium fruticosum DC.	Myrtaceae	2.15	2.22	2.17	6.54
Syzygium jambos L.	Myrtaceae	0.28	0.14	0.55	0.96
Syzygium operculatum (Roxb.) Nied.	Myrtaceae	0.28	0.21	0.00	0.49
Lingustrum robustum Bl.	Oleaceae	0.42	0.42	0.80	1.64
Olea dioica Roxb.	Oleaceae	0.21	0.24	0.54	0.99
Butea monosperma Lamk.	Pailionaceae	0.42	0.38	0.81	1.60
Dalbergia sisoo Roxb.	Pailionaceae	0.49	0.49	0.01	0.98
Derris indica Lamk.	Pailionaceae	0.28	0.28	0.54	1.09
Erythrina indica Lamk.	Pailionaceae	0.83	0.56	0.86	2.25
Eurya acuminata DC.	Pentaphylacaceae	0.07	0.03	0.00	0.10
Dillenia indica L.	Ranunculaceae	1.04	1.08	0.86	2.98
Dillenia pentagyna Roxb.	Ranunculaceae	0.35	0.35	0.00	0.70
Magnolia pterocarpa Roxb.	Ranunculaceae	0.35	0.35	0.00	0.70
Michelia champaca L.	Ranunculaceae	0.49	0.59	0.81	1.88
Xerospermum glabratum Kurz.	Rhamnaceae	0.28	0.14	0.81	1.22
Carallia brachiata Merr.	Rhizophoraceae	0.55	0.63	0.01	1.19
Anthocephalus cadamba Miq.	Rubiaceae	1.46	1.32	0.86	3.64
Zanthoxylum rhesta Roxb.	Rutaceae	0.21	0.21	0.81	1.23
Chrysophyllum lanceolatum DC.	Sapotaceae	0.97	1.15	0.01	2.13
Chrysophyllum roxburghii G.Don	Sapotaceae	2.22	2.15	0.90	5.27
Madhuca indica Gmel.	Sapotaceae	2.01	2.05	0.89	4.95
Mimusops elengi Roxb.	Sapotaceae	0.35	0.38	0.53	1.26
Ailanthus integrifolia Lamk.	Simaroubaceae	0.55	0.56	0.00	1.11
*Sterculia villosa*Roxb.	Sterculiaceae	0.83	0.90	1.67	3.41
Tetrameles nudiflora R.Br.	Tetramelaceae	0.42	0.42	0.89	1.73
Callicarpa arborea Roxb.	Verbenaceae	0.28	0.31	0.74	1.33
Gmelina arborea Roxb.	Verbenaceae	1.87	2.36	0.90	5.13
Premna benghalensis Cl.	Verbenaceae	0.35	0.31	0.86	1.52
Tectona grandis L.f.	Verbenaceae	0.35	0.42	0.81	1.57
Vitex altissima L.f.	verbenaceae	1.04	0.94	1.69	3.66

RF= Relative frequency; RD= Relative density; RDo= Relative dominance; IVI= Importance value index.

Table 13. Top fifteen tree species having highest IVI value in **ILRF**.

S. No.	Tree species	Family	IVI
1	*Artocarpus chama* Buch- Ham.	Moraceae	11.06
2	*Syzygium cumini* L.	Myrtaceae	7.26
3	*Syzygium fruticosum* DC.	Myrtaceae	6.54
4	*Diospyras taposia* Ham.	Ebenaceae	6.00
5	*Dysoxylum gobora* Miq.	Meliaceae	5.87
6	*Toona ciliata* M. Roem.	Meliaceae	5.75
7	*Chrysophyllum roxburghii* G.Don	Sapotaceae	5.27
8	*Gmelina arborea* Roxb.	Verbenaceae	5.13
9	*Artocarpus lakoocha* Roxb.	Moraceae	4.99
10	*Madhuca indica* Gmel.	Sapotaceae	4.95
11	*Cynometra polyandra* Roxb.	Leguminosae	4.94
12	*Castonopsis indica* DC.	Fagaceae	4.76
13	*Euphorbia pulcherrima* Willd.	Euphorbiaceae	4.26
14	*Mesua ferra* L.	Clusiceae	4.16
15	*Vitex altissima* L.f.	verbenaceae	3.66

Table: 14. Identified tree species across the habitat of **Patharia Reserve Forest** and their relative calculated parameters.

Scientific name	Family	RF	RDEN	Rdom	IVI
Artcarpus lakoocha Roxb.	Moraceae	3.45	3.68	1.42	7.24
Artocarpus integrifolia Linn.	Moraceae	2.30	2.33	1.33	5.96
Artocarpus chama Ham.	Moraceae	3.83	4.90	2.41	11.15
Artocarpus heterophyllus Lamk.	Moraceae	2.30	2.33	2.40	7.03
Alianthus grandis Prain.	Simaroubaceae	2.11	1.96	1.27	5.34
Alianthus integrifolia Linn.	Moraceae	2.30	2.08	1.40	5.79
Artocarpus gomeziaana	Moraceae	1.92	1.96	0.33	4.20
Albazzia lebbek(L)Benth.	Mimosaceae	1.92	1.72	1.40	5.03
Albazzia procera Benth.	Mimosaceae	1.72	1.84	0.04	3.60
Albazzia lucida Roxb.	Mimosaceae	1.92	1.72	0.03	3.67
Anthocephalus codombo Miq.	Rubiaceae	1.92	1.84	1.40	5.15
Anthocephalus chinensis	Rubiaceae	1.72	1.59	1.39	4.71
Antidesma acidum Retz.	Euphorbiaceae	1.53	1.59	0.26	3.39
Adinacordifolia Benth.	Euphorbiaceae	1.15	1.23	1.32	3.69
Amoora waaichii Roxb.	Meliacae	0.96	0.74	1.00	2.70
Acacia lebbek Benth.	Mimosaceae	0.57	0.61	0.92	2.10
Annoma squamosa L.	Meliacae	0.96	0.61	1.20	2.77
Bacaurea remiflora Lour.	Euphorbiaceae	1.72	1.96	1.39	5.08

Bischofia javanica BC.	Euphorbiaceae	1.34	1.35	1.26	3.95
Bombax insigneWall.	Bombaceae	0.97	0.68	1.23	2.83
Bursera serrata Coleb.	Burseraceae	0.57	0.37	1.11	2.05
Castronopsis indica DC.	Fagaceae	1.34	1.72	1.32	4.37
Callicapra arborea Roxb.	Verbeneaceae	1.34	1.59	1.39	4.32
Canarium bengalensis Roxb.	Burseraceae	1.34	1.47	1.26	4.07
Chrysophyllum lanceolatum DC.	Sapotaceae	1.15	1.47	1.20	3.82
Chrysophyllum roxburghii G.Don	Sapotaceae	0.77	0.98	1.10	2.85
Cordia myxa L.	Boraginaceae	0.77	0.98	1.15	2.90
Caseria glomerata Roxb.	Flacortiaceae	0.77	0.49	1.31	2.57
Cinamomum glanduliferum (Wall)	Lauraceae	0.57	0.37	1.20	2.14
Cinamomum splendens Kosterm.	Lauraceae	0.38	0.25	1.05	1.68
Croton roxburghii Balake	Euphorbiaceae	0.57	0.49	0.87	1.94
Careya arborea Roxb.	Lecythidaceae	0.38	0.37	0.74	1.49
Cedrela toona Roxb.	Meliaceae	0.38	0.37	1.26	2.01
Cyanometra polyandra Roxb.	Leguminosae	0.57	0.49	1.10	2.17
Crataeva religosa Frost.f.	Copparaceae	0.38	0.37	1.15	1.90
Dysoxylum gobora Miq.	Meliaceae	1.15	1.35	1.39	3.89
Dillenia indica L.	Ranunculaceae	0.96	0.98	1.31	3.25
Dillenia pentagyna Roxb.	Ranunculaceae	0.37	0.22	0.87	1.30
Diplospora singularis Korth	Rubiaceae	0.38	0.25	0.91	1.54
Dipterocarpus robusta Roxb	Diptocarpaceae	1.34	1.47	1.39	4.20
Dipterocarpus turbinatus Gearth	Diptocarpaceae	0.38	0.49	1.15	2.02
Dulbergia sisoo Roxb.	Papilionaceae	0.38	0.49	0.65	1.52
Drypetes assamica Hook.f	Euphorbiaceae	0.38	0.37	1.05	1.80
Diospros toposia Ham.	Ebenaceae	0.42	0.45	0.75	1.64
Elaeocarpus floribundus BE.	Elaeocarpaceae	0.49	0.53	1.23	2.13
Elaeocarpus robustus Roxb.	Elaeocarpaceae	0.38	0.37	1.00	1.75
Endospamum chinesis Benth	Euphorbiaceae	0.38	0.25	1.10	1.73
Emblica officinalis Gaertn.	Euphorbiaceae	0.35	0.67	1.76	1.58
Ficus religosaGeartn.	Moraceae	1.72	1.96	1.38	5.06
Ficus bengalensis L.	Moraceae	1.34	1.72	1.14	4.20
Ficus glomerata Roxb	Moraceae	2.11	1.84	1.30	5.24
Ficus auriculata Lour.	Moraceae	1.34	1.35	1.25	3.94
Ficus heterophylla L.f.Supl.	Moraceae	1.15	1.47	1.37	3.99
Ficus benjamina L.	Moraceae	0.68	0.19	1.05	1.64
Ficus lamponga Miq.	Moraceae	0.57	0.49	0.95	2.01
Gamelina arborea Roxb.	Verbenaceae	1.15	1.23	1.37	3.74
Garcinia cowa Roxb.	Clusiaceae	1.34	1.35	1.24	3.93
Garcinia pedunculata Roxb.	Clusiaceae	0.61	0.55	1.07	2.08
Gynocordia odoratus R.Br	Flacourtiaceae	0.57	0.37	1.09	2.03

Garuga floribunda Deen.	Bursereaceae	0.38	0.37	1.09	1.84
Grewia microcos L.	Malvaceae	0.41	2.19	0.72	1.52
Hydrocarpus kurzii (King)Warb	Flacourtiaceae	1.15	1.23	1.30	2.04
Heritiera angustata (Pierre).	Malvaceae	0.57	0.49	0.90	1.97
Mangifra sylvatica Roxb	Anacardiaceae	1.72	2.08	1.36	5.17
Mangifra indica L.	Anacardiaceae	2.11	2.21	1.35	5.67
Morus laevigata L.	Moraceae	0.19	0.25	0.69	1.12
Musua ferrae L.	Clusiceae	0.19	1.47	1.35	3.01
Michelia champaca L.	Magnoliaceae	1.92	1.84	1.35	5.10
Magnolia insignia Wall.	Magnoliaceae	0.38	0.37	0.72	1.47
Magnolia pterocarpa Roxb.	Rananculaceae	0.57	0.49	1.30	2.37
Palquium polyandrum Hyata.	Annonaceae	0.38	0.25	0.94	1.57
Rhus semialata	Anacardiaceae	0.92	0.63	1.28	2.29
Randia dumetorum (Retz)Poir	Rubiaceae	0.38	0.37	1.03	1.78
Syzygium cumini L	Myrtaceae	2.11	1.47	1.30	4.87
Syzygium fruticosum DC.	Myrtaceae	1.34	0.98	1.34	3.66
Syzygium operculatum(Roxb)Neid.	Myrtaceae	0.96	0.61	1.08	2.65
Sapium baccatum Roxb	Euphorbiaceae	1.15	0.98	1.29	3.42
Spondias pinnata Kurz.	Anacardiaceae	1.72	1.72	1.23	4.67
Sterculia vellosa Roxb.	Sterculiaceae	0.57	0.37	0.94	1.88
Saraca indica Roxb.	Fabaceae	0.96	0.61	1.08	2.65
Schima wallici Choisy	Theaceae	0.96	0.86	1.03	2.84
Styrax serrulata Roxb	Styracaceae	1.34	1.10	1.29	3.73
Toona ciliate M.Roem.	Meliaceae	0.96	0.86	1.18	2.99
Terminalia chebula Retz.	Combretaceae	1.53	1.84	1.34	4.71
Terminalia myriocarpa HEurck et	Combretaceae	0.57	0.37	0.59	1.53
Terminalia belerica Roxb	Combretaceae	1.34	1.35	1.29	3.98
Terminalia arjuna DC	Combretaceae	1.34	1.23	1.13	3.70
Tetrameles nudiflora R.Br	Tetramelaceae	0.77	0.49	1.28	2.54
Tectona grandis L.f.	Verbenaceae	1.34	1.23	1.28	3.85
Trewia nudiflora L.	Euphorbiaceae	0.57	0.37	0.98	1.92
Tallauma phelocarpa R.Br.	Tetramelaceae	0.57	0.37	1.18	2.12
*Vitex peduncularis*Wall.Ex.Schauer.	Lamiaceae	0.35	0.56	0.54	1.37

RF= Relative frequency; RD= Relative density; RDo= Relative dominance; IVI= Importance value index.

Table 15. Top 15 tree species having highest IVI value in **Patharia Reserve Forest**.

Sl. No.	Tree species	Family	IVI
1	*Artcarpus lakoocha* Roxb.	Moraceae	7.24
2	*Artocarpus integrifolia* Linn.	Moraceae	5.96
3	*Artocarpus chama Buch,* Ham.	Moraceae	11.15
4	*Artocarpus heterophyllus* Lamk.	Moraceae	7.03
5	*Alianthus grandis* Prain.	Simaroubaceae	5.33
6	*Alianthus integrifolia* Linn.	Simaroubaceae	5.78
7	*Albazzia lebbek(L)*Benth.	Mimosaceae	5.03
8	*Anthocephalus cadombo* Miq.	Rubiaceae	5.15
9	*Bacaurea remiflora* Lour.	Euphorbiaceae	5.08
10	*Ficus religosa* Geartn.	Moraceae	5.06
11	*Mangifra sylvatica* Roxb.	Annacardiaceae	5.17
12	*Mangifra indica* L.	Annacardiaceae	5.67
13	*Michelia champaca* L.	Magloniaceae	5.11
14	*Syzygium cumini* L.	Myrtaceae	4.87
15	*Tectona grandis* L.f.	Verbenaceae	3.84

Table 16. Tree species across the habitat of **Longai Reserve Forest** and their relative calculated parameters.

Tree species	Family	RF	RD	Rdom	IVI
Aliantus grandis Prain.	Simaroubaceae	3.11	3.16	1.42	7.68
Aliantus integrifolia Linn.	Moraceae	2.13	2.18	1.33	5.64
Artocarpus chama Buch,Ham	Moraceae	3.44	4.13	1.41	8.99
Artocarpus heterophyllus Lamk.	Moraceae	1.64	1.74	1.33	4.70
Artocarpus lakoocha Roxb.	Moraceae	1.80	1.74	1.27	4.81
Artocarpus integrifolia Roxb.	Moraceae	1.80	1.85	1.40	5.05
Alostina scholaris R.Br.	Apocyanaceae	1.96	2.07	1.40	5.43
Albazzia lebbek (L)Benth.	Mimosacea	1.64	1.52	1.40	4.56
Albazzia procera (Benth).	Mimosacea	1.47	1.63	0.04	3.14
Albazzia lucida Roxb.	Mimosacea	1.64	1.52	0.03	3.19
Anthocephalus codombo Miq.	Rubiaceae	1.64	1.63	1.40	4.67
Anthocephalus chinensis	Rubiaceae	1.47	1.41	1.39	4.28
Antidesma velutinosum Blume.	Euphorbiaceae	1.31	1.41	1.26	3.99
Azadirachta indica A.Juss.	Meliaceae	0.98	1.09	1.32	3.39
Antidesma acidum Miq.	Euphorbiaceae	0.82	0.65	1.00	2.48
Adina cordifolia Benth	Rubiaceae	0.49	0.54	0.92	1.95
Acacia catechu Willd.	Mimosacea	0.82	0.54	1.20	2.57
Acacia lebbek Benth.	Mimosacea	1.47	1.63	1.39	4.50

Annoma squamosa L.	Annonaceae	1.15	1.20	1.26	3.60
Bacaurea remiflora Lour.	Euphorbiaceae	1.15	1.31	1.39	3.84
Bischofia javanica BC.	Euphorbiaceae	0.49	0.33	1.11	1.92
Bombax ceiba L.	Bombaceae	1.15	1.52	1.32	3.99
Baccaurea sapida(Lour).	Phyllanthaceae	1.15	1.41	1.39	3.95
Castronopsis indica DC.	Fragaceae	1.15	1.31	1.26	3.71
Callicapra arborea Roxb.	Verbanaceae	0.98	1.31	1.20	3.49
Canarium bengalensis Roxb.	Burseraceae	0.65	0.87	1.10	2.63
Chrysophyllum lanceolatum DC	Sapotaceae	0.65	0.87	1.15	2.68
Chrysophyllum roxburghii G.Don.	Sapotaceae	0.65	0.44	1.31	2.40
Cassia fistula L.	Caesalpiniceae	0.65	0.44	1.20	2.29
Caseria glomerata Roxb.	Flacourtiaceae	0.33	0.22	1.05	1.60
Cinamomum glanduliferum Wall	Luraceae	0.49	0.44	0.87	1.80
Cinamomum splendens Kosterm	Lauraceae	0.33	0.33	0.74	1.39
Cedrela febrifuga C.DC.	Meliaceae	0.33	0.33	1.26	1.91
Croton roxburghii Balake.	Lecythidaceae	0.49	0.44	1.10	2.03
Careya arborea Roxb.	Meliaceae	0.33	0.33	1.15	1.81
Cedrela toona Roxb.	Leguminosae	0.98	1.20	1.39	3.57
Cyanometra polyandra Roxb.	Capparaceae	0.82	0.87	1.31	3.00
Crataeva religosa Frost.f.	Meliaceae	0.33	0.22	0.91	1.45
Dysoxylum gobora Miq.	Ranunculaceae	1.15	1.09	1.39	3.62
Dillenia indica L.	Rubiaceae	0.33	0.44	1.15	1.91
Diplospora singularis Korth.	Diptocarpaceae	0.33	0.44	0.65	1.41
Dipterocarpus robusta Roxb.	Diptocarpaceae	0.33	0.33	1.05	1.70
Dipterocarpus turbinatus Gearth.	Pailionaceae	0.98	1.09	1.38	3.45
Dulbergia sisoo Roxb.	Pailionaceae	0.33	0.33	1.00	1.65
Drypetes assamica Hook.f.	Euphorbiaceae	0.33	0.22	1.10	1.64
Elaeocarpus floribundus BE.	Elacocarpaceae	1.47	1.63	1.38	4.48
Elaeocarpus robustus Roxb.	Elacocarpaceae	1.15	1.52	1.14	3.81
Endospamum chinesis Benth.	Euphorbiaceae	1.15	1.52	1.31	3.98
Ficus religosa Geartn.	Moraceae	1.15	1.20	1.25	3.59
Ficus bengalensis L.	Moraceae	0.98	1.31	1.37	3.66
Ficus glomerata Roxb.	Moraceae	0.49	0.44	0.95	1.88
Euphorbia nerifolia	Euphorbiaceae	0.98	0.98	1.37	3.33
Ficus auriculata Lour.	Moraceae	1.15	1.20	1.24	3.59
Ficus heterophylla L.f.Supl.	Moraceae	0.98	1.09	1.14	3.21
Ficus lamponga Miq.	Moraceae	0.49	0.33	1.09	1.91
Gamelina arborea Roxb.	Verbenaceae	0.33	0.33	1.09	1.75
Garcinia cowa Roxb.	Clusiaceae	0.98	1.09	1.30	3.37
Garcinia pedunculata Roxb.	Clusiaceae	0.49	0.44	0.90	1.83
Gynocordia odoratus R.Br.	Flacourtiaceae	0.82	0.54	1.19	2.55

Garuga floribunda Deen.	Bursereaceae	1.47	1.85	1.36	4.68
Hydrocarpus kurzii (King)Warb.	Flacoustiaceae	1.80	1.85	1.35	5.00
Heritiera angustata	Malvaceae	0.16	0.22	0.69	1.07
Holigarna longifolia Roxb.	Anacardiaceae	1.31	1.31	1.35	3.97
Mangifra sylvatica Roxb.	Anacardiaceae	1.64	1.63	1.35	4.62
Mangifra indica L.	Anacardiaceae	0.33	0.33	0.72	1.37
Morus laevigata L.	Anacardiaceae	0.49	0.44	1.30	2.23
Musua ferrae L.	Clusiceae	0.33	0.22	0.94	1.49
Michelia champaca L.	Ranunculaceae	1.80	1.63	1.30	4.73
Magnolia insignia Wall.	Magnoliaceae	0.33	0.33	1.03	1.69
Michelia montana	Magnoliaceae	1.80	1.31	1.30	4.40
Madhucha insignia	Magnoliaceae	1.15	0.87	1.34	3.36
Magnolia pterocarpa Roxb.	Ranunculaceae	0.65	0.54	1.08	2.28
Palquium polyandrum Hyata.	Sapotaceae	0.98	0.87	1.29	3.14
Rhus semialata Roxb.	Anocardiaceae	1.47	1.52	1.23	4.23
Randia dumetorum (Retz)Poir.	Rubiaceae	0.49	0.33	0.94	1.76
Syzygium cumini L.	Myrtaceae	0.82	0.54	1.08	2.44
Syzygium fruticosum DC.	Myrtaceae	0.82	0.76	1.03	2.61
Syzygium operculatum Roxb.	Myrtaceae	1.15	0.98	1.29	3.41
Sapium baccatum Roxb.	Euphorbiaceae	0.82	0.76	1.18	2.76
Spondias pinnata Kurz.	Anocardiaceae	1.31	1.52	1.34	4.17
Sterculia vellosa Roxb.	Sterculiaceae	0.33	0.33	0.59	1.24
Saraca indica Roxb.	Fabaceae	1.15	1.41	1.29	3.85
Schima wallici Choisy.	Theaceae.	1.15	1.09	1.13	3.36
Styrax serrulata Roxb.	Styracaceae.	0.65	0.44	1.28	2.37
Toona ciliate M.Roem.	Meliaceae.	1.31	1.31	1.28	3.90
Terminalia chebula Retz.	Combretaceae.	0.49	0.33	0.98	1.80
Terminalia myriocarpa Muell.	Combretaceae.	0.49	0.33	1.18	1.99
Terminalia belerica Roxb.	Combretaceae.	2.62	2.29	1.30	6.20
Terminalia arjuna DC.	Combretaceae.	1.96	1.85	1.03	4.85
Tetrameles nudiflora R.Br.	Tetramelaceae	1.31	1.09	0.03	2.43
Tectona grandis L.f.	Verbenaceae.	2.13	2.29	1.40	5.81

RF= Relative frequency; RD= Relative density; RDo= Relative dominance; IVI= Importance value index.

Table 17. Top 15 tree species having highest IVI value in **Longai Reserve Forest**.

Sl. No.	Tree species	Family	IVI
1	*Aliantus grandis* Prain.	Simaroubaceae	7.68
2	*Aliantus integrifolia* Linn.	Simaroubaceae	5.63
3	*Artocarpus chama Buch*,Ham	Moraceae	8.98
4	*Artocarpus heterophyllus* Lamk.	Moraceae	4.70
5	*Artocarpus lakoocha* Roxb.	Moraceae	4.80
6	*Artocarpus integrifolia* Linn.	Moraceae	5.05
7	*Alostina scholaris* R.Br.	Apocyanaceae	5.43
8	*Anthocephalus cadombo* Miq.	Rubiaceae	4.66
9	*Garuga floribunda* Deen.	Bursereaceae	4.68
10	*Hydrocarpus kurzii* Warb.	Flacoustiaceae	5.01
11	*Mangifra sylvatica* Roxb.	Annacardiaceae	4.62
12	*Michelia champaca* L.	Annacardiaceae	4.73
13	*Terminalia belerica* Roxb.	Combretaceae	6.20
14	*Terminalia arjuna* DC.	Combretaceae	4.84
15	*Tectona grandis* L.f.	Verbenaceae	5.81

Table 18.Tree species across the habitat of **Singla Reserve Forest** and their relative calculated parameters.

Scientific name of tree species	Family	RF	RDEN	Rdom	IVI
Aliantus grandis Prain.	Simaroubaceae	3.45	3.68	1.42	8.54
Aliantus integrifolia Linn	Simaroubaceae	2.30	2.33	1.33	5.96
Artocarpus chama Buch,Ham.	Moraceae	3.83	4.90	1.41	10.15
Artocarpus heterophyllus Lamk.	Moraceae	1.92	1.96	1.33	5.20
Artocarpus lakoocha Roxb.	Moraceae	2.11	1.96	1.27	5.34
Artocarpus integrifolia Linn.	Moraceae	2.30	2.08	1.40	5.79
Alostina scholaris R.Br.	Apocyanaceae	2.30	2.33	1.40	6.03
Albazzia lebbek (L) Benth.	Mimosacea	1.92	1.72	1.40	5.03
Albazzia lucida Roxb.	Mimosacea	1.92	1.72	0.03	3.67
Anthocephalus codombo Miq.	Rubiaceae	1.92	1.84	1.40	5.15
Anthocephalus chinensis	Rubiaceae	1.72	1.59	1.39	4.71
Antidesma acidum Retz.	Euphorbiaceae	1.53	1.59	1.26	4.39
Bombax ceiba L.	Bombaceae	1.34	1.47	1.39	4.20
Baccaurea sapida(Lour)	Phyllanthaceae	0.57	0.37	1.11	2.05
Castronopsis indica	Fragaceae	1.34	1.72	1.32	4.37
Callicapra arborea Roxb.	Verbanaceae	1.34	1.59	1.39	4.32
Canarium bengalensis Roxb.	Burseraceae	1.34	1.47	1.26	4.07
Chrysophyllum lanceolatum DC.	Sapotaceae	1.15	1.47	1.20	3.82
Chrysophyllum roxburghii G.Don.	Sapotaceae	0.77	0.98	1.10	2.85

Cassia fistula L.	Caesalpiniceae	0.77	0.98	1.15	2.90
Cinamomum glanduliferum Wall.	Lauraceae	0.57	0.37	1.20	2.14
Cyanometra polyandra Roxb.	Leguminosae	0.57	0.49	1.10	2.17
Dillenia indica L.	Ranunculaceae	0.96	0.98	1.31	3.25
Dipterocarpus robusta Roxb.	Diptocarpaceae	1.34	1.47	1.39	4.20
Drypetes assamica Hook.f.	Euphorbiaceae	0.38	0.37	1.05	1.80
Elaeocarpus floribundus BE.	Elacocarpaceae	1.15	1.23	1.38	3.75
Elaeocarpus robustus Roxb.	Elacocarpaceae	0.38	0.37	1.00	1.75
Endospamum chinesis Benth.	Euphorbiaceae	0.38	0.25	1.10	1.73
Ficus religosa Geartn.	Moraceae	1.72	1.96	1.38	5.06
Ficus bengalensis L.	Moraceae	1.34	1.72	1.14	4.20
Ficus glomerata Roxb.	Moraceae	1.34	1.72	1.31	4.37
Ficus auriculata Lour.	Moraceae	1.34	1.35	1.25	3.94
Ficus heterophylla L.f.Supl.	Moraceae	1.15	1.47	1.37	3.99
Ficus lamponga Miq.	Moraceae	0.57	0.49	0.95	2.01
Gamelina arborea Roxb.	Verbenaceae	1.15	1.23	1.37	3.74
Garcinia cowa Roxb.	Clusiaceae	1.34	1.35	1.24	3.93
Garuga floribunda Deen.	Bursereaceae	0.38	0.37	1.09	1.84
Hydrocarpus kurzii (King) Warb.	Flacoustiaceae	1.15	1.23	1.30	3.68
Mangifra sylvatica Roxb.	Anacardiaceae	1.72	2.08	1.36	5.17
Mangifra indica L.	Anacardiaceae	2.11	2.21	1.35	5.67
Musua ferrae L.	Clusiceae	0.19	1.47	1.35	3.01
Michelia champaca L.	Ranunculaceae	1.92	1.84	1.35	5.10
Magnolia insignia Wall.	Magnoliaceae	0.38	0.37	0.72	1.47
Magnolia pterocarpa Roxb.	Ranunculaceae	0.57	0.49	1.30	2.37
Rhus semialata Roxb.	Anocardiaceae	2.11	1.84	1.30	5.24
Randia dumetorum (Retz) Poir.	Rubiaceae	0.38	0.37	1.03	1.78
Syzygium cumini L.	Myrtaceae	2.11	1.47	1.30	4.87
Syzygium fruticosum DC.	Myrtaceae	1.34	0.98	1.34	3.66
Syzygium operculatum Roxb.	Myrtaceae	0.96	0.61	1.08	2.65
Sapium baccatum Roxb.	Euphorbiaceae	1.15	0.98	1.29	3.42
Spondias pinnata Kurz.	Anocardiaceae	1.72	1.72	1.23	4.67
Sterculia vellosa Roxb.	Sterculiaceae	0.57	0.37	0.94	1.88
Styrax serrulata Roxb.	Styracaceae.	1.34	1.10	1.29	3.73
Toona ciliate M.Roem.	Meliaceae.	0.96	0.86	1.18	2.99
Terminalia chebula Retz.	Combretaceae.	1.53	1.84	1.34	4.71
Terminalia myriocarpa Muell.	Combretaceae.	0.57	0.37	0.59	1.53
Terminalia belerica Roxb.	Combretaceae.	1.34	1.35	1.29	3.98
Terminalia arjuna DC.	Combretaceae.	1.34	1.23	1.13	3.70
Tectona grandis L.f.	Verbenaceae.	1.34	1.23	1.28	3.85

RF= Relative frequency; RD= Relative density; RDo= Relative dominance; IVI= Importance value index.

Table 19. Top 15 tree species having highest IVI value in **Singla Reserve Forest**.

Plants	Family	IVI
Artcarpus lakoocha Roxb.	Moraceae	8.54
Artocarpus integrifolia Linn.	Moraceae	5.96
Artocarpus chama Buch,Ham.	Moraceae	10.14
Artocarpus heterophyllus Lamk.	Moraceae	6.02
Alianthus grandis Prain.	Simaroubaceae	5.33
Alianthus integrifolia Linn.	Simaroubaceae	5.78
Alostina scholaris R.Br.	Apocyanaceae	5.20
Anthocephalus cadamba Miq.	Rubiaceae	5.15
Albazzia lebbek(L.)Benth.	Mimosaceae	5.03
Bacaurea remiflora Lour.	Euphorbiaceae	5.07
Ficus religosa L.	Moraceae	5.06
Ficus glomerata Roxb.	Moraceae	5.24
Mangifra sylvatica Roxb.	Annacardiaceae	5.16
Mangifra indica L.	Annacardiaceae	5.66
Michelia champaca L.	Magnoliaceae	5.10

Table 20. Food plants of gibbon across the habitat of the four reserve forests of Barak Valley, Assam.

Local Name	Scientific name	Family
Satan	*Alstonia scholaris* L.	Apocynaceae
Koroi	*Acacia lebek*Benth.	Mimosaceae
Kadambo	*Anthocephalus cadamba* Miq.	Rubiaceae
Cham kathal	*Artocarpus chama*Buch- Ham.	Moraceae
Dewa	*Artocarpus lakoocha*Roxb.	Moraceae
Bash	*Bambusa sp.*	Poeceae
Simul	*Bombax ceiba* L.	Bombaceae
Mirtenga	*Bursera serrata* Coleb.	Burseraceae
Katowa	*Castonopsis indica* DC.	Fagaceae
Pithali	*Chrysophyllum lanceolatum* DC.	Sapotaceae
Satu	*Chrysophyllum roxburghii* G.Don	Sapotaceae
Bon chalta	*Dillenia pentagyna* Roxb.	Ranunculaceae
Gosa alu	*Dioscorea bulbifera* L.	Dioscoreaceae
Gular, Kendu	*Diospyras taposia* Ham.	Ebenaceae

Amsa	*Drymicarpus racemosus* Hook.f.	Anacardiaceae
Bandardim	*Dysoxylum gobora* Miq.	Meliaceae
Mirika tenga	*Elaegnus caudate* Schlechi ex.	Thymeleaceae
Belpoi	*Elaeocarpus floribundus* Bl.	Elaeocarpaceae
Dumur	*Ficus auriculata* Lour.	Moraceae
Bot	*Ficus benghalensis*L.	Moraceae
Jori	*Ficus benjamina*L.	Moraceae
Joggo dumur	*Ficus glomerata*Roxb.	Moraceae
Kanai dumur	*Ficus heterophylla*L.f. Supl.	Moraceae
Khoja dumur	*Ficus hispida*Vahl.	Moraceae
Khangal dumur	*Ficus racemosa* Vahl.	Moraceae
Peepol	*Ficus religiosa*L.	Moraceae
Thekera	*Garcinia cowa* Roxb.	Clusiceae
Bonmisiri	*Garuga floribanda* Roxb.	Burseraceae
Gambar	*Gmelina arborea* Roxb.	Verbenaceae
Chalmogra	*Hydnocarpus kurzii* Warb.	Flacourtiaceae
Mahua	*Madhuca indica* Gmel.	Sapotaceae
Aam	*Mangifera indica* L.	Anacardiaceae
Bon aam	*Mangifera sylvatica* Roxb.	Anacardiaceae
Nahar, nageswar	*Mesua ferra* L.	Clusiceae
Shanlota	*Mikania micrantha*Kunth.	Asteraceae
Bhola	*Morus laevigata*Wall.	Moraceae
Noga tenga	*Myrica esculenta*Buch-Ham.	Myricaceae
Pipolee	*Piper longum*L.	Piperaceae
Hattilata	*Pothos scandens* L.	Araceae
Nag tenga	*Rhus semialata* Murr.	Anacardiaceae
Shiris	*Samanea saman* Merr.	Mimosaceae
Seleng	*Sapium baccatum*Roxb.	Euphorbiaceae
Jakhini lata	*Schefflera venulosa*Harms.	Araliaceae
Amra	*Spondias pinnata* Kurz.	Anacardiaceae

Odal	*Sterculia villosa* Roxb.	Sterculiaceae
Bandar lathi	*Sterospermum chelonoides* DC.	Bigoniaceae
Jamun	*Syzygium cumini* L.	Myrtaceae
Bonjam/kathiajam	*Syzygium fruticosum*DC.	Myrtaceae
Tetol	*Tamarindus indica* L.	Caesalpiniaceae
Shilikha	*Termanilia chebula* Retz.	Combretaceae
Bohera	*Terminalia belerica* Roxb.	Combretaceae
Poma	*Toona ciliata*M. Roem.	Moraceae
Bhelkal	*Trewia nodiflora*L.	Euphorbiaceae
Awal	*Vitex altissima* L.f.	Verbenaceae
Boroi	*Ziziphus jujuba* Lamk.	Rhamnaceae

3.3 THREAT ANALYSIS:

A number of threats were ascertained in the study area,based on field observations, questionnaires, personal interviewsand discussions with village heads, hunters and localpeople. These threats were grouped into two categories i. e. direct (hunting) and indirect (habitat destruction and fragmentation) based on their impact on the populationof *H. leuconedys* and their habitats (Fig. 5).

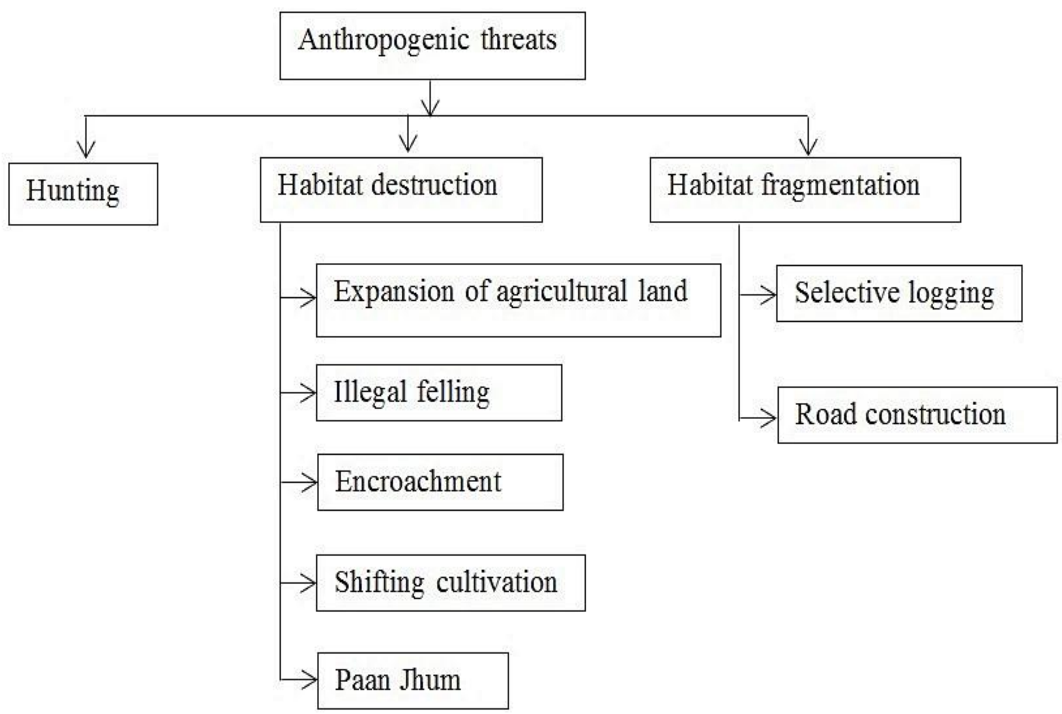


Fig. 5. Flow chart of anthropogenic threats for the hoolock gibbon in the study area.

A. <u>Hunting:</u>

According to the wildlife (Protection) Act, 1972, section 49 (b) and 51 states that capturing, selling and hunting, or any type of damage of wildlife is prohibited in the country. Yet, hunting was found to be the major threat to the gibbons in the study area (Inner-line, Patheria, Longai and Singla Reserve Forest) and its adjoining areas. In the study site, Hoolock gibbons were found to be hunted by some ‘Khasi’ and ‘Mizo’ for its bush-meat.Some of the tribes believe that the bones of Hoolock gibbon have medicinal value and are killed frequently. During this study on 11 different occasion (4 in Inner-line, 3 in Singla, 3 in Longai and once in Patheria Reserve forest), groups of hunters were met across the forest who happened to search Hoolock gibbon and other primates.

B. <u>Habitat destruction and fragmentation:</u>

Fragmentation of habitat is largely due to selective timber logging and road construction, whereas habitat destruction was driven by a number of anthropogenic activities such as expansion of agricultural land, encroachment, tree felling for commercial purposes and shifting cultivation. Other indirect threat damaging the habitat of the gibbon include livestock grazing, over extraction and over exploitation of non- timber forest product (including wild vegetables, leaves, barks and roots of many medicinal plants fuel wood etc).

Habitat destruction was one of the predominant threat factors for the gibbon in the bordering areas of the reserve forest. The physical alteration of the landscape are largely due to human interference The rate of forest damage has reached a level that signal impending danger, needs conservation measures, otherwise cannot be recovered. The principal cause of deforestation as observed during the course of study include over pressure on forest products due to population explosion, felling of trees for timber, planting of exotic trees species, illegal timber extraction,poaching and over- extraction of fire wood for commercial purpose and poor management. Population explosion, rapid urbanization, industrial growth has further added to the elimination of species at an alarming rate. Deforestation has provided land for agriculture and rural inhabitation.

Encroachment of forest areas for illegal setting of village has created additional pressure on forest resources. Felling of trees for commercial use, bamboo extraction for paper mills, pan jhum (betal leaf cultivation) and clearing of forest for agricultural land use are the major threat for the habitat loss. Moreover, there is no protected area that can provide legal protection for Hoolock gibbon and their habitat. Based on the recorded data it was found that the timber logging, illegal feeling, jhum cultivation and hunting of wild fauna caused maximum threats to Hoolock gibbon in the surveyed areas in the reserve forests and its adjoining areas. Livestock grazing, human settlement, jhum cultivation and illegal feeling of trees were recorded in the study area within the reserve forest. Apart from this rampant illegal felling of food plants of gibbon such as *Artocarpus chaplasha*, *Anthocephaluscodombo, Michelia champaca, Ficus sp.* has caused a scarcity of food resources in the habitat.

Human impacts on the forests of the study sites include a few more. Some of which is discussed as under:

B/i. **Shifting cultivation:** In some areas within the forest, vegetation are cut and burned for cultivation of rice, vegetables and fruits etc. The impacts of such practices are negative from ecological point of view. The tribal people such as Khashi, Rheang, Chakmas, Kuki and Hmar residing inside the Reserve forest area clears all the herbs and shrubs of the forest areas in order to practice Jhum cultivation. Forest fire is also documented in the course of survey as a means of clearing the forest for ‘Slash and burn ‘cultivation.

B/ii. Fuel wood extraction: In all the four reserve forests about 50% of the total population rely on forest for fire wood cutting of naturally grown trees for fuel wood. It has a tremendous impact on forest, primates and other wild life in general.

B/iii. **Extraction of timber:** The traditional houses in the Reserve forests of the study area are solely made out of wood with a roof of grasses or corrugated tin. Villagers collected their building materials illegally from the surrounding forest. Doors, windows and household furniture are also made from timbers which are extracted directly from the forest.

B/iv. **Livestock herbivore:**The actual effect of livestock grazing in and around the study site has not been quantified, however feeding activity of cows and buffaloes destroy most of the seedlings of the silviculture nursery and some new plantation. Feeding behavior of livestock may be influenced to some extent by competition for food with primates because some plant species are common to both. When herbivores are highly generalized in their food choice, they remove certain plant species that negatively affect the food chain.

B/v.**Traditional use**: The vegetation of the reserve forest is utilized both by human and livestock for their sustenance. Some people living in the forest village owe herds of cattle, buffalo, goat and sheep. They extract supplementary feed for their livestock. Other traditional use of the forest include growing of betel leaf and betel nut in the forest, cultivation of agriculture crops by clearing forest patches and large scale fuel wood extraction. All those practices are recognized all throughout the survey area most specifically near the forest villages. The forest edges have been observed cleared to establish betel leaf plantation in many remote areas. Regenerated bamboos and trees are used for fencing and roofing of many houses. Fuel wood extraction is common.

B/vi.Extraction of tree bark: Extraction of bark is wide spread and is not uncommon throughout the range of the study areas. Some people collects bark from some valuable tree species such as *Dillenia,Garcinia cowa,Microcospaniculata* and sell it to local agents. This type of extraction is unlawful and damaging. Subsequently, after some months most of these trees die out. Thereafter the fuel wood collector cut down these dead trees for commercial purpose.

B/vii.Betel leaf plantation: It is one of the alarming issues throughout the range of the study area mainly in Inner-line, Longai and Single reserve forest. Betel leaf plantation inside the reserve forest or at the edge of the forest has a negative impact on the wild habitats. These are mainly practiced by the Khashi people residing in the Inner-line, Longai and Singla reserve forest. They usually cleared large tract of the forest patches in order to cultivate betel leaf. The ground cover is cleared and the vine is grown creeping up the tree trunk. The tree trunk of all trees inside the plantation is used and large branches are looped off. These trees are avoided by gibbon as these trees do not produce fruits.

B/viii.Food source: People inhabiting in the forest villages consume some of the fruits of the forests that are eaten by gibbon and in turn cause scarcity of food for the gibbon. This has created direct conflict between man and gibbon. This has threatened the species in their habitat due to shortage of food. Naturally they must come out of the forest in search of food and fell prey to hunters and other wild animals.

C. <u>Habitat fragmentation:</u>

C/i. Selective logging: Selective loggingisone of the primarycauses of the fragmentation of habitat largely for the gibbons as they depend on the continuity of the forest. Selective logging is brought about mainly because of the valuable timbers and timber products. This has also destroyed the canopy of the forest trees which restrict gibbon movement for food and mates. But in the name of selective timber logging, indiscriminate loggings of trees were done as evident in the course of study in all the three Reserve forest (Plate. 4).

C/ii. Road construction: Road construction within the Reserve forest is vulnerable for the wildlife as it makes the forest fragmented. The wild animals unable to move across the roads or they fell prey to the hunters whenever they try to cross the roads to move to the other side of the forest. It is more vulnerable for gibbon as the construction of road not only makes the forest fragmented but also destroys the continuity of the forest and forest canopy (Plate 4).

4.3.1. Threats in Reserve Forests:

Specifically various types of threats to the gibbons were operation in the four Reserve forests of the study area and are discussed below separately:

1) **Threats in Inner-line Reserve forest**:

In Inner-line Reserve forest, major threats observed were illegal tree felling, selective timber logging, hunting, jhum cultivation and betel leaf plantaion.Hunting was found to be the major activity posing a direct threat to the gibbons in the ILRF and its adjoining area. In the study site, hoolock gibbons were found to be hunted for bush-meat by some ‘Khasi’ and ‘Mizo’ tribe. About 3-5 gibbons were reported killed for bush-meat in the last three years. During the study period one juvenile female gibbon was rescued which was injured by local people in the adjoining area of ILRF and sent to Veterinary Hospital, Guwahati for treatment and subsequent was shifted to Assam State Zoo cum Botanical Garden, Guwahati, during 2013. Betel nut/betel leaf plantation near Khasiapunjee in Loharbond area, fire wood collection, ‘Jhum’ cultivation inside the reserve forest is widely practised in the Naxa tilla, Baghkhal, Pancherra extension, Hadamma areas where the Reang, Kuki, Hmar and P’nar tribes inhabits. Illegal felling of trees were recorded in the Khashipunji, dakhinthal, Shantasora, Jhumkona, Dholabalu, Balisuri and Shantasora areas in the reserved forest. InLoharbond and Dholai range, it has been observed that illegal tree felling/ timber logging is in full practice as documented during the field study. Road construction and developmental activities inside the reserve forestwere also observed in loharbond, gurdayalpur and dholai area during the study.

Table 21. Threats in Inner-line Reserve forest

Category of Threat	Types of threat	Status
Social threat	Scarcity of mating partner	+
	Imbalance troop composition	+
Ecological threat	Temporary scarcity of food	++
Anthropogenic threat	Hunting	+++
	Habitat destruction	+++
	Shifting cultivation	+ ++
	Fuel wood extraction	+ +
	Extracting tree bark	+
	Extracting timber	+ +
	Live stock herbivory	+
	Betel leaf plantation	+ +
	Food source	+

(+ =Medium, ++=High, +++= Very high)

2) **Threats in Patheria Reserve forest**:

In Patheria Reserve forest, major threats observed were timber logging. Betel nut/betel leaf plantation near Khasiapunjee in Bilbari area, fire wood collection, jhum cultivation and hunting by the Khasi people inhabiting in near Bilbari area and poaching. In Adamtilla range, it has been observed that illegal timber logging is in full practice as documented during the field study. Near Bilbari area, the khasia people residing in the fringe areas clear out the forest for plantation of the betel leaf/nut. This is one of the potential threats in the extant as well as existing habitat of gibbon. It has also been observed that roads were constructed amidst the habitats of gibbon by the BSF personals for patrolling the forest areas adjacent to the fencing of the Indo-

Bangladesh Border. Along the entire western side of the Patheria Reserve forest is trans-national boundary with neighboring Bangladesh. To prevent illegal infiltration of people , the Border Security Force (BSF) has established as many as 3 camps and 7 vigilance patrol posts .But there is a stretch of three Kms forest along the forest patch is having barbed fence. The camps and patrolling along with the stretch of forest patch helped the gibbon to thrive in the adjoining forest, since they act as a natural barrier to resist anthroponogic threats of various types. This has observed to be a positive factor for the growth and sustenance of Hoolock gibbon in the area. Specifically BSF camps were established in Bilbari, Sonatola and Makumtilla (Near Adamtilla).

In many areas of the forest the local people of the area are cutting the trees of the forest for fire wood. Most of the forest near Sonatula and Champabari area is cleared by the local people for jhum cultivation. It has also been reported by the forest personal that hunting of gibbon is done frequently by the tribal people inhabiting near Bilbari area. Poaching is also done by Khasi people for meat and flesh as frequently reported by the local people.

Table 22. Threats in Patheria Reserve forest

Category of Threat	**Types of threat**	**Status**
Social threat	Scarcity of mating partner	+
	Imbalance troop composition	+
Ecological threat	Temporary scarcity of food	+
Anthropogenic threat	Hunting	+
	Habitat destruction	+
	Shifting cultivation	+ +
	Fuel wood extraction	+ +
	Extracting tree bark	+
	Extracting timber	+ +
	Live stock herbivory	+
	Betel leaf plantation	+ +
	Food source	+

(+ =Medium, ++=High, +++= Very high)

3) **Threats in Longai Reserve Forest**:

Habitat destruction is one of the major threats of gibbon as observed in Longai Reserve Forest. In Katamoni area it has been observed that forest was cleared for plantation of betel leaf. Timber logging is another threat towards the destruction of habitat of gibbon as has been observed in the course of study. This has resulted in the fragmentation of the habitat of gibbon .The forest is not spared from hunting of gibbon. Jhum cultivation is also observed here and there in the forest area. It has also been reported by the local people residing nearby forest area that the gibbon frequently comes down to the ground to move from one fragmented habitat to the other. In course of their journey, they fall victim to the hunters and other predators. River Longai also act as barrier for the gibbon movement.

Table 23. Threats in Longai Reserve Forest

Category of Threat	**Types of threat**	**Status**
Social threat	Scarcity of mating partner	+ +
	Imbalance troop composition	+ +
Ecological threat	Temporary scarcity of food	+ +
Anthropogenic threat	Hunting	+ + +
	Habitat destruction	+ + +
	Shifting cultivation	+ +
	Fuel wood extraction	+ +
	Extracting tree bark	+
	Extracting timber	+ + +
	Live stock herbivory	+ +
	Betel leaf plantation	+ + +
	Food source	+ +

(Medium, ++=High, +++= Very high)

4) **Threats in Singla Reserve forest:**

This Reserve forest is more threat prone in comparison to the other two Reserve forests. In Singla reserve forest large scale timber logging is in practice as this forest contains valuable timber yielding plants like *Tectona grandis, Artocarpus chaplasha* and many like. This is one of the leading causes of canopy destruction and habitat fragmentation. Though fair amount of gibbon are still occurring in the Singla RF, but if the present trend of habitat destruction will continue, the gibbon will find it difficult to survive in the Singla Reserve Forest. It has also been reported by the forest personals that the Mizo people usually visited the forest in search of gibbon as the gibbon meat and flesh has medicinal value. In south of Cheragi it has been observed that large areas of the forest has been cleared for betel leaf cultivation. This has resulted gibbon to shift to the other nearby habitat.

Table 24. Threats in Singla Reserve forest

Category of Threat	**Types of threat**	**Status**
Social threat	Scarcity of mating partner	+
	Imbalance troop composition	+
Ecological threat	Temporary scarcity of food	+ +
Anthropogenic threat	Hunting	+ + +
	Habitat destruction	+ + +
	Shifting cultivation	+ +
	Fuel wood extraction	+ +
	Extracting tree bark	+
	Extracting timber	+ + +
	Live stock herbivory	+ +
	Betel leaf plantation	+ + +
	Food source	+

(Medium, ++=High, +++= Very high)

Table 25. Plant species selectively logged by the villagers from the reserve forests and their purpose. ('+' indicates food plants of gibbon).

Sl. No	**Local name**	**Scientific name**	**Purpose**	**Food plant**
1	Cham	*Artocarpus chama* Buch-Ham	Construction	+
2	Kathal	*Artocarpus heterophyllus* Lamk.	Construction	+
3	Barpat	*Alianthus integrifolia* Lamk.	Fuelwood	

4	Kadam	*Anthocephalus cadamba* Miq.	Fuelwood	+
5	Satni	*Alostina scholaris* R.Br.	Fuelwood	+
6	Kanchan	*Bauhinia purpurea* L	Fuelwood	
7	Simul	*Bombax ceiba* L.	Construction/ Fuelwood	+
8	Dhuna	*Canarium bengalensis* Roxb.	Construction	
9	Uriaam	*Bischofia javanica* BI.	Construction	+
10	Singri	*Castronopsis indica* DC.	Fuelwood	+
11	Pithali	*Chrysophyllum lanceolatum* DC.	Construction	+
12	Tezzia	*Cinamomum cacharensis* R.N. Parker	Construction	
13	Shisoo	*Dulbergia sisoo* Roxb.	Construction	
14	Chalta	*Dillenia indica L.*	Fuelwood	
15	Gular	*Diospras taposia* Ham	Fuelwood	+
16	Rata	*Garcinia xanthochymus* Hook.f	Construction	
17	Gamari	*Gamelina arborea* Roxb.	Construction	+
18	Mahua	*Madhucha indica* Gmel.	Construction	+
19	Nageswar	*Mesua ferra* L.	Construction	+
20	Champa	*Michelia champaca* L.	Construction	
21	Bhola	*Morus laevigata* Wall.	Consrtuction	+
22	Shiris	*Samanea saman* Merr.	Construction	
23	Amra	*Spondias pinnata* Kurz.	Fuel wood	+
24	Kala Jaam	*Syyzgium cumini* L.	Construction	+
25	Teak	*Tectona grandis*	Construction	+
26	Shilikha	*Terminalia chebula* Retz.	Construction	+
27	Jinari	*Terminalia myriocarpa* HeurcketMuell.	Construction	+
28	Awal	*Vitex altissima* L.f	Construction	+

PLATE 4

Plate: Various anthropogenic activities in and around the reserve forest;
a and b: Illegal tree felling; c: clearing of forest patch; d: road construction; e: paan jhum; f: poacher’s camp; g: road widening; h: expansion of agricultural field.

PLATE 5

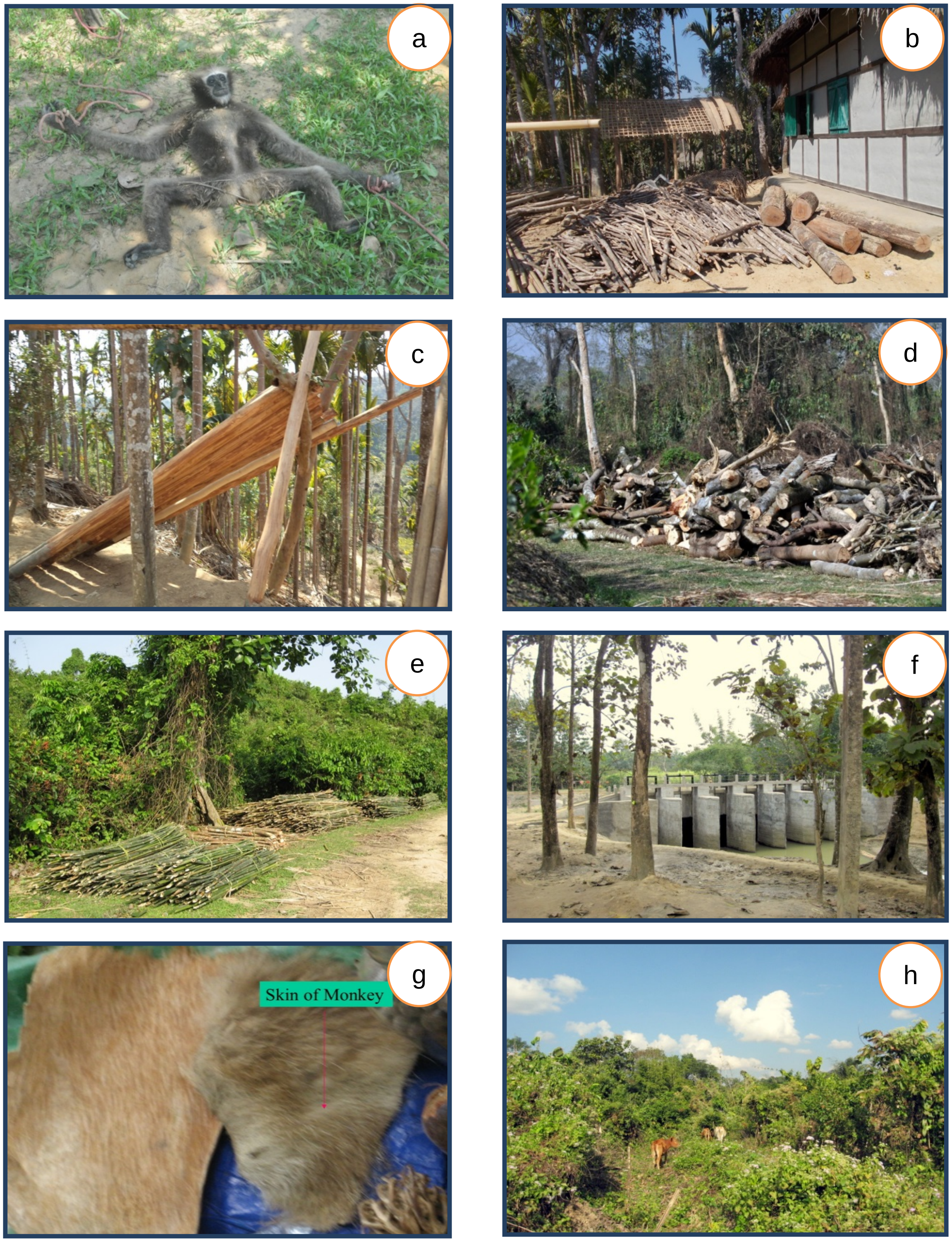


Plate: Various anthropogenic activities in and around the reserve forest;
a: gibbon injured by villagers; b: timber log and fuel wood; c: clearing of forest patch; d: NTFP and timber logging; e: bamboo collection; f: dam construction; g: quack used skin of monkey as medicine; h: livestock grazing.

3.4 MASS AWARENESS CAMPAIGN:

As an important component of the project a total of ten training and awareness campaign/ mass awareness programmes were organized for forest villagers in fringe areas of the reserve forests during the three years duration of the long-term UGC major research project (01/04/2013 to 31/03/2016). Out of the ten awareness programme, nine were organized during the month of December, 2015. The awareness campaigns were conducted in different schools near the fringe areas of Inner-Line Reserve Forest of Cachar district, and Patharia RF, Longai RF and Singla (Cheragi) RF of Karimganj district, Assam, where Western Hoolock gibbons are fighting for their last survival in few isolated groups (Table 26). These campaigns were held in the presence of students as well as local inhabitants.The awareness campaigns were organized in 7 schools from Cachar distircit and 3 from Karimgnaj district which are located near the reserve forest areas. And they are: **Cachar**: Mohanlal ME school, Nayabil; Brajakishore High school, Duwarbond; Nowagaon ME school, Pratappur; Bandhan guwala LP school, loharbond; Rosekandi High School; Dargakona Public HS school, Dargakona; Barjalenga MV school, Barjalenga; **Karimganj**: Satkoragol LP school, Ujangaon; Dubri LP school, Patharkandi and Khasiapunji tribal LP school, Khasiapunji (Table - 26).

Training and awareness programmes were organized for villagers in fringe areas to identify the habitat of Hoolock gibbon, their food plants, plantation of food plants etc. so as to increase the awareness for conservation of wildlife, highlighting Western Hoolock Gibbon as a flagship species. The awareness/training camps were organized in Cachar and Karimganj Districts near the fringe areasof Hoolock Gibbon habitat to make villagers aware ofthe need of wildlife conservation. Pre and postawareness questionnaire survey were carried out to do the concept mapping among the villagers about wildlife conservation. Close ended questionnaire was formed to get quantitative assessments of theperceptions of wildlife conservation among the fringe villagers and forest dwellers. It was helpful for assessing the success of the awareness campaign.

All the programmes were organized under the banner of the Department of Ecology and Environmental Science, Assam University, Silchar, as a module of the UGC funded major Research Project entitled, "Status Survey of Western Hoolock gibbon (*Hoolock hoolock*) and conservation initiative through mass awareness in the reserve forest areas of Barak Valley, Assam, India".During the campaigns the behaviour and ecology of Hoolock gibbon was taught as well as the need of conservation and the various survival stress of this elusive animal that occur in the reserve forest areas. The awareness/training programme was carried out under the leadership of Prof. Parthankar Choudhury and the reserch scholars Mofidul Islam (Project fellow under the UGC-MRP), along with Dipankar Debnath carried out the training and awareness campaingns.

Table 26. Date and name of the school where training/awareness campaign programmes were organized.

Sl. No.	Date	School name/ district.
1	16/11/2013	Rose Kandy High school, Rosekandy tea estate, Cachar.
2	05/12/2015	Mohanlal ME school, Nayabil, Cachar.
3	10/12/2015	Brajakishore High school, Duwarbond, Cachar
4	14/12/2015	Nowagaon ME school, Pratappur, Cachar
5	16/12/2015	Bandhan guwala LP school, loharbond, Cachar
6	18/12/2015	Dargakona Public HS school, Dargakona,Cachar
7	21/12/2015	Barjalenga MV school, Barjalenga, Cachar
8	24/12/2015	Satkoragol LP school, Ujangaon, Karimganj
9	25/12/2015	Dubri LP school, Patharkandi, Karimganj
10	26/12/2015	Khasiapunji tribal LP school, Khasiapunji, Karimganj

PLATE 6

Mohanlal ME School, Nayabil, Cachar.

Barjalenga MV School, Barjalenga, Cachar

Brajakishore High school, Duwarbond, Cachar

Dargakona Public HS school, Cachar

Bandhan guwala LP school, loharbond, Cachar

Khasiapunji tribal LP school, Karimganj

Plate: Photographs of some awareness programme during the study

PLATE 7

Rosekandy high school, Rosekandy, Cachar

Rosekandy high school, Rosekandy, Cachar

Dubri LP school, Patharkandi, Karimganj

Nowagaon ME school, Pratappur, Cachar

Satkoragol LP school, Ujangaon, Karimganj

Rosekandy high school, Rosekandy, Cachar

Plate: Photographs of some awareness programme during the study

4. DISCUSSION:

The study was undertaken in the four Reserve Forests (Inner-line RF, Patharia RF, Longai RF and Singla RF) of Cachar and Karimganj district of Barak Valley, Assam, India. Hoolock gibbons surviveprimarily in tropical evergreen forests, tropical wet evergreen, tropical semi-evergreen,and tropical moist deciduous and subtropical hill forests in India (Srivastava et al.,2001b; Molur et al., 2005). There is no prior information on the population size of *H.hoolock*, based on systematic studies in those Reserve Forests of Barak Valley. In the north-eastern states, Das et al. (2005) reported the occurrence of *H. Hoolock* populations in Assam (in 1994) and Tripura (2003), comprising 1,985 and 97individuals, respectively. In the present study, all the gibbon groups were found intropical mixed evergreen and deciduous forest patches. Most forests were usually small patches surrounded on all sides by barren hills used for shifting cultivation.The description of the geographical location of the study area indicates that the area is surrounded on all sides by tea gardens and shifting cultivation, creating a fragmented habitat for the brachiators beyond which they cannot move for foraging andother activities. The commonly available food plants in the localities are *Ficus bengalensis*, *Ficus hispida*, *Artocarpus lacucha*, *Dysoxylum binectariferum*, *Gmelina arborea* and *Syzygium cumini*. As hoolock gibbons are largely frugivorous, and in the studyarea it has been observed that they feed mainly on *Ficus* spp., food availability may be a limiting factor for their survival and distribution. Joseph and Ramachandran (2003) were also of the opinion that compared with other sympatric primate species such ascapped langurs, Phayre’s leaf monkeys and rhesus monkeys, which are both frugivorous and folivorous, gibbons, the frugivorous species, are facing more threats in terms of territory confinement and foraging.

Hoolock gibbons are monogamous and maintain a social network within a group and social proximity with neighbouring groups of the same species (Alfred and Sati, 1990); these authors also reported that a typical family group consists of a mated pairand 1–3 immature offspring. However, solitary individuals were also found near an existing group (Alfred and Sati, 1990). During the present study, it is found that the group consists of a mated pair and 1–4 immature offspring; solitary individuals were also found. Perhaps, the individual was in quest of a partner.

The group composition and group size were compared with the standard literature, as furnished by Choudhury (1990, 1991) for Assam. The present findings, i.e.average mean group size 3.16±0.47 individuals for 55 groups, is closely comparable to other studies conducted in different parts of the *H. hoolock* distribution range, as reported in Kumar et al., (2009), i.e. 3.2 individuals for 24 groups and 3.4 for 7 groups (Tilson, 1979), 3.1 for 8 groups and 3.0 for 14 groups (Choudhury, 1990, 1991) in Assam, 3–3.2 for 6–10 groups (Mukherjee, 1982), 2.1 for 34 groups (Gupta, 1994) in Tripura, 3.0 individuals for 42 groups (Alfred and Sati, 1990) in Meghalaya, 3.5 for 6 groups (Gittins and Tilson, 1984), 2.3 for 5 groups and 2.9 for 15 groups (Ahsan, 1984, 1994), and 2.9 for 13 groups (Feerozand Islam, 1992) in Bangladesh.

Most gibbon populations in the north-east are very small and declining (Mukherjeeet al., 1991–1992; Choudhury, 1996; Molur et al., 2005; Walker et al., 2007). In thenear future, there is a high probability of extinction for several fragmented populations (Molur et al., 2005; Kumar et al., 2009). In the present study, fragmentation of habitat appears to have had no immediate impact on group size; however, its effect inthe long term should be the subject of further study.As mentioned, various authors have reported the group size of hoolock gibbons to range between 2.1 and 3.5 for group numbers ranging variously from 5 to 42. The present study revealed the mean group size of gibbon populations in the study areaas 3.16±0.47. However, this may not be encouraging at all. That the group size is much thesame as reported by previous authors might be due to the fact that the immediate effectof forest fragmentation has not yet appeared as an impending threat in the localities, but the same may not be so in the future.

Globally, primate population declines have occurred as a result of habitat destruction, among other things such as human population pressure and political unrest (Oates 1999, Gain 2002, Setchell and Curtis 2003). Extricating the root cause of population declines insuch a variety of factors those influence primate populations is oftendifficult. The use of a large number of small plots for habitat measurements proved efficient in this study and allowed the detection of fine-scale differences in vegetation characteristics.Gibbon population was found to be highly correlated to vegetation parameters, in particularcanopy cover (i.e. 50-70%) and tree height (16- 25m). As gibbons preferentially use high canopy layers throughouttheir activity budget (Johns, 1986; Brockelman and Ali, 1987; O'Brien et al., 2004; Nijman,2001), this result is not surprising, although gibbons have proved to be relatively adaptable todisturbances of canopy cover following logging by shifting their use of canopy layers to thelower canopy (Johns, 1985; Johns, 1986; Nijman, 2001). Canopy cover and tree height havebeen found to influence the density of other arboreal primates (Tana red colobus and crested mangabey: Medley, 1993; orangutans: Felton et al., 2003), as gaps in canopy impair theirtravelling. Other variables that were found to be correlated with gibbon density in this studywere the density of large trees and the availability of food trees. All the authorsproposed that this relationship was due to greater availability of food where more large treeswere present, which is in conformity with results linking food abundance to primate densities(e.g. Wieczowski, 2004; Mather, 1992a; Mather, 1992b). The correlation betweencross-sectional areas of food trees was weak in this study, primarily due to large variationsbetween plots, it is supported by the results of other studies on gibbons (Mather, 1992a) which found that gibbon density was strongly influenced by the availability of their preferredfood trees. In this study the food tree abundance found to be nearly 50% of the total tree abundance. Alternatively, this could be due to the gibbons' extensive range of food trees inthe study area.

Borah and Garkoti (2011), studied on Tree Species Composition and Diversity, in undisturbed and disturbed forests of Barak Valley, South Assam, and reported 137 species and out of which the main dominant species were *Cynometra polyandra, Palaquium polyanthus, Tetrameles nudiflora, Artocarpus chama, Dysoxylum binectariferum, Tetrameles nudiflora, Mitragyna rotundi-folia, Schima wallichii, Stecospermum chelonoides, Castanopsis purpurella etc.* In the present study, we also found a total of 143 tree soecies belonging to 45 families were found. The dominant species presently revealed are *Vitex altissima* L.f., *Zanthoxylum rhesta* Roxb., *Mangifera sylvatica* Roxb., *Ficus benghalensis* L., *Hydnocarpus kurzii* Warb., *Artocarpus chama* Buch- Ham., *Artocarpus lakoocha* Roxb.,*Ficus auriculata* Lour., *Gmelina arborea* Roxb., *Plumeria acuminata* Ait., *Syzygium fruticosum* DC., *Mangifera indica* L., *Anthocephalus cadamba* Miq., *Castonopsis indica* DC., *Chrysophyllum lanceolatum* DC., *Mesua ferra* L., *Bombax ceiba* L., *Garcinia cowa* Roxb., *Elaegnus caudata* Schlechi ex. etc.

Tree species richness was within the range reported for similar forests in the region

(Bhuyan et al., 2003, Upadhaya et al., 2004, Nath et al., 2005. Thespecies richness was comparable with that in thetropical forests in Luquillo Mountain in Puerto Rico (Weaver and Murphy 1990), Yanamono, Peru (Gentry1988, 1992). However, present species richness values were lower than that of tropical wet evergreen forests (149 species) in Western Ghats (Parthasarathy, 1999). Consistent with the findings of Nath et al., (2005) but contrary to the findings of Upadhaya et al., (2004), the species richness declined with disturbance (90 species). Species richness was not uniformly distributed in present study forests rather the mosaic of both low and high diversity patches were spread along the landscape. This appearsto be the result of the combined effect of non-extremestable environmental condition and gap phase dynamicswithin the forest (Whittaker 1972). In this respect, the present study forests are somewhat similar to the rainforests, which have often been described as harbouring patchy vegetation (Ashton 1969, Herwitz 1981, Poore1968) primarily due to gap phase. In present study, majority of species showed contagious distribution. This is likely to be related to seed dispersal mechanism of the species and gap formation (Barik et al., 1996).

The influence of logging on gibbon populations has been the focus of several studies (e.g. Wilson and Wilson, 1975; Johns, 1986; Meijaard et al., 2005), as it constitutes a major threat to gibbons. Selective logging, which targets large, commercially valuable trees, has been shown to reduce canopy cover and continuity, as well as to restrict the availability offood for the gibbons (Meijaard et al., 2005; Johns, 1988). The damage on forest trees also exceeds the sole trees that are felled, as it was found that selective removal of 3.3% of trees resulted in the destruction of over 50% of surrounding trees (Johns, 1988). Because of their dietary flexibility, gibbons may be relatively resilient to logging. Meijaard et al., (2005) listed five studies having found gibbon densities equal or higher after selective logging. Six studiescited in the same review found decreased gibbon densities after logging. Since gibbon density is highly correlated to canopy cover and tree height, the results of the present study seem to indicate that gibbons in Barak Valley may have been positively affected by logging in near future.

Lowland tropical rain forests in Northeast India are the most species rich terrestrialecosystems harboring gibbons in India. Substantial degradationof these rain forests in and outside of protected areas hasled to fragmentation and conflict, affecting the populationsof both the western hoolock (*Hoolock hoolock*) and eastern hoolock (*Hoolock leuconedys*) gibbons. Populations in the wild have declined by more than 90% over the past threedecades due to numerous anthropogenic threats (Walker et al.,2007). The western hoolock gibbon is the species most studied for anthropogenic threats in its range (Choudhury1990, 1991; Mukherjee et al.,1992; Srivastava 1999; Ahmed2001; Srivastava et al.,2001a, 2001b; Malone et al.,2002; Dasand Bhattacherjee 2002; Das et al.,2004; Solanki and Chuita2004; Das et al.,2006; Walker et al.,2007), and most of thethreats apply also to the western hoolock gibbon in Barak Valley, Southern Assam. These threats have affected the conservation statusof the gibbons (Alfred and Sati 1990, 1994; Choudhury 1991;Islam and Feeroz 1992; Kakati 1997). Hunting, habitat loss and fragmentation, have been reported as majoranthropogenic threats for the hoolock gibbon throughout its known range (Lwin et al., 2011; Fan et al., 2011; Das et al., 2006; Chetry et al., 2008, 2010; Chetry and Chetry, 2010; Kumar et al., 2013). Same have been also reported in the present study.

From the study, it has been observed that in the Reserve forests of valley, varieties of primate species are facing multidimensional threats. The land use pattern is gradually changing; more andmore local farmers are switching to short-duration, cash-cropcultivation for quick returns. The rate and extent of forestencroachment, disturbance and depletion are determined bymany factors, including the legal status and land ownershipof each forest area (Baranga et al.,2009). In the reserve forests the semi evergreen forest (both dense and open) has reduced considerably mainly because of illegal tree felling, timber logging, jhum cultivation, expansion of agricultural land and encroachments (Islam et al., 2013). Local people haveno clear understanding about reserve forest, wildlife Act as well as the importance of conservation of the wildlife due to the lack of education as well as mass awareness. As such theybelieve they have the right to hunt and to carry out their day-to-day activities there. Occasional huntingand illegal selective logging and collection of timber are widespread in the area. The economic status of local people affects the gibbon population and its habitat directly and indirectly and this has become a major concern for gibbon conservation. Local people use forest resources and land for extracting fuel wood, housing materials, medicinal plants, wild vegetables, and for agricultural activities. This results in forest fragmentation and degradation in the form of canopy gaps, and food paucity in both quantity and quality. This makes gibbons' particularly vulnerable to hunting and predation by domestic and wild dogs while moving on forest floor to forage for food, mate, and find safe shelter. Community hunting for their flesh and socio-cultural practices by tribal people is one of the major threats to primate species, including the endangered *H. hoolock* (Biswas, 1970; Solanki and Chutia, 2004). Further, the songs of gibbons act as a definite guide for hunters, allowing them to locate gibbons easily (Gupta et al., 2005). This has also contributed in a sharp decline of gibbon populations in the entire northeast, of which the reserve forests of Barak valley is no exception.

The forest inside the reserve is still dense, but timber poachers are now targeting felling for commercial purposes inside the forest.The forests in the foothills are suffering from considerableexploitation, which leads to the destruction and fragmentationof the habitat, adversely affecting the survival ofthe gibbons. Besides the protected areas, unclassifiedstate forests, that hold a significant portion of the total gibbonpopulation in the state, are facing serious threats in terms ofencroachment for agricultural and horticultural practices and logging (Panor, 2011). These threats are found to be common in the present study sites.

The majority of gibbon populations in the northeast are very small and declining (Choudhury, 1996; Mukherjee et al., 1991-92; Walker et al., 2007; Molur et al., 2005) and several fragmented populations face a high probability of extinction (75%) in the near futuredue to isolation ,decrease in habitat quality, availability of food and hunting. Gupta et al., (2005), stated that the alarming changes in gibbon habitat that has taken place in the recent years, in the ecology and landscape, have brought about a number of changes in the distribution and population structure of *H. hoolock* in the species range.

Of all the factors that have been identified as responsible for the stress of Hoolock gibbon,few critically important factors include: infiltration and illegal settlement of people, either from the neighboring states / countries, and clearing of forest, for agriculture; increased family members of the forest villagers clearing more forest areas for longer cultivable land coverage; “Pan Jhum” practiced by the Khasi tribes; reduced cycle length of Jhum cultivation due to increased population; religious conversion of local tribes:

change in culture emerging as a major threat to primates, as with change of religion, there has been dietary shift, and dependency on non-veg food increase; andcross border huntingacross the state in the Reserved Forests of Barak Valley by the Mizo and Manipuri tribes.

Based on these anthropogenic threats, the gibbon populationis believed to have declining rapidly. Immediate intervention is needed to conserve this vulnerable species; various degrees of habitat degradation have created an alarming situation for this creature. Proper adoption and implementation of conservation measures would perhaps be of immense help in enabling the left out species of gibbon to grow and thrive well in the reserve forestareas of Barak valley, Assam. More pro-active measures from the law enforcement / implementing authorities would definitely help to ameliorate the scenario of the study area and would perhaps help to restore its past glory in terms of faunestic composition in general, and more particularly hoolock gibbons.Adequate protection, ban on timber logging, control of *jhum* cultivation and poaching, and conservation education/awareness and mass involvement of local communities can help this valuable species to survive in their natural habitats in thereserve forests, Barak Valley, Assam, India.

5. RECOMMENDATIONS:

Man, the closest relative of Hoolock is mainly responsible for creating a sort of hostile environment leading to a strain situation for the species to survive. If the present trend of habitat destruction and other negative activities go on uninterrupted then it will not be a surprise that Hoolock's calls will vanish forever. Mankind should keep in mind that this planet is not only for human alone. We share this planet with myriad of species including Hoolock gibbon. We should come forwarded for the conservation of this charismatic species.

However, conservation is a very complex issue and needs careful handling Priotization of the issues is important as it is not feasible to deal with all conservation problems at a time. After the completion of three years of study the following important steps can be recommended for the conservation of Hoolock gibbons in Barak Valley. These recommendations are specific conservation action points that can be carried out for the conservation of the species. These do not take into account lifestyle changes and other social parameters such as 'jhumming' and traditional hunting that greatly influence the wildlife in this region that are outside the scope of conservation action. The following measures arerecommended:

1. **Conservation of habitat:**Habitat loss is the primary threats for Western Hoolock gibbon in the ILRF. This decline in habitat must be arrested both in quantity and quality through multi-species plantations, checking illegal felling and other measures. Since habitat loss is the principal threat to Hoolock gibbon, it should be the highest priority. If the forest habitats can be preserved then not just the Hoolock

gibbon but the entire bio-diversity of the region will be enriched and preserved. Legislative support is urgently required for preventing illegal activities such as poaching, encroachment, etc. Even existing legislation can be effectively implemented through a coordinated approach, nurturing working relationship with NGOs, academics, local communities, and makers, training and sensitization of legislators towards the need of Western Hoolock gibbon.

2. **Habitat restoration and plantation:**A nation cannot progress without developmental activities, but we can put our effort to minimize the impact of various developmental activities on the entire fauna, and in particular, the Hoolock and their habitats. Quality of habitats can be restored by taking up plantation program. Plantation will also help in bridging the canopy gaps within habitat. However, it is important to go for the plantation of key plant species which are vital for the survival of the important fauna of the area.
3. **Ficus species conservation:** Conservation of Ficus species in the habitat of Hoolock gibbon is very essential not because they are the major food plants of Hoolocks alone, but other primates and lots of other species also depend upon them. They also produce maximum oxygen than any other species.
4. **Legal protection:** It is also an urgent need to bring the key areas outside the protected area network which support substantial populations of Hoolock gibbon within the ambit of protected area network. This will ensure legal protection to the populations which are otherwise neglected. The private forests having Hoolock gibbon groups can be included in the community reserves keeping in view the need

and aspirations of the people involved. Ban on timber logging, illegal felling, jhum cultivation should be checked in the reserve forests.

5. **Improvement of socio-economy:** Socio- economy of the fringe communities is related with conservation of the wildlife and to reduce the dependency on forest viable alternative livelihood should be provided to the people in phases.
6. **Eco-development programme:** Community-based eco-development programmes to be developed in to generate alternate livelihood to check illegal activities in Western Hoolock gibbon habitat to minimize habitat loss.
7. **Communityparticipation:**No matter what sort of conservation efforts are applied, without the communities support it is not possible to reach the ultimate goal of conservation. Here, conservation education has a very important role to play in making people aware of the importance of conservation of the species. Genuine effort should be made to sensitize the communities with the concept of wildlife conservation.
8. **Mass awareness:** There is a need of more awareness campaigning among the villagers in and around the reserve forests of the Valley.Important trains, buildings, auditoria etc. can be named after gibbons to generate public awareness about the species. Hoolock gibbon should be made one of the target species in eco-tourism.
9. **Need of unity:** Above all both political will and public support are needed to achieve the conservation goal. Therefore, government, NGOs and public must come together and join hands to save Hoolock gibbons and their habitats.

5. REFERENCES:

1) Ahmed, A. (2001). Illegal trade and utilization of primates in India. *ENVIS Bull.: Wildlife Protected Areas. Non-human of India*, A.K. Gupta, ed. 1(1): 177–184.
2) Ahsan, M. F. (1984). Study of primates in Bangladesh: Determination of population status and distribution of non-human primates in Bangladesh with emphasis on the Rhesus Monkey. Unpublished M. Phil Thesis, University of Dhaka, Dhaka, Bangladesh.
3) Ahsan, M. F. (1994). Behavioral ecology of the hoolock gibbon (*Hylobates hoolock*) in Bangladesh. Ph.D. Thesis, Department of Anatomy, University of Cambridge, UK.
4) Alfred, J. R. B and Sati, J. P. (1987). Sexual behavior in the *Hylobates hoolock*. *Abstract in International Journal of Primatology*. 8(5). Pp. 414.
5) Alfred, J. R. B and Sati, J. P. (1991). First record of infanticide in the hoolock gibbon (*Hylobates hoolock*) in the wild. *Records of the Zoological Survey of India.* 89(1-4): 319-321.
6) Alfred, J. R. B. and Sati, J. P. (1986). The gibbon with special reference to Hylobates hoolock, In: Majupuria T. C. (editor). *Wildlife Wealth of India: Resource and Management.* Tec Press Service, Bangkok. pp. 384-390.
7) Alfred, J. R. B. and Sati, J. P. (1990). Survey and census of the Hoolock Gibbon in West Garo Hills, northeast India. *Primates.* 31(2): 299-306.
8) Alfred, J. R. B. and Sati, J. P. (1990a). Behavioural study of the Hylobates hoolock Harlan. In *Current Trends in Environmental Biology*, Mishra, R. R., K. Chatterjee (eds.), School of Life Sciences, Northeastern Hill University, Shillong. Pp. 85-93.
9) Anderson, J. (1878).*Anatomical and Zoological Researches. Comprising an account of the zoological results of the two expeditions to western Yunnan in 1868 and 1875.* Quaritch, London.
10) Ashton, P. S. (1969). Speciation among tropical forest trees; some deduction in the light recent evidence. *Biological Journal of Linnaean Society.* 1: 155-196.
11) Baranga, D., Chapman, C. A. and Kasenene, J. M. (2009). The structure and status of forest fragments outside protected areas in central Uganda. *Afr. J. Ecol*. 47: 664– 669.

12) Barik, S. K., Tripathi, R. S., Pandey, H. N. and Rao, D. P. (1996). Tree regeneration in subtropical humid forest: effect of cultural disturbance on seed production and germination. *Journal of Applied Ecology*. 33: 1551-1560.

13) Bhuyan, P., Khan, M. L. and Tripathi, R. S. (2003). The tree diversity and population structure in undisturbed and human impacted stands of tropical wet evergreen forest in Arunachal Pradesh, Eastern Himalayas, India. *Biodiversity and Conservation*. 12 (8): 1753-1773.

14) Biswas, J., Sangma, A., Ray P. C., Das, J., and Tapi, T. (2010). Status survey and bio-geography of hoolock gibbon in Arunachal Pradesh. *Final Report of Primate Research Centre NE India and U.S. Fish and Wildlife Services Collaborative Project*. Pp. 49.

15) Biswas, S. (1970). White-browed gibbon (*Hylobates hoolock* Harlan) and Capped Langur (*Presbytis pileatus* Blyth) as human food. *J. Bengal Nat Hist*. *Soc*. 36 (1): 78–80.

16) Blanford, W. T. (1888–91) The Fauna of British India including Ceylon and Burma. *Mammalis* (2 vols.). Taylors and Francis, London

17) Borah, N. and Garkoti, S. C. (2011). Tree Species Composition, Diversity, and Regeneration Patterns in Undisturbed and Disturbed Forests of Barak Valley, South Assam, India. *International Journal of Ecology and Environmental Sciences*. 37 (3): 131-141.

18) Borang, A. and Thapliyal, G. S. (1993). Natural distribution and ecological status of non-human primates in Arunachal Pradesh. *Indian Forester.* 119(10): 834-844.

19) Brandon-Jones, D., Eudey, A. A., Geissmann, T., Groves, C. P., Melnick, D. J., Morales, J. C., Shekelle, M., Stewart, C. B. (2004). Asian Primate Classification. *International Journal of Primatology.* 25 (1): 97-164.

20) Brockelman W, Molur S, Geissmann T. (2008). Hoolock hoolock. In: *The IUCN Red List of Threatened Species*. Version 2014.1. Available at: www.iucnredlist.org

21) Brockelman, W. Y. and Ali, R. (1987). Methods of Surveying and Sampling Forest Primate Populations. In: Marsh, C.W., Mittermeier, R. A., (eds.) *Primate Conservation in the Tropical Rain Forest*. New York: Alan R. Liss, Inc. pp. 23-62.

22) Burnham, K. P., Anderson, D. R. and Laake, J. L. (1980). Estimate of density from line transect sampling of biological populations. *Wildlife Monographs.* 72: 1–202.

23) Chetry, D., Chetry, R., Das, A., Loma, C. and Panor, J. (2008). New distribution records for *Hoolock leuconedys* in India. *Primate Conservation.* 23: 125–128.

24) Chetry, D., Chetry, R., Gosh, K. and Singh, A. K. (2010). Status and distribution of the eastern hoolock gibbon (*Hoolock leuconedys*) in Mehao Wildlife Sanctuary, Arunachal Pradesh, India. *Primate Conservation*. 25: 87- 94.

25) Chetry, D., Medhi, R. and Bose, J. (2003). Distribution of Hoolock Gibbon (*Bunopithecus hoolock hoolock*) in India and Bangladesh. *Zoos' Print Journal*. 18(1): 969-976.

26) Chetry, R. and Chetry, D. (2010). First record of eastern hoolock gibbon in Assam, India. *Primate Conserv*. 25: 95– 97.

27) Choudhury A. (1990). Population dynamics of Hoolock gibbons (*Hylobates hoolock*) in Assam, India. *American Journal of Primatology,* 20 (1):37- 41.

28) Choudhury A. (1991). Ecology of the Hoolock gibbon (*Hylobates hoolock*), a lesser ape in the tropical forests of north-eastern India. *Journal of Tropical Ecology*. 7(1):147-53.

29) Choudhury, A. (1987). Notes on distribution and conservation of Phayre's leaf monkey and hoolock gibbon in India. *Tiger Paper*. 14 (2): 2-6.

30) Choudhury, A. (1987). Notes on distribution and conservation of Phayre's leaf monkey and hoolock gibbon in India. *Tiger Paper.* 14 (2): 2-6.

31) Choudhury, A. (1988). A primate survey in southern Assam, India. *Primate Conservation.*9: 123-125.

32) Choudhury, A. (1996). Primates in Assam - status and conservation. *Tiger Paper.* 23 (3): 14-17.

33) Choudhury, A. (1996a). A survey of hoolock gibbon (*Hylobates hoolock*) in southern Assam, India. *Primate Report.* 44: 77-85.

34) Choudhury, A. (1996b). Primates in Bherjan, Borajan and Podumoni Reserved Forests of Assam, India. *Asian Primates*.5(3-4): 10-11.

35) Choudhury, A. (1998). Père David's macaque discovered in India. *The Rhino Foundation.* 2: 7.

36) Choudhury, A. (2000). A survey of Hoolock Gibbon (*Hylobates hoolock*) in Dibru-Saikhowa National Park, Assam, India. *Primate Report.* 56: 61-66.

37) Choudhury, A. (2001). *Primates in northeast India: An overview of their distribution and conservation status.*ENVIS Bulletin: Wildlife and Protected Areas (Non-human primates of India, A. K. Gupta (ed.) 1(1): 92-101.

38) Choudhury, A. (2009). The distribution, status and conservation of hoolock gibbon, Hoolock hoolock, in Karbi Anglong District,Assam, Northeast India. *Primate Conservation* (24). 1-10 (online).

39) Choudhury, A. (2013). *The Mammals of North East India*. Gibbon Books, Guwahati 781007, Assam, India. pp. 19 – 36.

40) Choudhury, A. 2009. The distribution, status and conservation of hoolock gibbon, Hoolock hoolock, in Karbi Anglong District,Assam, Northeast India. *Primate Conservation* (24): 1-10 (online).

41) Choudhury, A. U. (1986). Wildlife in Northeast India. *North-Eastern Geographer*, 18 (1 and 2): 92–101.

42) Choudhury, A. U. (2003). *The Mammals of Arunachal Pradesh*. Regency Publications. New Delhi, India.

43) Choudhury, A. U. 2006. The distribution and status of hoolock gibbon, *Hoolock hoolock*, in Manipur, Meghalaya, Mizoram, and Nagaland in northeast India. *Primate Conservation*. (20): 79–87.

44) Das J, Bhattacharjee, P. C., Biswas, J. and Chetry, D.(2005). Western Hoolock Gibbon: Socioecology, threats and conservation action plan. Department of Zoology, Gauhati University and Primate Research Centre, North-east Centre, Guwahati. 1-70.

45) Das, J. (2002). *Socio-ecology of hoolock gibbon in response to habitat change*. PhD thesis, Department of Zoology, Gauhati University, Guwahati, India.

46) Das, J. and Bhattacherjee, P. C. (2002). Effect of habitat destruction on behaviour and ecology of hoolock gibbon. In: *Caring for Primates*. Abstract of the 19th Congress of the International Primatological Society, Beijing, China, (Abstract). Pp.118–119.

47) Das, J., Bhattacharjee, P. C., Biswas, J. and Chetry, D. (2004). Western Hoolock Gibbon: Socioecology, Threats and Conservation Action Plan. A Report of Primate Research Centre, Guwahati Universtiy, Assam.

48) Das, J., Biswas, J, Medhi, R., Bose, J., Chetry, D., Bujorborua and Begum, F. (2003b). Distribution Status of Hoolock Gibbon (*Bunopithecus Hoolock*) and their Conservation in Southern Assam, India. *Tiger Paper*. 30 (4): 26-29.

49) Das, J., Biswas, J., Bhattacharjee, P.C., and Mohnot, S.M. (2006). First distribution records of the Eastern Hoolock Gibbon (Hoolock hoolock leuconedys) from India. *Zoo's Print Journal*. 21(7): 2316-2320.

50) Das, J., Feeroz, M. M., Islam, M. A., Biswas, J., Bujaborua, P., Chetry, D., Medhi, R. and Bose, J. (2003a). Distribution of Hoolock Gibbon (*Bunopithecus hoolock hoolock*) in India and Bangladesh. *Zoos' Print Journal*. 18(1): 969-976.

51) Das, J., J. Biswas, P. C. Bhattacharjee and S. M. Mohnot. (2006). First distribution records of the eastern hoolock gibbon (*Hoolock hoolock leuconedys*) from India. *Zoos' PrintJournal*. 21 (7): 2316–2320.

52) Fan, P. F., Wen, X., Sheng, H., Sen, A. H., Can, W. T. and Tao, L. R. (2011). Distribution and conservation status of the vulnerable eastern hoolock gibbon *Hoolock leuconedys* in China. *Oryx*. 45: 129–134.

53) Felton, A. M., Engstrom, L. M., Felton, A., Knott, C. D. (2003). Orang-utan Population Density, Forest Structure and Fruit Availability in Hand-logged and Unlogged Peat Swamp Forests in West Kalimantan, Indonesia. *Biological Conservation*. 114: 91-101.

54) Geissmann, T. (2007). Status reassessment of the gibbons: results of the Asian primate red list workshop 2006. *Gibbon Journal*. 3: 5-15.

55) Gentry, A. H. (1992). Tropical forests biodiversity, distributional patterns and their conservational significance. *Oikos*. 93: 19-28.

56) Gentry, H. A. (1988). Tree species richness of upper Amazon forest. Proceedings of *National Academy of Science*, USA. 85: 156- 459.

57) Gittins S. P. and Akonda, A. W. (1982). What survives in Bangladesh? *Oryx*.**16**: 275-281.

58) Gittins, S. P. (1980). Territorial Behaviour in the Gibbon. *International Journal of Primatology*. 1 (4): 381-399.

59) Green, K. M. (1978). Primates of Bangladesh: A preliminary survey of population and habitat. *Biological Conservation*. 13: 141-160.

60) Groves C. P. (1967). Geographic variation in the hoolock or white-browed gibbon (*Hylobates hoolock*). *Folia Primatologica.* 7: 276- 283.

61) Groves C. P. (1972). Systematics and phylogeny of gibbons. In: Rumbaugh DM (ed.) *Gibbon and siamang.* 1: 1-89.

62) Groves, C. P. (1970). Taxonomic and individual variations in gibbon. *Symp. Zool. Soc.* 26: 127–134.

63) Groves, C. P. (1971). Geographic and individual variation in Bornean gibbons, with remarks on the systematics of the subgenus *Hylobates*. *Folia Primatologica* 14: 13-53.

64) Groves, C. P. (2005). Order Primates. in *Mammal Species of the World: A Taxonomic and Geographic Reference*, 3rd Edition, D. E. Wilson and D. M. Reeder (eds.), Johns Hopkins University Press, Baltimore, Maryland, 1: 111–184.

65) Gupta, A. K. (1994). Status and conservation of non-human primates in Tripura, India. *In Current Primatology* (Thierry B, Anderson JR, Roeder J. J., Herrenschmidt, N. eds.), Strasbourg, Université Louis-Pasteur. Pp. 101–111.

66) Gupta, A. K. and Dasgupta, S. (2005). Conservation status of Hoolock Gibbon (*Bunopithecus hoolock*) in Tripura. *ENVIS Bulletin: Wildlife and Protected Areas.* 8: 151-170.

67) Gupta, A. K. and Sharma, N. (2005b). Conservation status of Hoolock gibbon (*Binopithecus Hoolock*) in Mizoram. In: Gupta, A.K., N. Sharma, S. Dasgupta, D. Chakraborty, D. & R. Hazarika (eds.) *Conservation of Hoolock Gibbon in Northeast India. ENVIS Bulletin: Wildlife and Protected Areas.* 8: 27-86.

68) Gupta, A. K., Sharma, N., Dasgupta, S., Chakraborty, D., and Hazarika, H. (2005). Conservation of hoolock gibbon (Bunopithecus hoolock) in Northeast India. *ENVIS Bulletin, Wildlife and Protected Areas.* 8: 1-252.

69) Gupta, A.K. and Sharma, N. (2005a). Conservation status of Hoolock gibbon (*Binopithecus Hoolock*) in Meghalaya. In: Gupta, A.K., N. Sharma, S. Dasgupta, D. Chakraborty and R. Hazarika (eds.) *Conservation of Hoolock Gibbon in Northeast India. ENVIS Bulletin*: *Wildlife and Protected Areas.* 8: 87-150.

70) Haimoff, E. H., Xiao-Jun, Y., Swing-Jing, H. and Nan, C. (1987). Conservation of gibbons in Yunnan Province, China. *Oryx.* 21:168.

71) Hajra, P. K. and Jain S. K. (1978). *Botany of Kaziranga and Manas*. Surya International Publications. Dehradhun, India.

72) Harlan, R. (1834). Description of a species of Orang from the North-eastern Province of British East India, lately the Kingdom of Assam. *Trans. Amer. Phil Soc.* 4: 52–59.

73) Herwitz, R. S. (1981). Regeneration of Selected Tropical Tree Species in Corcovado National Park, Costa Rica. *Geography.* 20: 141.

74) Howe, H. F. (1986). Seed dispersal by fruit-eating birds and mammals, In: Murray, D. R. (ed.) *Seed Dispersal*. Academic Press, Sydney. Pp.123-189.

75) Hunter, W. W. (1879). *A Statistical Account of Assam*. Spectrum Publication, Guwahati. 2: 373-389.

76) Islam, M. A., and Feeroz, M. M. (1992). Ecology of hoolock gibbon of Bangladesh. *Primates.* 33: 451- 464.

77) Islam, M., Basumatary, N., Choudhury, P., Sarma, P. K. and Das, A. (2013). Studies on land use and land cover change using multi- temporal satellite data in the Inner-line reserve forest, Barak Valley, Assam, India. *NeBIO.* 4 (5): 46- 50.

78) Johns, A. D. (1986). Effects of selective logging on the behavioural ecology of West Malaysian Primates. *Ecology.* 67: 684–694.

79) Johns, A. D. (1988). Effects of "selective" timber extraction on rain forest structure and Composition and some consequences for frugivores and folivores. *Biotropica*. 20 (1): 31- 37.

80) Joseph, G. K. and Ramachandran, K. K. (2003). Distribution and demography of the Nilgiri Langur (*Trachypithecus johnii*) in Silent Valley National Park and adjacent areas, Kerala, India. *Primate Conservation.* 19: 78-82.

81) Kakati, K. (1997). Food Selection and Ranging in the Hoolock Gibbon (*Hylobates hoolock*) in Borajan Reserve Forest, Assam. MSc dissertation, Wildlife Institute of India, Dehradun, Uttarakhand, Inida.

82) Kanjilal, U. N. and A. Das. (1934-1940). *Flora of Assam*, Vols. 1-4, Calcutta, India.

83) Khan, M. A. R. (1981). The non-human primates of Bangladesh. *Tiger Paper*. 8(1): 12-15.

84) Kumar, A., Mary, P. P. and Bagchie, P. (2009). Present distribution, population status, and conservation of Western hoolock gibbons Hoolock hoolock (Primates:

Hylobatidae) in Namdapha National Park, India. *Journal of Threatened Taxa*. 1: 203–210.

85) Lan, D. (1994). Progress of surveys of hoolock gibbon in Yunnan: Distribution, population size, habitat and conservation. *Chinese Primate Research and Conservation News* 3(1): 8-10.

86) Lwin, N., Geissmann, T., Aung, S. S., Aung, T. N., Aung, Z. M., Hla, T. H., Grindley, M. and Momberg, F. (2011). The Myanmar Hoolock Gibbon Conservation Status Review: first results. *Gibbon J*. 6: 18– 22.

87) Mackinnon, J., and Mackinnon, K. (1987). Conservation status of the primates of the Indo-Chinese Subregion, *Primate Conservation*. 8: 187-195.

88) Malone, N., Purnama, A. R., Wedana, M., and Fuentes, A. (2002). Assessment of the sale of primates at Indonesian bird markets. *Asian Primates,***8** (1-2): 7-11.

89) Mather, R. J. (1992a). Distribution and Abundance of Primates in Northern Kalimantan Tengah: Comparisons with other parts of Borneo and Peninsular Malaysia. In: Ismail, G., Mohamed, M., Omar, S. (eds.) *Forest Biology and Conservation in Borneo*, Kota Kinabalu: Sabah Foundation, pp. 175-189.

90) Mather, R. J. (1992b). A Field Study of Hybrid Gibbons in Central Kalimantan, Indonesia. Unpublished PhD thesis, University of Cambridge, Cambridge.

91) McCann, C. (1933). Notes on the colouration and habits of the White-browed Gibbon or Hoolock (*Hylobates hoolock* Harl.). *Journal of Bombay Natural History Society.* 36: 395-405.

92) Medley, K. E. (1993). Primate conservation along the Tana River, Kenya: an examination of the forest habitat. *Conservation Biology*. 7: 109–121.

93) Meijaard, E., Sheil, D., Nasi, R., Augeri, D., Rosanbaum, B., Iskandar, D., Setyawati, T., Lammertink, M., Rachmatika, I., Wong, A., Soehartono, T., Stanley, S., O'Brien, T. (2005). *Life after logging: reconciling wildlife forestry and production forestry in Indonesian Borneo*. CIFOR, Bogor, Indonesia.

94) Mishra, C., Raman, T. R. S. and Johnsingh, A. J. T. (1994). *Survey of primates, serow and goral in Mizoram*. Wildlife Institute of India, Dehradun. pp. 30.

95) Mittermeier, R. A., Ratsimbazafy, J., Rylands, A. B., Williamson, L., Oates J. F., Mbora D., Ganzhorn J. U., Rodríguez-Luna E., Palacios E., Heymann E. W., Kierulff

M.C.M., Long Y.C., Supriatna J., Roos C., Walker S., and Aguiar J.M. (2007). Primates in peril: the world's 25 most endangered primates, 2006–2008. *Primate Conservation.* 22: 1–40.

96) Mohnot, S. M. (2000). *Indo-U. S. Primate Projectreport: Annual report year 06*. Department of Zoology, J. N. V. University, Jodhpur, Rajasthan, India.

97) Molur, S., Brandon-Jones, D., Dittus, W., Eudey, A., Kumar, A., Singh, M., Feeroz, M. M., Chalise, M., Priya, P. and Walker, S. (eds.) (2003). Status of South Asian Primates: Conservation Asessment and Managament Plan (C.A.M.P.) Workshop Report, 2003. Zoo Outreach Organisation / CBSG-South Asia, Coimbatore, India. Pp. 432.

98) Molur, S., Walker, S., Islam, A., Miller, P., Srinivasulu, C., Nameer, P. O., Daniel, B. A. and Ravikumar, L. (2005). Conservation of Western Hoolock Gibbon (*Hoolock hoolock hoolock*) in India and Bangladesh. *Zoo Outreach Organization/ CBSG-South Asia, Coimbatore, India.* Pp. 132.

99) Mootnick, A. and Groves, C. P. (2005). A new generic name for the hoolock gibbon (Hylobatidae). *International Journal of Primatology.*26: 971-976.

100) Mueller-Dombois, D. and Ellen berg, H. (1974). *Aims and Methods of Vegetation ecology*. John Wiley and Sons, Inc., New York.

101) Mukherjee, R. P. (1982). Survey of non-human primates of Tripura, India. *Journal of the Zoological Society, India*. 34 (1-2): 70-81.

102) Mukherjee, R. P. (1984). The ecology of the Hoolock Gibbon (*Hylobates hoolock*), of Tripura, India. *International Journal of Primatology.* 5(4): 363.

103) Mukherjee, R. P., Chaudhuri, S. and Murmu, A. (2008). A note on Hoolock Gibbon (*Bunopithecus hoolock*) in northeast, India. *Zoological Survey of India*. 108 (1-4): 121- 123.

104) Mukherjee, R. P., Chaudhury, S. and Murmu, A. (1988). Hoolock Gibbons in Arunachal Pradesh, Northeast India. *Primates Conservation.* 9:121-123.

105) Mukherjee, R. P., Choudhury, S. and Murmu, A. (1992)**.** Hoolock Gibbons (*Hylobates hoolock*) in Arunachal Pardesh, Northeast India: The Lohit District. *Primate Conservation.* 12 (13): 31-33.

106) Myers, N., Mittermeier, R. A., Miittermeier, C. A., Fonseca, G. A. B. and Kent, J. (2000). Biodiversity Hotspots for Conservation Priorities. *Nature*. 403: 853-858.

107) Napier, J. R. and Napier, P. H. (1967). A handbook of living primates: morphology, ecology and behaviour of non-human primates. Academic Press, London. RSG - http://www.iucnsscrsg.org.

108) Nath, P. C., Arunachalam, A., Khan, M. L. Arunachalam, K. and Barbhuiya, A. R. (2005). Vegetation analysis and tree population structure of tropical wet evergreen forests in and around Namdapha National Park, Northeast India. *Biodiversity Conservation*. 14: 2109-2136.

109) Nijman, V. (2001). Effect of behavioural changes due to habitat disturbance on density estimation in rain forest vertebrates, as illustrated by gibbons (Hylobatidae). In Hillegers, P.J.M. and De Iongh, H. H. (eds.), *The balance between biodiversity conservation and sustainable use of tropical rain forests*. Wageningen: Tropenbos. pp. 217-225.

110) NRC. (1981). *Techniques for the Study of Primate Population Ecology*. National Research Council (NRC), National Academy Press, Washington, DC. Pp. 277.

111) O'Brien, T. G., Kinnaird, M. F., Nurcahyo, A., Iqbal, M., Rusmanto, M. (2004). Abundance and distribution of sympatric gibbons in a threatened Sumatran rain forest. *International Journal of Primatology.* 25(2): 267-284.

112) Oates, W. E. (1999). An Essay on Fiscal Federalism. *Journal of Economic Literature.* 37: 1120 – 1149.

113) Panor, J. (2011). Outings with hoolock of Delo. *Zoos' Print J*. 12: 19–20.

114) Parthasarathy, N. (1999). Changes in tropical forest composition and structure in three sites of tropical wet evergreen forest around Sengaltheri. Western Ghats. *Current Science*. 80: 389-393.

115) Peart, J. F. (1934). Notes on the colouration of the White-Browed gibbon (*Hylobates hoolock* Harlan). *J. Bombay Nat. Hist. Soc.* 37: 214.

116) Pocock, R. I. (1939). The fauna of British India, including Ceylon and Burma: *Mammalia.I,Primates and Carnivora(in part), families Felidae and Viverridae.* 2nd ed. Taylor and Francis, London.

117) Poore, M. E. D. (1968). Studies in Malayasian rain forest. I. The forest on Trassic sediments in Jengka forest reserve. *Journal of Ecology*. 56: 143-196.

118) Prater, S. H. (1971). *The Book of Indian Animals*. Bombay Natural History Society, Bombay, India.

119) Prouty, L. A., Buchanan, P. D., Pollitzer, W. S. and Mootnick, A. R. (1983b). Bunopithecus: A genus level taxon for the Hoolock Gibbon (*Hylobates hoolock*). *American Journal of Primatology.* 5: 83- 87.

120) Prouty, L. A., Buchanan, P. D., Pollitzer, W. S. and Mootnick, A. R. (1983a). A presumptive new hylobatid subgenus with 38 chromosomes. *Cytogenetics and Cell Genetics*. 35: 141- 2.

121) Raman, S. T. R., Mishra, C. and Johnsingh, A. J. T. (1995). Survey of Primates of Mizoram, Northeast India. *Primate Conservation.* 16: 59- 62.

122) Schultz, A. H. (1969). *The Life of Primates.* London: Weidenfield and Nicolson.

123) Setchell, J. M. and Curtis, D. J. (2003). *Field and Laboratory Methods in Primatology*. Cambridge University Press, Cambridge. Singleton.

124) Shortridge, G. C. (1914). Notes on the weight of animals. *J. Bombay Nat. Hist. Soc.* 22: 793–794.

125) Siddiqi, N. A. (1986).Gibbons (*Hylobates hoolock*) in the West Bhanugach Reserved Forest of Sylhet District, Bangladesh. *Tigerpaper.* 13(3): 29-31.

126) Singh, D. N. (2001). Status and distribution of primates in Arunachal pradesh. In: *Non-human Primates of India*, A. K. Gupta (ed.), *Envis Bulletin*: *Wildlife and Protected Areas*. Wildlife Institute of India, Dehradun, India. 1(1): 113-119.

127) Singh, R. (1989). Ontogeny of aggressive and submissive behavior in free living rhesus monkeys (*Macaca mulatta*). *Proceedings of the Indian Academy of Science Animal Science.* 98(2): 139-148.

128) Solanki, G. S. and Chutia, P. (2004). Ethno Zoological and Socio-cultural aspects of Monpas of Arunachal Pradesh. *Journal of Human Ecology.* 15 (4): 251-254.

129) Srivastava A., Das J., Biswas J., Buzarbarua P., Sarkar P., Bernstein I.S. and Mohnot S.M. (2001a). Primate population decline in response to habitat loss: Borajan Reserve Forest of Assam, India. *Primates.* 42 (4): 401-6.

130) Srivastava, A. (1999). *Primates of Northeast India*. Bikaner, Rajasthan, India: Megadiversity Press, pp. 207.

131) Srivastava, A., and Mohnot, S. (2001b). Distribution, conservation status and priorities for primates in Northeast India. ENVIS Bulletin: Wildlife and protected areas: *Non-human primates of India*, 1(1), 102-108.

132) Strushaker, T. T. (1975). *The red colobus monkey.* Chicago: University of Chicago Press.

133) Terborgh, J. (1990). Seed and fruit dispersal-commentary, In: Bawa, K.S. & M. Handley (ed.) *Reproductive ecology of tropical forest plants*. The Parthenon Publishing Group, Paris. Pp.181-190.

134) Tickell, S. R. (1864). Notes on the gibbon of Tenasserim, *Hylobates lar. Journal of the Asiatic Society of Bengal* 33: 196-199.

135) Tilson, R. L. (1979). Behaviour of hoolock gibbon (*Hylobates hoolock*) during different seasons in Assam, India. *J. Bombay Nat. Hist. Soc*. 76 (1): 1-16.

136) Upadhaya, K., Pandey, H. N., Law, P. S. and Tripathi, R. S. (2004). Diversity and population characteristics of woody species in subtropical humid forest exposed to cultural disturbance in Meghalaya, Northeast India. *Tropical Ecology.* 45 (2): 303-314.

137) Walker, R. S., Daniel, B. A., Marimuthu, R., Lathat, G., and Kumar, R. (2007). *Report of the workshop series on conservation education for northeast India hoolock gibbon with particular reference to shared hoolock gibbon and tiger localities, Assam, India*, 59 pp.

138) Weaver, P. L. and Murphy, P. G. (1990). Forest structure and productivity in Puerto Rico’s Loquillo Mountains. *Biotropica*. 22: 69-82.

139) Whittaker, R. H. (1972). Evolution and measurement of species diversity. *Taxon*. 21: 213-251.

140) Wieczkowski, J. (2004). Ecological correlates of abundance in the Tana mangabey (*Cercocebus galeritus*). *American Journal of Primatology*. 63: 125-138.

141) Williamson, E. A. (1993). Methods used in the evaluation of lowland gorilla habitat in the Lope Reserve, Gabon. *Tropics.* 2 (4): 199 - 208.

142) Wilson, C. C. and Wilson, W. L. (1975). The influence of selective logging on primates and some other animals in East Kalimantan. *Folia Primatologica*. 23: 245–274.

APPENDIX- I

Tree species of the reserve forests in Barak Valley

S. No.	Scientific name	Family
1	*Acacia auriculiformis* A. Cunn ex Benth.	Mimosaceae
2	*Acacia catechu* Willd.	Mimosaceae
3	*Acacia lebek* Benth.	Mimosaceae
4	*Ailanthus integrifolia* Lamk.	Simaroubaceae
5	*Albizia lebbeck* (L.) Benth.	Leguminosae
6	*Aleurites moluccana* (L.) Willd.	Euphorbiaceae
7	*Alseodaphne owdenii* Parker.	Lauraceae
8	*Alstonia scholaris* R. Br.	Apocynaceae
9	*Annona squamosa* L.	Annonaceae
10	*Anthocephalus cadamba* Miq.	Rubiaceae
11	*Antidesma acidum* Retz.	Euphorbiaceae
12	*Antidesma ghaesembilla* Gaertn.	Euphorbiaceae
13	*Antidesma velutinosum* Blume	Euphorbiaceae
14	*Artocarpus chama* Buch- Ham.	Moraceae
15	*Artocarpus gomeziana* Wall.	Moraceae
16	*Artocarpus heterophyllus* Lamk.	Moraceae
17	*Artocarpus lakoocha* Roxb.	Moraceae
18	*Azadirachta indica* A. Juss.	Meliaceae
19	*Baccaurea remiflora* Lour.	Euphorbiaceae
20	*Balakata baccata* (Roxb.) Esser	Euphorbiaceae
21	*Bauhinia malabarica* Roxb.	Caesalpiniaceae
22	*Bauhinia purpurea* L.	Caesalpiniaceae
23	*Beilschmiedia assamica* Meissn.	Lauraceae
24	*Bischofia javanica* Bl.	Euphorbiaceae
25	*Bombax ceiba* L.	Bombaceae
26	*Bombax insigne* Wall.	Bombaceae
27	*Bridelia stipularis* Bl.	Euphorbiaceae
28	*Bursera serrata* Coleb.	Burseraceae
29	*Butea monosperma* Lamk.	Pailionaceae
30	*Caesalpania pulcherrima* Sw.	Caesalpiniaceae
31	*Callicarpa arborea* Roxb.	Verbenaceae
32	*Canarium benghalense* Roxb.	Burseraceae
33	*Carallia brachiata* Merr.	Rhizophoraceae
34	*Casearia glomerata* Roxb.	Flacourtiaceae
35	*Cassia fistula* L.	Caesalpiniaceae
36	*Castanopsis purpurella* (Miq.) Balak.	Fagaceae
37	*Castonopsis indica* DC.	Fagaceae

38	*Cedrela febrifuga* C. DC.	Meliaceae
39	*Chrysophyllum lanceolatum* DC.	Sapotaceae
40	*Chrysophyllum roxburghii* G.Don	Sapotaceae
41	*Cinamomum cacharensis* R. N. Parker.	Lauraceae
42	*Cinamomum cecicodaphne* Meissn.	Lauraceae
43	*Cinamomum tamala* Buch- Ham.	Lauraceae
44	*Cordia fragrantissima* Kurz.	Ehretiaceae
45	*Couroupita guianensis* Aublet.	Lacythidaceae
46	*Crataeva religiosa* Frost. f.	Capparaceae
47	*Croton roxburghii* Balak.	Euphorbiaceae
48	*Cryptocarya amygdalina* Nees.	Lauraceae
49	*Cynometra polyandra* Roxb.	Leguminosae
50	*Dalbergia sisoo* Roxb.	Pailionaceae
51	*Derris indica* Lamk.	Pailionaceae
52	*Dillenia indica* L.	Ranunculaceae
53	*Dillenia pentagyna* Roxb.	Ranunculaceae
54	*Diospyras taposia* Ham.	Ebenaceae
55	*Dipterocarpus manni* King ex Kanjilal	Dipterocarpaceae
56	*Dipterocarpus turbinatus* Gaertn.	Dipterocarpaceae
57	*Drymicarpus racemosus* Hook.f.	Anacardiaceae
58	*Drypetes assamica* Hook.f.	Euphorbiaceae
59	*Dysoxylum gobora* Miq.	Meliaceae
60	*Elaeocarpus floribundus* Bl.	Elaeocarpaceae
61	*Elaeocarpus robustus* Roxb.	Elaeocarpaceae
62	*Elaeocarpus sphaericus* Gaertn.	Elaeocarpaceae
63	*Endospermum chinense* Benth.	Euphorbiaceae
64	*Engelhardtia spicata* Lechan ex Bl.	Juglandaceae
65	*Erythrina indica* Lamk.	Pailionaceae
66	*Eucalyptus maculata* Hook.	Myrtaceae
67	*Euphorbia neriifolia* L.	Euphorbiaceae
68	*Euphorbia pulcherrima* Willd.	Euphorbiaceae
69	*Eurya acuminata* DC.	Pentaphylacaceae
70	*Ficus auriculata* Lour.	Moraceae
71	*Ficus benghalensis* L.	Moraceae
72	*Ficus benjamina* L.	Moraceae
73	*Ficus fistulosa* Reinwdt. Ex Bl.	Moraceae
74	*Ficus glomerata* Roxb.	Moraceae
75	*Ficus heterophylla* L.f. Supl.	Moraceae
76	*Ficus hirta* Vahl.	Moraceae
77	*Ficus hispida* Vahl.	Moraceae
78	*Ficus lamponga* Miq.	Moraceae

79	*Ficus racemosa* L.	Moraceae
80	*Ficus religiosa* L.	Moraceae
81	*Flacourtia cataphracta* Roxb.	Flacourtiaceae
82	*Garcinia assamica* Kost.	Clusiceae
83	*Garcinia cowa* Roxb.	Clusiceae
84	*Garcinia pedunculata* Roxb.	Clusiceae
85	*Garcinia xanthochymus* Hook.f.	lamiaceae
86	*Garuga floribunda* Deen.	Burseraceae
87	*Glochidion lanceolarium* (Roxb.) Voigt	Euphorbiaceae
88	*Gmelina arborea* Roxb.	Verbenaceae
89	*Gynocardia odorata* R. Br.	Flacourtiaceae
90	*Hydnocarpus kurzii* Warb.	Flacourtiaceae
91	*Kydia calycina* Roxb.	Malvaceae
92	*Lagerstroemia reginae* Roxb.	Lacythidaceae
93	*Lagerstroemia speciosa* (L.) Pers.	Lythraceae
94	*Lingustrum robustum* Bl.	Oleaceae
95	*Linnea grandis* A. Rish.	Anacardiaceae
96	*Madhuca indica* Gmel.	Sapotaceae
97	*Magnolia insignis* Wall.	Magnoliaceae
98	*Magnolia pterocarpa* Roxb.	Ranunculaceae
99	*Mangifera indica* L.	Anacardiaceae
100	*Mangifera sylvatica* Roxb.	Anacardiaceae
101	*Mesua ferra* L.	Clusiceae
102	*Michelia champaca* L.	Ranunculaceae
103	*Mimusops elengi* Roxb.	Sapotaceae
104	*Moringa oleifera* Lamk.	Moringaceae
105	*Morus australis* Poir.	Moraceae
106	*Morus laevigata* Wall.	Moraceae
107	*Myrica esculenta* Buch- Ham.	Myricaceae
108	*Olea dioica* Roxb.	Oleaceae
109	*Parkia bigemium* Benth.	Mimosaceae
110	*Plumeria acuminata* Ait.	Apocynaceae
111	*Polyalthia longifolia* Thw.	Annonaceae
112	*Premna benghalensis* Cl.	Verbenaceae
113	*Pterygota alata* (Roxb.) R.Br.	Malvaceae
114	*Rhus semialata* Murr.	Anacardiaceae
115	*Samanea saman* Merr.	Mimosaceae
116	*Sapium baccatum* Roxb.	Euphorbiaceae
117	*Sapium eugeniaefolium* Benth.	Euphorbiaceae
118	*Saraca asoca* Roxb.	Caesalpiniaceae
119	*Semecarpus anacardium* L.	Anacardiaceae

120	*Shorea assamica* Dyer	Dipterocarpaceae
121	*Spondias pinnata* Kurz.	Anacardiaceae
122	*Sterculia villosa* Roxb.	Sterculiaceae
123	*Sterospermum chelonoides* DC.	Bigoniaceae
124	*Syzygium balsameum* Wall.	Myrtaceae
125	*Syzygium cumini* L.	Myrtaceae
126	*Syzygium fruticosum* DC.	Myrtaceae
127	*Syzygium jambos* L.	Myrtaceae
128	*Syzygium operculatum* (Roxb.) Nied.	Myrtaceae
129	*Tamarindus indica* L.	Caesalpiniaceae
130	*Tectona grandis* L.f.	Verbenaceae
131	*Termanilia chebula* Retz.	Combretaceae
132	*Termanilia myriocarpa* Heurck et Muell.	Combretaceae
133	*Terminalia arjuna* DC.	Combretaceae
134	*Terminalia belerica* Roxb.	Combretaceae
135	*Tetrameles nudiflora* R.Br.	Tetramelaceae
136	*Toona ciliata* M. Roem.	Meliaceae
137	*Trewia nodiflora* L.	Euphorbiaceae
138	*Vatica lanceifolia* (Roxb.) Blume	Dipterocarpaceae
139	*Vitex altissima* L.f.	verbenaceae
140	*Vitex peduncularis* Wall. Ex. Schauer	Lamiaceae
141	*Walsura robusta* Roxb.	Meliaceae
142	*Xerospermum glabratum* (Kurz.) Radlk	Rhamnaceae
143	*Zanthoxylum rhesta* Roxb.	Rutaceae

PUBLICATION(S) IN BOOKS AND JOURNALS:

1. **Islam, M.,** Choudhury, P. and Bhattacharjee, P. C. (2013), "Preliminary study on Population status and Activity budgeting of Western Hoolock Gibbon (*Hoolock hoolock*) in the Inner-line Reserved Forest of Barak valley, Assam, India**"** in ***International Journal of Scientific and Research Publications*** (**IJSRP- an e-journal**) March 2013 Edition, Vol-3:Issue 3.

2. **Islam, M.,** Choudhury, P**.** and Bhattacharjee, P. C. (2013), Survey and census of Hoolock gibbon (*Hoolock hoolock*) in the Inner- line reserve forest and the adjoining areas of Cachar district, Assam, India in ***Folia Primatologica*** 2013;84:170–179 (**Impact factor=1.5**)

3. **Islam, M.,** Basumatary, N., Choudhury, P., Sarma, P. K. and Das, A (2013), "Studies on Land Use and Land Cover using multi-temporal satellite data in the Inner-Line Reserve forest, Barak Valley, Assam, India" in ***NeBio***, India (ISSN 2278-2281(Online Version) ISSN 0976-3597(Print Version)); October issue, 2013 Vol: 4(5): P-46-50

4. **Islam, M.,** Choudhury, P. and Bhattacharjee, P. C. (2014), 'Canopy utilization pattern of western Hoolock Gibbon *Hoolock hoolock* (Mammalia: Primates: Hylobatidae) in the Inner-Line Reserve forest of Barak Valley, Assam, India. ***Journal of threatened taxa***(www.threatenedtaxa.org)(ISSN Online 0974–7907 Print 0974–7893). Vol- 6(9): p. 6222–6229. (**NAAS Rating=4.72**)

5. **Islam, M**., Choudhury, P and Bhattacharjee, P. C. (2014), "Some Aspects Of Behavioral Study And Ancillary Conservation Threats Of Western Hoolock Gibbon (*Hoolock Hoolock*) In The Inner-Line Reserve Forest, Cachar, Assam, India" in ***Sustainable Biodiversity in the 21st Century***(Ed: B. K. Dutta and P. Choudhury): (ISBN No:978-81-920947-1-9). P 217-231.

6. **Islam, M**., Choudhury, P and Bhattacharjee, P. C. (2014), "Plant animal interaction: A case study in reference to Hoolock gibbon (*Hoolock hoolock)* in the Inner-line reserve forest, Cachar, Assam." in ***Emerging Environmental Issues with Special reference to Northeast India"***(In press).

7. Dey, A. and **Choudhury, P.** (2013). "Distribution and status of Western Hoolock gibbon (*Hoolock hoolock)* in Patharia reserve forest of Karimganj district, Assam. **Lap Lambert Academic Publishing**, Germany. Saarbrucken (ISBN No:978-3-659-46832-2). Pp. 51-67.

8. Dey, A. and **Choudhury, P.**and Bhattacharjee, P.C. (2014).“Status of Western Hoolock gibbon in some selected reserve forest of Karimganj district, Assam”. ***Sustainable Biodiversity in the 21st Century***(Ed: B. K. Dutta and P. Choudhury): (ISBN No:978-81-920947-1-9). P 117-124.

9. Dey, A. and **Choudhury, P.**(2015). “Distribution and status of Hoolock gibbon in Longai reserve forest of Karimganj district, Assam. ***Emerging Environmental Issues with Special reference to Northeast India*”.**(ISBN No: 978-93-8471-07-1). Pp. 24-37.